NPSN: 00600-413/2017/18

Annual Report

2073/74 (2016/17)

Government of Nepal
Nepal Agricultural Research Council
National Maize Research Program
Rampur, Chitwan

2017

Newly released hybrid , OPVs and QPM maize varieties

Rampur hybrid-8
(Yield-7.8 t/ha)

Rampur hybrid-10
(Yield-8.05 t/ha)

Rampur-4
(Yield-5.4 t/ha)

Manakamana 7
(Yield-6.46 t/ha)

Poshilo makai-2
(Yield- 4.5 t/ha),
(Lysine 0.42%, Tryptophan 0.114%)

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2017

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Foreword

National Maize Research Program (NMRP), Rampur presents this annual report that reflects on-station and on-farm research, production, financial and administrative activities carried out by this program in the fiscal year 2073/074 (2016/17). NMRP aims to generate high yielding maize based eco-friendly technologies that contribute to the food, feed, nutritional security, employment generation and livelihood enhancement of the Nepali people. It focuses on development of high yielding hybrids and open-pollinated varieties, maintenance, seed multiplication, and development of appropriate maize based cropping system to enhance production and productivity in collaboration with national and international institutions.

On behalf of NMRP, I would like to thank NARC management; especially Executive Director, Director for Crops and Horticulture, Director for Planning and Coordination, Director for Administration, Director for Finance and Director for Livestock and Fisheries for their technical and financial support, guidance and encouragement to run the program smoothly and improve its performance.

This annual report is a collaborative achievement, and we express our appreciation to all those who have contributed to its publication. This report would have been impossible to bring in this form without the joint efforts and cooperation of the collaborators from RARSs, ARSs, and commodity programs, disciplinary divisions, CIMMYT, DADOs, CBOs, I/NGOs, cooperatives and agricultural groups. I would like to express my sincere thank to all senior scientists, scientists, technical officers, technicians, support staffs and farmers involved directly or indirectly in conducting research activities, source seed production, data compilation, analyzing and report writing. We are also indebted to the administrative and financial staffs for their contribution.

I would like to appreciate the tireless and continuous efforts of entire workforce. Without them, our success in 2016/17 would not have been possible. Our thanks also go to those helping hands who directly or indirectly supported the Program's objectives to be met. I hope, this publication provides clear and transparent progress made on maize research for increased productivity in Nepal and proves useful to stakeholders. Productive comments and noble suggestions are highly appreciated.

Keshab Babu Koirala, Ph.D.
Coordinator
National Maize Research Program, Rampur, Chitwan, Nepal

Abbreviation and Acronyms

ABD	Agriculture Botany Division
ARS	Agriculture Research Station
ASI	Anthesis Silking Interval
BLSB	Banded Leaf and Sheath Blight
CFFT	Coordinated Farmer's Field Trial
CA	Conservation Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CV	Coefficient of Variation
CVT	Coordinated Variety Trial
DADO	District Agricultural Development Office
DAS	Days after Sowing
FAT	Farmers' Acceptance Test
GLS	Gray Leaf Spot
GRP	Ginger Research Program
HCRP	Hill Crop Research Program
HC	Husk Cover
HTMA	Heat Stress Tolerant Maize for Asia
IET	Initial Evaluation Trial
IYT	Intermediate Yield Trial
KUBK	Kisan ka lagi Unnat Biu Karyakram
LSD	Least Significant Difference
MNCH	Multinational Company Hybrid
NLB	Northern Leaf Blight
NMRP	National Maize Research Program
NSB	Nepal Seed Board
OPV	Open Pollinated Variety
OR	Outreach Research
PVS	Participatory Variety Selection
QPM	Quality Protein Maize
RCBD	Randomized Complete Block Design
RCT	Resource Conservation Technology
RFFT	Regional Farmer's Field Trial
RARS	Regional Agriculture Research Station
SD	Standard Deviation
SE	Standard Error
SLB	Southern Leaf Blight
TIT	Terai and Inner Terai
WVD	Wheat Varietal Display

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राष्ट्रिय मकैबाली अनुसन्धान कार्यक्रमद्वारा बर्णशंकर मकैको अनुसन्धान र विकास अन्तर्गत तराई र पहाडमा गरी १३ वटा कृयाकलापहरु संचालन गरिएको थियो जस अर्न्तगत इन्ब्रेड लाईनको अवलोकन, मूल्याङ्कन र बीउ उत्पादन, नयां इन्ब्रेड लाईनको विकास र छनौट, हाईब्रिडको अवलोकन नर्सरी (ओ.बि.एन.), टेष्ट क्रस, समन्वयात्मक वर्णशंकर जातीय परीक्षण (सि.एच.टि., तराई र पहाड) र किसानको खेतबारीमा गरिने हाईब्रिड मकैका परीक्षणहरु (सि.एफ.एफ.टि.) मूल्याङ्कन र सिफारिस भएका ईन्ब्रेड लाइनहरुको बीउ उत्पादन, सिमिट मेक्सीको बाट प्राप्त तातो सहन सक्ने हाईब्रिड मकैका परिक्षणहरु र त्यसबाट छानिएका उत्कृष्ट जातहरुको ठूलो क्षेत्रफलमा कृषकको खेतमा परिक्षणहरु गरिएको थियो । धेरै वर्षको परीक्षण पछि यस वर्ष दुई वटा मकैका तातो सहन सक्ने बर्णशंकर जातहरु क्रमशः रामपुर हाईब्रिड ८ (सि.ए.एच.-१५१) र रामपुर हाईब्रिड १० (सि.ए.एच.-१५३) सिफारिस भएका छन । यस बर्ष २६० वटा फिक्स इन्ब्रेड मध्ये राम्रा देखिएका हरुमा क्रमशः जेड.एल.१२६६२, सी.एम.एल.४५१, भि.एल. १०९१२६, सी.ए.एल.१४२१, सी.जेड.एल.०७१८, सी.ए.एल. १४६५, सी.ए.एल.१४१२, एन.एम.एल.१, एन.एम.एल.-२, एन.एम.एल.-३, एन.एम.एल.-४, एन.एम.एल.-५, आर.एम.एल.-६, आर.एम.एल.-७, आर.एम.एल.-८, आर.एम.एल.-१८, आर.एम.एल.-१९, आर.एम.एल.-२०, आर.एम.एल.-३२, आर.एम.एल.-३६, आर.एम.एल.-५७, आर.एल.-१७४, आर.एम.एल.-६२, आर.एम.एल.-८५, आर.एम.एल.-९५, आर.एम.एल.-९६, आर.एम.एल.-९७, आर.एम.एल.-११८, आर.एम.एल.-११९, आर.एल.-१००, आर.एल.-१०५, आर.एल.-१०७, आर.एल.-१४०, सी.एल.ए.-१२, सी.एल.ए.-८३, सी.एल.ए.-१०५, सी.एल.ए.-१११, सी.एल.ए.-४४ र सी.एल.ए.-१६० थिए । हाईब्रिडको अवलोकन नर्सरीमा आर.एम.एल.-४/आर.एल.-१११, आर.एम.एल.८७/आर.एल.-१०५, एन.एम.एल.-२/आर.एम.एल.-१७ र आर.एम.एल.-५७/आर.एल.-१०५ बढी उत्पादन दिने र राम्रा जातको रुपमा पाइएका छन् । त्यस्तै विभिन्न टेष्ट क्रसहरु (टेष्ट क्रस १–५) को नतिजा अनुसार जि.आर.जि.टि. एस. १ ६-४-३-१-२-३-२-२-१/आर.एम.एल.-१७, बायो.एस.इ.इ.डि.एस.१-५-१-४-२-१-१-१-३-२/आर.एम.एल.-१७, आर.ए.एम.पि.यु.आर. एच.वाइ.वि.आर.आइ.डि.-६/आर.एम.एल.-९६, आर.सी.एस. १-९-४-३-१-२-१-१-२-२/ एन.एम.एल.-२, बायो.एस.इ.इ.डि.एस. १-५-१-४-२-२-२-१-२-२/एन.एम.एल.-२ र पि.आइ.ओ.एन.इ.इ.आर.एस. १-२-३-१-१-२-४-३-२-२/आर.एल.-११ बढी उत्पादन दिने र राम्रा देखिएका छन । त्यस्तै तराई र पहाडमा गरिएको समन्वयात्मक परीक्षणमा सी.ए.एच.-१५३, सी.ए.एच.-१५१५, सी.ए.एच.-१५१, आर.ए.एम.पि.यु.आर. एच.वाइ.वि.आर.आइ.डि.-४, आर.एम.एल.-९८/आर.एल.-१०५, जे.एम.-४, जे.एम.-८ र आर.एम.एल.-७६/आर.एल.-१०५ बढी उत्पादन दिने र उत्कृष्ट पाईएका छन । कृषकको

खेतमा गरिएको परीक्षणको नतिजा अनुसार आर.एम.एल.-९५/आर.एम.एल.-९६, आर.एम.एल.-८६/आर.एम.एल.-९६, सी.ए.एच.-१५३र आर.एम.एल.-४/आर.एम.एल.-१७ बढी उत्पादन दिने र कृषकले पनि मन पराएका छन । तातो सहन सक्ने हाईब्रिडको विभिन्न चरणको परीक्षणहरुबाट राम्रो देखिई किसानको खेतमा परीक्षणगर्दा पनि दुई वटा हाईब्रिडहरु क्रमशः सी.ए.एच.-१५१ र सी.ए.एच.-१५३ हरु बढी उत्पादन दिने र कृषकको छनौटमा पनि परेको हुनाले यि जातहरुलाई यस बर्ष सिफारिस गरिएको छ ।

राष्ट्रिय मकैबाली अनुसन्धान कार्यक्रममा २०७३ मा गरिएको परीक्षणमा १५ वटा पप कर्न जातहरु मध्ये उत्पादनको आधारमा पप कर्न लुम्ले वाइ (३.७३ टन/हे.), पप कर्न गोर्खा (३.४१ टन/हे.) र पप कर्न रामपुर (३.३९ टन/हे.) राम्रो पाइएको छ । त्यस्तै ११ वटा सुइट कर्न मध्ये, आइ.डि. ९१९३-डव्लु. र आइ.डि. ८००७-वाइ. राम्रो उत्पादन दिने जातको रुपमा पाइएको छ ।

पाख्रीबास र दोलखाका कृषकको खेतवारीमा संचालन गरिएको गुणस्तरीय प्रोटिनयुक्त मकैको समन्वयात्मक परीक्षणको नतिजालाई विश्लेशण गर्दा एस.ओ.१ एस.आइ.वाइ.क्यू.ले राम्रो उत्पादन दिएको पाइयो । त्यस्तै दैलेख र खुमलटारमा गरिएको सोही परिक्षणमा क्रमशः एस.९९ टि.एल.वाइ.क्यू.-एच.जि.-ए.वि. र खुमल पहेँलोको राम्रो नतिजा पाइयो । यसैगरि गुणस्तरीय प्रोटिनयुक्त मकैको समन्वयात्मक जातीय परीक्षण (सी.भि.टि.) मा, एस.ओ.३ टि.एल.वाइ.क्यू.-ए.वि.-२ ले दैलेखमा, एस.ओ.१एस.आइ.वाइ.क्यू.ले पाखीबासमा, किसानको जात ले सुर्खेतमा र एस.ओ.ओ.टि.एल.डव्लु.क्यू.-वि. ले खुमलटारमा राम्रो उत्पादन दिएको थियो । त्यस्तै पाख्रीबासमा गरिएको प्रारम्भिक उत्पादन परिक्षण (आइ.वाइ.टि.) मा किसानको जातको उत्पादन अन्य परिक्षित जातहरुभन्दा राम्रो पाइयो ।

पाखिबास्, काब्रे, खुमलटार, दैलेख र लुम्लेमा संचालित पहाडी क्षेत्रको लागि उपयुक्त, लामो समयमा पाक्ने जातहरुको प्रारम्भिक उत्पादन परिक्षणहरुको संयुक्त विश्लेषण गर्दा रामपुर एस१३एफ२८ ले सबैभन्दा बढी (६.३२ टन/हे.) उत्पादन दिएको पाइयो । त्यसपछि बढी उत्पादन दिनेमा क्रमशः मनकामना-३ (६.२३ टन/हे.) र रामपुर एस०३एफ०८ (६.०२ टन /हे.) देखियो । त्यस्तैगरि पहाडी क्षेत्रको लागि तयार गरिएको लामो समयमा पाक्ने जातहरुको समन्वयात्मक जातीय परिक्षणहरुमा ०५एस ए डि भि आईले सबैभन्दा बढी (५.२३ टन/हे.) उत्पादन दिएको पाइयो भने त्यसपछि बढी उत्पादन दिनेमा क्रमशः मनकामना-३ (४.८८ टन/हे.) र जेड एम ४०१ (४.८९ टन/हे.) देखियो । पहाडी क्षेत्रका किसानको खेतमा संचालित लामो समयमा पाक्ने जातहरुको समन्वयात्मक जातिय परिक्षण गर्दा, बि जि बि वाई पप ले सबैभन्दा बढी (५.६३ टन/हे.) उत्पादन दिएको पाइयो । त्यसपछि बढी उत्पादन दिनेमा क्रमशः ०५एस ए डि भि आइ (५.३५ टन/हे.) र टि एल बि आर ०७ एफ १६ (५.३२ टन/हे.) देखियो ।

तराई क्षेत्रको लागि तयार गरिएको लामो समयमा पाक्ने जातहरु लाई डोटि, सुर्खेत र रामपुरमा संचालन गरिएको प्रारम्भिक उत्पादन परिक्षणहरुको संयुक्त विश्लेषण गर्दा, पोजारिका ९५३१ ले सबैभन्दा बढी (३.६२ टन/हे.) उत्पादन दिएको पाइयो । त्यसपछि बढी उत्पादन दिनेमा क्रमशः रामपुर एस ०३ एफ ०८ (३.२६ टन/हे.) र एस ०१२८ (३.२४ टन/हे.) देखियो । यसै गरी लामो समयमा पाक्ने जातहरु (तराई सेट) को समन्वयात्मक जातिय परिक्षणहरुको नतिजालाई विश्लेषण गर्दा आर-पप-१ ले सबैभन्दा बढी (३.९१ टन/हे.) उत्पादन दिएको पाइयो । त्यसपछि बढी उत्पादन दिनेमा क्रमशः सेल ओ.एच.जि.वा.ई.ए × सेल ओ.एच.जि.वा.ई.बि. (३.६२ टन/हे.) र एचजि-ए (३.५५ टन/हे.) देखियो ।

बाली विज्ञान

हाइब्रिड मकैको लागि उपयुक्त बोट संख्या र खाद्यतत्व पत्ता लगाउने अभिप्रायले गरिएको परिक्षणमा परिक्षित दुई हाइब्रिड अनुजातहरु (आर.एम.एल ९५/आर.एम.एल ९६ र आर.एम.एल ८६/आर.एम.एल ९६) को उत्पादन, बोट र घोगाको उचाइमा कुनै पनि भिन्नता पाईएन तथापी यी हाइब्रिड अनुजातहरुको बोटसंख्या प्रति हेक्टर ७७,५९१ राखि मलखाद १७४:८७:५८ ना.फ.पो किलो/हे. का दरले प्रयोग गर्दा अर्थपरक रुपमा बढी उत्पादन (७.५५ टन/हे) दिएको पाइयो ।

झारपात व्यवस्थापन अभ्यासले मकैको उत्पादन र झारपातको सुख्खा पदार्थको संचयमा प्रत्यक्ष प्रभाव पारेको देखियो । कालो प्लाष्टिकको छापो राखि उपचार गरिएको प्लटमा मकैको उत्पादन उल्लेख्य रुपमा सवैभन्दा बढी (७.९७ टन/हे) देखियो त्यसपछि क्रमिक रुपमा पुरै झारपात निकालिएको (७.३६ टन/हे) र धानको परालको छापोले उपचारित (६.०६ टन/हे) प्लटमा मकैको उत्पादन राम्रो देखियो । झारपातको सुख्खा पदार्थ संचयको हकमा, पुरै झारपात निकाल्ने अभ्यास गरिएको उपचार बाहेक, मकै लगाएपछि हरेक ३०, ६० र ९० दिनमा लिइएको विवरणलाई हेर्दा पनि कालो प्लाष्टिकको छापो राखि उपचार गरिएको प्लटमा निकै कम रहेको देखियो ।

गुल्मी र अर्घाखांची जिल्लामा मकैबारीमा गरिएको सर्वेक्षणको नतिजालाई हेर्दा उक्त क्षेत्रमा अमिले झार र गन्धे झारको प्रकोप निकै समस्याको रुपमा रहेको पाइयो जहाँ उक्त झारहरुको घनत्व प्रति वर्ग मिटर क्रमशः ३०७.४ र २२०.३ थियो ।

वर्षैभरि हरेक १० दिनको फरकमा मकै लगाउदा हाइब्रिड मकै (आर.एम.एल ९५/आर.एम.एल ९६) हकमा चैत्र २९ मा लगाएको मकैमा बढी उत्पादन (१५.७ टन/हे.) र क्रमशः चैत्र १९ (१४.१० टन/हे.) र भाद्र १९ (१३.४७ टन/हे.) पाईयो । त्यसैगरि मकैको खुल्ला परसेचित जात एस.०३ टि.इ.वाइ.-एफ.एम. को हकमा, वैशाख २८ मा लगाएको मकैको उत्पादन

सबैभन्दा बढी (१०.१३ टन/हे.) र क्रमशः चैत्र २९ (८.३८ टन/हे.), चैत्र १९ (८.३० टन/हे.), र भाद्र १९ (८.२२ टन/हे.) पाईयो ।

पारम्पारिक जोताइ गरि लगाइएको मकै भन्दा कम जोती छापो राखेर प्रविधिबाट लगाइएको मकैको उत्पादन तुलनात्मक रुपमा बढी पाइयो । कम जोती छापो राखेर प्रविधिबाट मकै लगाउदा परिक्षण गरिएका चार वटा मकैका जात मध्ये आर.एम.एल ९५/आर.एम.एल ९६ को उत्पादन अर्थपरक रुपमा सवैभन्दा वढि (१०.३ टन/हे.) देखियो ।

कर्णाली क्षेत्रका लागि मकै विकासको लागि गरिएको समन्वयात्मक जातीय परिक्षणको नतिजा अनुसार, विरुवाको उचाइ (२५० से.मीं) र घोगाको उचाई (१४० से.मी) झुम्का पि.ओ.पी मा वढि देखियो भने कर्णाली पुल एल्लो को उत्पादन तुलनात्मक रुपमा सवैभन्दा बढी (४.९२ टन/हे.) देखियो ।

माटो विज्ञान

सन् २०१६/०१७ को हिउँदे मौसममा मकैका चार विभिन्न जातहरु र मलका विभिन्न दरहरु प्रयोग गरी गरिएको संयक्त परीक्षण (भि.सी.एफ.टि.) मा एस.९९ टि.एल.वाइ.क्यू.-एच.जि.-ए.वि., अरुण-४, टि.एल.वि.आर.एस.ओ.७ एफ १६ र वि.जि.वि.वाइ.पि.ओ.पि. ले सबैभन्दा बढी उत्पादन क्रमशः ३.७३ टन/हे (१८०:७५:५० ना. फ. पो के.जी/हे) दर प्रयोग गर्दा, २.७५ टन/हे (१२०:७५:५० ना. फ. पो के.जी/हे) दर प्रयोग गर्दा, ३.८६ टन/हे (१५०:६०:४० ना. फ. पो के.जी/हे) दर प्रयोग गर्दा, ४.१९ टन/हे (१८०:७५:५० ना. फ. पो के.जी/हे) दर प्रयोग गर्दा दिएको पाईयो ।

त्यसैगरी हिउँदे मौसममा रामपुरमा नाईट्रोजन, फसफोरस र पोटासका विभिन्न मात्राहरु प्रयोग गरी गरिएका हाईब्रिड जातको मकै आर.एम.एल.८६/आर.एम.एल.९६ को परीक्षणमा आर.एम.एल.८६ /आर.एम.एल.९६ ले ५.८३ टन/हे (२४०:६०:४० ना. फ. पो के.जी/हे) दर प्रयोग गर्दा र ७.०५ टन/हे (१८०:६०:४० ना. फ. पो के.जी/हे) दर प्रयोग गर्दा उत्पादन दिएको पाईयो जसमा मलका पाच वटा मात्राहरु प्रयोग गरी परीक्षण लगाईएको थियो।

त्यसैगरी मलका बिभिन्न मात्राहरु प्रयोग गरी गरिएका हाईब्रिड जातको मकै आर.एम.एल ९५/ आर.एम.एल. ९६ को परीक्षणमा उक्त जातले मलखादको मात्रा (१२०:६०:४० ना.फ.पो के.जी/हे) को दरले प्रयोग गदा ४.१६ टन/हे र मलखादको मात्रा (२००:६०:४० ना. फ. पो के.जी/हे) को दरले प्रयोग गदा ७.३९ टन/हे उत्पादन दिएको पाईयो जसमा मलका आठ वटा मात्राहरु प्रयोग गरी परीक्षण लगाईएको थियो । यस परीक्षणमा सिफारिस फस्फोरसका मात्रालाई दुई पटक गरी जमिन तयारीका समय र पहिलो गोडाइ पछि प्रयोग गरीएको थियो ।

धान-गहुँको वाली प्रणालीमा गरिएको दीर्घकालिन माटोको उर्वराशक्ति परिक्षणमा नाईट्रोजन, फस्फोरस र पोटास को छुट्टाछुट्टै परिक्षणहरु गरिएको थियो । अन्य रासायनिक मलको सिफारिस मात्रालाई स्थिर राखि नाईट्रोजनको मात्रालाई मात्र हेरफेर गरि गरिएको परिक्षणको नतिजा अनुसार नाईट्रोजन १०० किलो प्रति हेक्टर (सिफारिस मात्रा) का दरले प्रयोग गर्दा गहुँको उत्पादनमा उल्लेख्य वृद्धि (३.१६ टन/हे.) भएको पाईयो । अन्य रासायनिक मलको सिफारिस मात्रालाई स्थिर राखेर फस्फोरसको मात्रालाई मात्रै हेरफेर गरि गरिएको परिक्षणमा, माटोमा फस्फोरस ५० किलो प्रति हेक्टर (सिफारिस मात्रा भन्दा १२५ ५ बढी) का दरले राख्दा गहुँको उत्पादन (३.३१ टन/हे) भयो । त्यसैगरि पोटासको मात्रालाई मात्र थपघट गरि गरिएको परिक्षणमा, पोटासलाई सिफारिस मात्रा भन्दा ४० प्रतिशत (१२ किलो/हे.) बढाउँदा गहुँको उत्पादन सबैभन्दा धेरै (३.०० टन/हे) भयो ।

बसन्त ऋतुमा गरिएको परिक्षणमा रसायनिक मल १५०:६०:४०किलो ना.फ.पो/हे. दरले प्रयोग गर्दा दुईवटा वर्णशंकर मकैका जातहरु आर.एम.एल ८६/आर.एम.एल. ९६ र आर.एम.एल ९५/ आर.एम.एल. ९६ ले सवैभन्दा धरै उत्पादन १०.५ टन/हे. दिएको पाइयो । मकैको उत्पादनमा खनजोत, विना खनजोत, छापो र विना छापोको प्रभाव हेर्न गरिएको परिक्षणमा, विना खनजोत+छापो प्रयोग गर्दा मकै (मनकामना ४)को उत्पादन धेरै (७.२ टने/हे.) भयो ।

रामपुर कम्पोजिट मकैको उत्पादनमा गाईको गहुंतको प्रभाव अध्ययनको लागि गरिएको परिक्षणको नतिजा अनुसार जम्मा लाग्ने नाइट्रोजन (१२० के.जी./हे) को मात्रालाई ५० प्रतिशत गाईको गहुँत र ५० प्रतिशत युरियाबाट परिपुर्ति गरि गरिएको प्लटमा मकैको उत्पादन राम्रो (३.५४ टन/हे.) देखियो । यसैगरि वोटविरुवालाई जलाएर बनाएको धुलो ५ टन र १० टन/हे. र कम्पोष्ट संग अन्य रसायनिक मलहरु सिफारिस मात्रामा राख्दा मकैको उत्पादन सवैभन्दा बढी (३.०२ टन/हे.) आयो । यसको अर्थ वोटविरुवालाई जलाएर बनाएको धुलो ५ टन र १० टन प्रति हेक्टर राख्नुको कुनै औचित्य देखिएन जबकि काठको खरानी र अन्य रसायनिक मललाई सिफारिस मात्रामा राख्दा मकैको उत्पादन २.९७ टन/हे. आयो ।

कीटविज्ञान

ट्राइकोग्रामा एक किसिमको शुक्ष्म वारुला हो जसले पुतली समुहका कीराहरुका फुललाइ खाएर वालीविरुवामा ति किराहरुवाट हुने हानीवाट बचाउछ । यिनै परजीवीको प्रयोग गरि बीउ उत्पादनमा, कीराको क्षति प्रतिशत घटाउने उदेश्य अनुरुप रामपुरमा एउटा परीक्षण संचालन गरिएको थियो । जसमा १० वर्ग मिटरका चारवटा प्लट मध्ये ३ वटा प्लटमा ट्राइकोकार्ड (ट्राइकोग्रामा वारुला १००,००० प्रति हे) राखियो भने १ वटामा खाली कार्ड राखियो । ट्राइकोकार्ड राखेको प्लटमा, कार्ड राख्नुपुर्व कीराको क्षति १८.२ देखि ३० प्रतिशत

रहेकोमा कार्ड राखेपछि भने कीराको क्षति ६ देखि १२.४ प्रतिशत भएको पाइयो । खाली कार्ड राखेको प्लटमा कीराको क्षति प्रतिशत (२४ देखि ३७) भएको पाइयो ।

२०७३/७४ मा राष्ट्रिय मकैबाली अनुसन्धान कार्यक्रम, रामपुरमा ४० वटा राम्रा दखिएका जातहरुलाइ मकैमा लाग्ने धर्के गवारोका अबराधोक जातहरुको छनौट परीक्षण राखिएको थियो । जसमा के.के.टि.०३, एस.००टि.एल.वाइ.क्यू.-वि., के.इ.डव्लु.-पि.ओ.पि. जातहरुमा अन्य जातको तुलनामा गवारोको क्षति कम भएको पाइयो । त्यसै गरी उक्त गवारो कीरा नियन्त्रणका लागि बजारमा प्रचलनमा आएका बिभिन्न बिषादीका परीक्षण गरिएको थियो । जसमा स्पीनोस्याड ४५% इ.सी. ०.५ मि.ली. पति लिटर र इमीडाकोल्रोपिड १७.८ % ०. ५ मि.ली. प्रति लिटर पानीको दरले प्रयोग गर्दा नतिजा राम्रो पाइयो । त्यसै गरी १४ वटा मकैका जातहरुलाइ शिशा घर भित्र धर्के गवारो लाई छाडेर, तिनीहरुमा निहित गवारो अवरोधक जातहरुको छनौट परीक्षण संचालन गरिएको थियो । जसमध्ये एस.९९टि.एल.डव्लु.क्यू.ए.वि., देउती, पोसिलो मकै, आर.एम.एल.३२८ आर.एम.एल.१७ जातहरुमा अन्य जातको तुलनामा गवारोको क्षति कम भएको पाइयो ।

स्थानीय स्तरमा पाइने विभिन्न वनस्पतिको परीक्षणमा, बोझोको जराको धुलो १० ग्राम/के.जी. मकैको घुन व्यवस्थापनको लागि उत्तम पाइएको छ । त्यस्तै मकैको घुन व्यवस्थापनको लागि प्रयोग गरिएको विभिन्न भण्डारण भाँडाहरुमा, सुपर ग्रेन ब्याग र पीआइसीयस ब्याग दुवै १२% र १५% चिस्यानमा राम्रो पाइएको छ । फौजीकीरा व्यवस्थापन को लागि गरिएको विभिन्न विषादीहरुको परीक्षणमा, स्पीनोस्याड ४५% इ.सी. ०.५ एम.एल./लीटर पानीको प्रयोगले फौजीकीराको राम्रो व्यवस्थापन भएको भेटिएको छ। किसानको मकैवालीमा गरेको सर्वेक्षणमा फौजीकीराको क्षती मकैको “घुंडा घुंडा आउने अवस्था” भन्दा “धान चमार छोड्नु अगाडिको अवस्था” मा बढी भेटिएको छ ।

रोग व्यवस्थापन

मकैका विभिन्न रोगहरुमध्ये तराई र पहाडमा मकैमा लाग्ने मूख्य मूख्य रोगहरुको व्यवस्थापनको निम्ति मकैका विभिन्न जातहरुलाई, रोग अवरोधक जात छनौट नर्सरीमा परीक्षण गरियो । देशका विभिन्न भागहरुबाट प्राप्त परीक्षणको नतिजा अनुसार मकैको ध्वांसे, थेग्ले (जि.एल.एस.) रोग नलाग्ने/सहन सक्ने जातहरुमा क्रमशः जेड. एम.-६२७, जेड. एम.-४०१, ०५ एस. ए. डि. भि. आइ., ०७ एस. ए. डि. भि. आइ., टि. एल. वि. आर. एस. ०७ एफ.१६, वि. जि. वि. वाइ. पि. ओ. पि. र आर. ए. एम. पि. यु. आर.-२१ पाइयो । त्यस्तै उत्तरी पात डढुवा (टि. एल. वि.), धब्बे रोगको (वि. एल. एस. वि.) र दक्षिणी पात डढुवा (एस. एल. वि.) रोगहरुको परीक्षणको नतिजा अनुसार वि. जि. वि. वाइ. पि. ओ. पि., आर. ए. एम. पि. यु. आर.-३३, आर. ए. एम. पि. यु. आर. एस. ०३ एफ.०८, जेड. एम.-६२७, पि. ५०१ एस. आर. सी. ओ./ पि. ५०२ एस. आर. सी. ओ.,

आर. एम. एल.-७६ /आर. एल. १०५, आर. एम. एल.-५५ /आर. एल.-१०५, आर. एम. एल.-५/आर. एल.-१०५, आर. एम. एल.-८७ /आर. एल.-१०५, आर. एम. एल.-५५ /आर. एल. -१०५, आर. एल.-३६ /आर. एल.-१९७, आर. ए. एम. पि. यु. आर. -२७, आर.एम.एल.-९५ /आर.एम.एल.-९६ ०५ एस.ए.डि.भि.आइ., टि.एल.वि.आर.एस.०७ एफ.१६ र आर.एम.एल.-३२ /आर.एम.एल.-१७ हरु रोग अवरोधक पाइयो ।

मकैमा लाग्ने डाँठ कुहिने रोगको प्रकोप दाङ, चितवन, नवलपरासी र सुर्खेत जिल्लामा बढी साथै ललितपुर, काभ्रे र पाखिबासमा ध्वाँसे थेग्ले रोगको प्रकोप बढी भएको पाइयो। मकैको डाँठ कुहिने रोग सहन सक्ने जातहरुमा रामपुर कम्पोजीट, अरुण २, रामपुर ३४, रामपुर एस ओ ३ एफ ओ ८, टि एल बि आर एस वो ७ एफ ६ र रामपुर ३४ पाइयो। त्यसैगरी दाङमा लगाएको परीक्षणको नतिजा अनुसार ब्याक्टेरिया नासक स्ट्रेप्टोसाइक्लिन २ ग्राम प्रति लिटर साथै किटनासक (साइपरमेथ्रिन ं क्लोरोपाइरीफस) २.५ एम एल प्रति लिटर पानीमा छुट्टा छुट्टै मिसाइ मकै घुँडा घुँडा हुने अवस्थामा एक पटक साथै त्यसको १५ दिनपछि सोहि मात्रामा पुन छर्नाले, किसानको मकै खेति गर्ने अभ्यास सँग तुलना गर्दा डाँठ कुहिने रोग नियन्त्रण ५२.३६% साथै ४०.२९% ले उत्पादनमा पनि वृद्धि भएको पाइयो ।

वाह्य अनुसन्धान

वर्णशंकर अनुजातका मकैमा कृषकको खेतमा गरिएको समन्वयात्मक जातीय परिक्षणको नतिजानुसार सि ए एच १५१ नामको अनुजातले सवैभन्दा वढी उत्पादन (१२.३ टन/हे.) दियो । त्यसपछि क्रमश उत्पादन बढी दिने अनुजातहरुमा सि.पी. ८०८ (११.६ टन/हे.) र सि ए एच १५१५ (११.१ टन/हे.) थिए । त्यसैगरि मकैको चाडैं पाक्ने जातहरुमा कृषकको बारीमा गरिएको जातीय परिक्षणमा एस.०३ टि.इ.वाइ.-आइ.एन. ले उल्लेख्य रुपमा बढी उत्पादन (७.२ टन/हे.) दियो । उक्त जातको बोटको उचाई (१७६ से.मी.) र घोगाको उचाई (८८ से.मी.) पनि अन्य परिक्षित जातहरु भन्दा बढी थियो । लामो समयमा पाक्ने मकैका जातहरुको उत्पादनलाई विश्लेषण गर्दा एच.जि.-ए.वि. जातको मकैको उत्पादन तुलनात्मक रुपमा राम्रो (५.५ टन/हे.) थियो । यसैगरि गुणस्तरिय प्रोटिनयुक्त मकैका जातीय परिक्षणमा एस.ओ.३ टि.एल.वाइ.क्यु.-ए.वि.-ओ.२ र पोषिलो मकै १ जातको मकैको उत्पादन (क्रमशः ५.५ र ५.४ टन/हे.) अन्य जातहरु भन्दा बढी थियो ।

कृषकको खेतमा गरिएको उपयुक्त समयमा पाक्ने धानको जातिय परिक्षणको नतिजा लाई विश्लेषण गर्दा, यी जातहरुको फुल फुल्ने समय, पाक्ने समय, वोटको उचाई, प्रति वर्ग मिटर गांज संख्या र उत्पादनमा विशेष फरक परेको देखियो । फुल फुल्ने समय (८२ दिन) र पाक्ने समय (१२४ दिन) एच.यु.ए. ५६५ र एन.आर.२१५७-१२२-१-२-१-१-१ जातका धानहरुमा चाडों देखियो भने एन.आर.२१६७-४८-५-१-२-१-१ जातको धानलाई चाहीं फुल फुल्न १०५ दिन र पाक्न १३२ दिन लाग्ने देखियो । सवै उन्नत जातका

धानहरुको उत्पादन एक अर्कामा उस्तै देखियो तथापी को आइ.आर. ८७६१५-९-३-१-३ उत्पादन (५.२४ टन/हे.) कृषकको स्थानिय जात (४.३२ टन/हे.) भन्दा विशेष बढी भएको पाइयो । मसिनो तथा वास्नादार धानको जातीय परिक्षणमा, सम्बा मसुली को उत्पादन तुलनात्मक रुपमा बढी (३.९ टन/हे.) थियो भने चाडैं पाक्ने धानको जातीय परिक्षणमा आइ.आर.८३७५४-वि.-वि.-४०-२ र आइ.आर.७०२१०-३९-सी.पि.ए.-७-१ को उत्पादन सबैभन्दा बढी (४.३ टन/हे.) थियो । यस गरि गहुँमा गरिएको जातिय परिक्षणमा सबै जातहरुको उत्पादन उस्तै देखिएता पनि तुलनात्मक रुपमा एन.एल.-११६४ को उत्पादन सबै भन्दा बढी (३.६ टन/हे.) थियो ।

राष्ट्रिय मकै वाली अनुसन्धान कार्यक्रमको विभिन्न वाह्य अनुसन्धान स्थलहरुमा गरिएको मकै र तरकारीको अन्तरवाली परिक्षणको नतिजालाई हेर्दा सबै भन्दा बढी आम्दानी (रु ४,५३,९००/ हे) मकै र काक्रोको अन्तरवालीले दियो । जुन आम्दानी मकै र करेलाको आम्दानी (रु ४,०७,१००/ हे) भन्दा तथ्यांकिय रुपमा खासै फरक देखिएन ।

बहुपक्षीय प्रविधि विकास

गहुँ

गहुँ बालीमा आ. व. २०७३/७४ मा जम्मा चार वटा जातिय परीक्षणहरु र एउटा रोग सम्बन्धि परीक्षण लगाईएको थियो । जातिय परीक्षणहरु मध्येमा प्रारम्भिक मूल्याङ्कन (आइ.इ.टि.) मा ३० वटा जातहरु समावेश गरिएकोमा बढी उत्पादन दिने जातहरु क्रमश एन.एल.१३२४ (४.१७ टन/हे.) र एन.एल.१३१२ (४.१० टन/हे.) पाईएको थियो । त्यस्तै समन्वयात्मक जातिय परीक्षण (सी.भि.टि.) मा २० वटा गहुँका जातहरु समावेश गरिएको थियो । परीक्षणको नतिजा अनुसार एन.एल.१२५३ (४.७३ टन/हे.) र एन.एल.१२५४ (४.६२ टन/हे.) बढी उत्पादन दिने पाईयो । त्यस्तै अर्को एक परीक्षण अन्तर्गत सुख्खा सहन सक्ने (एन.आर.एन.) सेटमा १०० वटा जातहरु समावेश गरिएकोमा बढी उत्पादन दिने जातहरु क्रमश एस.ओ.के.ओ.एल.एल./डब्लु.वि.एल.एल.१, ए.एल.टि.आइ.जि.ओ./... र ए.इ.आर.एस.ओ./५/... थिए । गहुंको जातीय परिक्षण (डब्लु.भि.डि.) अन्तर्गत ४३ वटा जात मध्ये आर.ओ.एच.आइ.एन.आइ., ए.एन.एन.ए.पि.यु.आर.एन.ए.-४, एम.यु.एन.ए.एल. र टि.आर.आइ.टि.आइ.सी.ए.एल.इ. ले ६ टन प्रति हेक्टर भन्दा बढी उत्पादन दिएको पाईयो ।

धान

धान बालीमा आ. ब. २०७३/७४ मा जम्मा तीन वटा जातिय परीक्षणहरु र एउटा रोग सम्बन्धि परीक्षण लगाईएको थियो । जातिय परीक्षणहरु मध्येमा उपयुक्त समयमा पाक्ने समन्वयात्मक जातिय सेट (सी.भि.टि.-नर्मल) मा २४ वटा धानका जातहरु

समावेश गरिएको थियो । परीक्षणको नतिजा अनुसार चाडो पाक्ने धानका जातहरु मध्येमा आइ.आर.५५४२३-०१ (४.९४ टन/हे.), एच.एच.जेड.१०-डि.टि.७-वाइ.१ (४.६७ टन/हे.), आइ.आर.१० एल.१५१ (४.६१ टन/हे.), आइ.आर.११ एन. ४०० (४.५७ टन/हे.) र आइ.आर.८८९६५-३९-१६-४ (४.४० टन/हे.) सबैभन्दा बढी उत्पादन दिने पाइएको थियो । त्यस्तै धानको मसिनो तथा वास्नादार सेटमा बढी उतपादन दिने जातहरुमा क्रमश एच.एच.जेड.१०-डि.टि.५-एल.११-एल.१ आइ. (४.४० टन/हे.), एन.आर.२१८८-३-२-४-१ (४.२० टन/हे.), एच.एच.जेड.२४-डि.टि.११-एल.१-एल.१ (४.०० टन/हे.) र एन.आर.२१२४-४३-३-१-१-१ (४.०५ टन/हे.) पाइएको थियो र साधारण धानको समन्वयात्मक जातिय सेट (सी.भि.टि.-नर्मल) मा आइ.आर.९६३२१-५५८-६४-वि.-४-१-१(४.४१ टन/हे.) र आइ.आर.९६३२२-३४-२०२-१३-२-१-२ (४.३१ टन/हे.) बढी उत्पादन दिने पाईयो ।

मसुरो

रामपुरमा संचालीत मुसुरोको समन्वय जातीय परिक्षण (सी.भी.टी.) २०१६/१७, को नतिजा अनुसार औषत उत्पादनलाई हेर्दा कालो मुसुरो (२.३९ टन प्रति हे.), आई.एल.एल ३३३८ (२.३९ टन प्रति हे.), आई.एल.एल १०२६५ (२.०२ टन प्रति हे.), आई.एल.एल ६८१९ (२.०० टन प्रति हे.) र डब्लु. वी. एल. ७७ (२.०० टन प्रति हे.) जातहरु सिफारिस जात सितल (१.५७ टन प्रति हे.) को दांजोमा बढी उत्पादन दिन सक्ने क्षमता भएको पाईयो । पूर्व-उन्मोचित जातीय परिक्षण (पी.आर.भि.टी) मा उत्पादनको दृष्टिले सिफारिस जात सगुन (१.३० टन प्रति हे.) को दांजोमा समग्रमा औषत उत्पादन क्षमता बढी भएको जातहरुमा आई.एल.एल. ८००६ (२.७८ टन प्रति हे.), कालो मुसुरो (२.४० टन प्रति हे.), आई.एल.एल. ७१६४ (२.४० टन प्रति हे.), आई.एल.एल. ६४६७ (२.३५ टन प्रति हे.) र आई.एल.एल. ७७२३ (२.०० टन प्रति हे.) भएको पाईयो ।

बीउ उत्पादन

यस आर्थिक वर्षमा रामपुरमा, ५३.४२९ टन मकैको बीउ उत्पादन भएको थियो । रामपुर कम्पोजिट अन्तर्गत ७.३६६ टन प्रजनन् बीउ, १३.०१९ टन मुलबीउ र ५.११ टन उन्नत बीउ उत्पादन भएको थियो । त्यसै गरी, अरुण-२ अन्तर्गत १.३४ टन प्रजनन् बीउ, ३.९३४ टन मुलबीउ र २.८८८ टन उन्नत बीउ उत्पादन भएको थियो । मनकामना-३ अन्तर्गत ३.१८९ टन प्रजनन् बीउ, ११.१ टन मुलबीउ र ०.६१२ टन उन्नत बीउ उत्पादन भएको थियो । त्यसैगरि, देउती अन्तर्गत १.२३५ टन प्रजनन् बीउ र २.६ टन मुल बीउ उत्पादन भएको थियो । पोषिलो मकै अन्तर्गत .०६ टन प्रजनन् बीउ र ०.११४ टन मुल बीउ उत्पादन भएको थियो । त्यसैगरि, धान, गँहु र ढैंचा अन्तर्गत, ४३.९९७ टन, ३.१ टन र ०.१५० टन मुल बीउ उत्पादन भएको थियो ।

जातीय कायम

अरुण २, मनकामना ३ र पोषिलो मकै १ मा ग्रिड छनौट पुरा गरियो । त्यसैगरि, कम्पोजिट र देउती मा हाफसिब फेमिलि छनौट पुरा गरि क्रमशः ३.५ के.जी. र २.३ के.जी. न्युक्लियस बीउ उत्पादन गरियो ।

विशेष परियोजना

कृषि तथा खाद्य सुरक्षा आयोजना

मकैको ३ टन प्रजनन् बीउ र २.६ टन मुल बीउ अनुसन्धान केन्द्र भित्र उत्पादन भएको थियो । मकैका उत्कृष्ट जातहरुको मुल्याङ्कन परीक्षणमा आर एम एल-९५/आर एम एल-९६ ले सबभन्दा बढी (८.७२ टन/हे)उत्पादन दिएको थियो । त्यसपछि बढी दिनेमा क्रमशः एक्स ९९४२/एक्स ९९४४ (७.६८ टन/हे) तथा प्रो भिटामिन-ए (ईन्ट्री नं.-८) (७.१२ टन/हे) छन् । सि भि टि अवलोकन भ्रमणका सहभागिहरुले जेड एम ६२७ मकैको जातलाई उत्कृष्ट पाए । त्यसपछि उत्कृष्ट पाउनेमा क्रमशः रामपुर एस १० एफ २० र रामपुर एस ०३ एफ ०४ छन् ।

किसानका लागि उन्नत बिउ बीजन कार्यक्रम

धानको मुल बीउ उत्पादन कार्यक्रम सल्यान (रामधान) र प्युठान (सावित्रि) दुवैमा ५-५ हेक्टरमा सन्चालन भईरहेको छ । किसानका लागि उन्नत विउ बीजन कार्यक्रम अर्न्तगत राष्ट्रिय मकैबाली अनुसन्धान कार्यक्रमले रामपुर कम्पोजिट (१.५ टन) र मनकामना-३ (१.५ टन) को प्रजनन् बीउ उत्पादन गरेको छ । रामपुर कम्पोजिटको मुल बीउ उत्पादन कार्यक्रम गुल्मि र अर्घाखाची दुवैमा ५-५ हेक्टरमा सन्चालन भईरहेको छ । गहुं (गौतम)को १ टन मुल बीउ उत्पादन गरिएको छ । एउटा पि भि एस धानको, दश वटा पि भि एस मकैको तथा दुई दुई वटा पि भि एस गहुँको के यु बि के का जिल्ला हरुमा सन्चालन गरिएको थियो । गहुँको पि भि एस मा सबैभन्दा बढी उत्पादन एन एल ११७९ (४.५१ टन/हे) ले दिएको थियो भने त्यसपछि बढी दिनेमा क्रमशः एन एल १२३१ (४.३७ टन/हे) र डब्लु के २४३० (३.९३ टन/हे) ।

मल्टि नेशनल कम्पनी हाईब्रिड परीक्षण कार्यक्रम

रामपुर, परवानीपुर, र तरहरामा गरिएको मल्टि नेशनल कम्पनी हाईब्रिडहरुको पहिलो सेटको जातीय परिक्षणको नतिजाहरुलाई संयुक्त रुपमा विश्लेषण गर्दा पी ३३७७ (११.५ टन /हे.) र के एम एच १३११ (१०.८९ टन/हे.) ले सबैभन्दा बढी उत्पादन दिएको पाइयो । यसैगरि दोस्रो सेटको नतिजा अनुसार, परवानीपुर र रामपुरमा एल जी ३४०५ को उत्पादन राम्रो (११.२९ टन/हे.) थियो भने तरहरामा एन के ७७२० को सबैभन्दा

बढी उत्पादन (१०.१४ टन/हे.) थियो । विभिन्न स्थानमा गरिएको दुई वर्षको परिक्षणलाई आधार मानी २०७४ सालमा जम्मा १३ वटा मल्टि नेशनल हाइब्रिडहरुलाई राष्ट्रिय विउ विजन बोर्डमा दर्ता गरिएको छ । दर्ता भएका जातहरुमा: पि.यल.-३३००, एच.पि.-२२२, पि. एल.-३३३१, पि.एल.-९७८४, पि.एल.-९५१, सुपर, पि.-३५३३, जे.एम.-४, जे.एम.-१, एल.जी. ३३.०१(एल.जि. ३२.७१), विस्को जम्बो ६५, जे.के.एम.एच. ५०२, कर्न किङ्ग ९५२२ (एम.९२९२), सुप्रिम ९०६३ (विकास) पर्दछन् ।

EXECUTIVE SUMMARY

Plant Breeding

Thirteen different activities under hybrid maize research and development were conducted in Terai and hilly areas by NMRP, Rampur during 2016/17. Activities namely inbred line observation, evaluation, seed production, new inbred line development and selection, hybrid observation nursery, test cross, coordinated hybrid trial, Farmers' field trial, evaluation and recommendation of inbred lines seed production, CIMMYT heat tolerant hybrid maize trials and selected hybrid trials were conducted in farmers' field in large scale. After five years of research, two heat tolerant hybrids, Rampur Hybrid-8 (CAH-151) and Rampur Hybrid-10 (CAH-153) were registered. Similarly, among 260 fixed inbreds, ZL12662, CML451, VL109126, CAL1421, CZL0718, CAL1465, CAL1412, NML-1, NML-2, NML-3, NML-4, NML-5, RML-6, RML-7, RML-8, RML-18, RML-19, RML-20, RML-32, RML-36, RML-57, RL-174, RML-62, RML-85, RML-95, RML-96, RML-97, RML-118, RML-119, RL-100, RL-105, RL-107, RL-140, CLA-12, CLA-83, CLA-105, CLA-111, CLA-44 / CLA-160 were found better. In hybrid observation nursery RML-4/RL-111, RML87/RL-105, NML-2/RML-17 / RML-57/RL-105 were found better in terms of yield and other agronomic characters. Among test crosses, GRGTS16-4-3-1-2-3-2-2-1/RML-17, BIOSEEDS1-5-1-4-2-1-1-1-3-2/RML-17, RAMPUR HYBRD-6/RML-96, RCS1-9-4-3-1-2-1-1-2-2/NML-2, BIOSEEDS1-5-1-4-2-2-2-1-2-2/NML-2 / PIONEERS1-2-3-1-1-2-4-3-2-2/RL-111 were high yielders and promising. Similarly, in coordinated varietal trial of hill and terai, CAH-153, CAH-1515, CAH-151, RAMPUR HYBRID-4, RML-98/RL-105, JM-4, JM-8 / RML-76/RL-105 performed better. In farmers field trial, RML-95/RML-96, RML-86/RML-96, CAH-153 / RML-4/RML-17 gave the high yield and preferred by farmers. In the trial conducted under HTMA, CAH-151 and CAH-153 were found better in grain yield and other aspects, and preferred by stakeholders, thus has been registered for commercial cultivation.

In the experiments conducted in NMRP on pop corn, among 15 different varieties, genotypes pop corn lumle yellow (3.73 t/ha), popcorn Gorkha (3.41 t/ha) and pop corn Rampur local (3.39 t/ha) gave highest yield respectively. Similarly, among 11 sweet corn varieties, genotypes ID 9193 W and ID 8007-Y gave highest yield respectively.

On the basis of performance of QPM genotypes, S01SIYQ gave the highest yield in CFFT (Pakhribas and Dolakha). Likewise, S99TLYQ-HG-AB performed better in CFFT Dailekh while normal maize genotype Khumal yellow ranked first in yield in CFFT at Khumaltar. In case of CVT, S03TLYQ-AB-2 in Dailekh, S01SIYQ in Pakhribas, Farmers' popular non-QPM variety in Surkhet and S00TLWQ-B in Khumaltar gave the highest yield. Similarly, in IYT at

Pakhribas, Farmers non-QPM variety performed better followed by Rampur S13FQ06.

The combined analysis of IYT full season hill set across Pakhribas, Khumaltar, Lumle, Kabre and Dailekh showed that RAMPUR S13F28 produced the highest yield (6.32 t/ha) followed by Manakamana-3 (6.23 t/ha) and RAMPUR S03F08 (6.02 t/ha), respectively. Combined analysis of CVT full season hill set showed that 05SADVI produced the highest yield (5.23 t/ha) followed by Manakamana-3 (4.88 t/ha) and ZM-401 (4.87 t/ha), respectively. Combined analysis of CFFT full season hill set showed that BGBYPOP produced the highest yield (5.63 t/ha) followed by 07SADVI (5.35 t/ha) and TLBRS07F16 (5.32 t/ha), respectively.

The combined analysis of IYT full season Terai set across Bhagetada, Dasrathpur and Rampur showed that POZARICA 9531 produced the highest yield (3.62 t/ha) followed by RAMPUR S03 F08 (3.26 t/ha) and S0128 (3.24 t/ha). In combined analysis of CVT full season Terai set, R-POP-1 produced the highest yield (3.91 t/ha) followed by CEL-OHGYA×CEL-OHGYB (3.62 t/ha) and HG-A (3.55 t/ha), respectively.

The analysis of IYT Early showed that SO3TEY/LN produced highest grain yield (5.64 t/ha), followed by 02SADVI (4.72 t/ha) and EEYC1 (4.50 t/ha). Similarly in CVT Early, among tested genotypes, SO3TEY/LN significantly produced highest yield (5.88 t/ha) followed by SO3TEY-LN/PP (5.77 t/ha) and EECY1 (4.96 t/ha). In case of CFFT Early experiment, SO3TEY-LN produced highest yield (5.16 t/ha) followed by Across-99402 (4.71 t/ha) respectively.

The result of the coordinated varietal trial (CVT) of maize for Karnali region conducted at NMRP, Rampur revealed that there were no difference in silking days among the tested genotypes but all the genotypes took comparatively less days for tasselling as compared with check variety Ganesh-1. Significantly higher plant height (250 cm) and ear height (140 cm) was observed in Jumka-POP. The yield of tested genotypes were statistically at par to each other but Karnali pool yellow genotype produced comparatively higher yield (4.92 t/ha).

Agronomy

In the experiment conducted for determining the optimum density and fertilizer level for hybrid maize the genotypic variation for grain yield, plant height and ear height was not observed between RML-95/RML-96 and RML-86/RML-96. However, irrespective of the genotypes, significantly higher grain yield (7.55 t/ha) was observed when the plant population was maintained at 77,519/ha with the fertilizer @ 174:87:58 $NP_2O_5K_2O$ kg/ha.

The maize grain yield and weed dry matter accumulations were significantly influenced by the weed management practices. Significantly higher grain yields were recorded in black plastic mulched (7.97 t/ha) and weed free (7.36 t/ha) treatments which were at par with rice straw mulched (6.06 t/ha). In case of weed dry matter accumulation, excluding the weed free treatment, significantly lower weed dry weight (0.017 t/ha, 0.013 t/ha and 0.008 t/ha were recorded in black plastic mulch in every computed time i.e 30, 60 and 90 DAS respectively

The maize field survey carried out at Gulmi and Argakhachi districts revealed that two weeds namely *Oxalis acetosella* (Amili Jhar) and *Ageratum* spp. (Gandhe jhar) were the very problematic weeds in the maize field where the weed densities of those weeds were 307.4/m^2 and 220.3/m^2, respectively.

Result of the experiment where maize genotypes were sown throughout the year at every 10 days interval revealed that the higher grain yield (15.70 t/ha) of hybrid maize RML-95/RML-96 was recorded when sown on 29th Chaitra followed by 19th Chaitra (14.10 t/ha), and 19th Bhadra (13.47 t/ha). In case of OPV maize S03TEY-FM the higher grain yield (10.13 t/ha) was recorded when the maize seed sown at 28th Baishakh followed by 29th Chaitra (8.38 t/ha), 19th Chaitra (8.30 t/ha) and 19th Bhadra (8.22 t/ha).

All the maize genotypes showed comparatively higher grain yield in mulching on no tilled practices as compared to the only tilled practices. The maize genotype RML-95/ RML-96 gave significantly higher grain yield (10.3 t/ha) when grown under mulching on no tilling method of practices.

Soil Science

In Long term fertility trial in rice-wheat cropping system conducted in Agronomy block in NMRP, experiments were conducted for Nitrogen, Phosphorus and Potassium update based on the recommended dose of fertilizer for irrigated wheat as100:40:30 kg NPK/ha. In Nitrogen update experiment keeping Phosphorus and Potassium level same for all treatments, the highest grain yield of wheat (3.16 t/ha) was obtained by 100 kg N/ha followed by 2.25 t/ha by 175 kg N/ha. In phosphorus update experiment, nitrogen and Potassium level was same for all treatments. The highest grain yield was found with the application of 50 kg P_2O_5/ha (3.31 t/ha) followed by the application of 75 kg $P_2O_{5/}$ ha as (2.89 t/ha). Similarly, in Potassium experiment where the nitrogen and Phosphorus level was same for all treatments, the highest grain yield was found with the application of 12 kg K_2O/ha (3.00 t/ha) which is followed by the application of 18 kg K_2O/ha (2.99 t/ha).

In spring maize conducted in NMRP, both RML-86/RML-96 and RML-95/RML-96 gave the highest grain yield (10.5 t/ha and 10.49 t/ha,

respectively) with 150:60:40 kg NPK/ha followed by RML-95/RML-96 (10.07 t/ha) with 120:60:40 kg NPK/ha.

The trial conducted at GRP, Salyan showed that the highest yield of Manakamana-4 (7.2 t/ha) was recorded with the treatment no tillage + mulch during 2016/17.

In a study conducted at NMRP, the plot treated with the combination of cattle urine, urea and FYM along with other recommended fertilizer revealed the highest grain yield of 3.55 t/ha. In this treatment, the total nitrogen i.e. 120 kg/ha was provided 50% by cattle urine and 50% by urea. Similarly, a trial was conducted in summer season at NMRP to study the effect of biochar and woodash on maize grain yield. The plots treated by the combination of biochar@5 t/ha and woodash @10 t/ha and FYM along with other recommended fertilizer revealed the highest grain yield i.e. 3.03 t/ha. It means biochar @ 5t/ha has same effect as biochar @ 10t/ha which was followed by 2.98 t/ha as a result of the application of woodash with other recommended fertilizers.

In variety cum fertilizer trial conducted at NMRP, during winter season of 2073/74, the highest grain yield was recorded as 3.86 t/ha in TLBRSO7F16 with the application of 150:60:40 NPK kg/ha. Similarly, S99TLYQ-HG-AB gave 3.72 t/ha in with the application of 180:75:50 NPK kg/ha, 2.76 kg/ha in Arun-4 (120:75:50 NPK kg/ha), and 4.19 t/ha in BGBYPOP with the application of 180:75:50 NPK kg/ha.

In the hybrid trial conducted during winter season of 2016/17, RML-86/RML-96 gave highest yield 7.05 t/ha with the application of 180:60:40 NPK kg/ha where as it yielded 5.83 t/ha only with the application of 240:60:40 NPK kg/ha. It is not always sure that higher rate of nitrogen must yield more. It is because excess nitrogen may cause soil acidic which in turn prevent plant nutrients uptake for effective growth and yield. Also, nutrients more than plant requirements will get unutilized.

In the hybrid trial of RML-95/RML-96 in winter season, the grain yield ranged from 6.14 t/ha (120:60:40 NPK kg/ha) to 7.39 t/ha (200:60:40 NPK kg/ha). In this experiment nitrogen fertilizer was applied as three splits whereas phosphorus fertilizer was applied as two splits at the time of land preparation and knee height stage with eight levels of fertilizers.

Entomology

The *Trichogramma* are minute wasps, potential bio-control agent whose adult female lays its eggs into stem borer's eggs. A total of four fields (each of 10 m^2) on maize seed production block at NMRP were selected and laboratory-reared *Trichogramma* @ 100000/ha were released on three plots out of 4 during the

month of Mangshir 2073. Total healthy plants, damaged plants, and number of dead heart plants in a plot were recorded. Results of field study revealed that infestation of maize stem borer was major on seed production block and released of *Trichogramma* was utmost necessary. The percent damage before release of *Trichogramma* was ranged from 18.2 to 30 while it was 6 to 12.4 % after release. In case of control plot, the percent damage was recorded in increasing trend from 24 to 37.

An experiment composed of forty elite maize genotypes were evaluated at NMRP, Rampur during 2016/17 spring season to find out the resistance source of maize stem borer. Out of the screened genotypes, the minimum damage was recorded on KKT 03 (4.33%) followed by S00TLYQ-B (5.67%), KEW-POP (6.67%) and Rampur Composite (6.67%) at tasseling stage. The high yielding genotypes were RML-86/RML-96 (2.60 t/ha), Rampur hybrid-4 (2.40 t/ha), RPOP 14 (2.33 t/ha), S00TLYQ-B (2.18 t/ha) and S03TLYQ-AB-02 (2.05 t/ha).

For the management of stem borer, field experiment with 8 treatments including control was conducted at NMRP, Rampur during 2016/17. Data on damage percentage and yield (t/ha) were recorded. The lower damage (5.29%) was observed at the plot sprayed with Spinosad 45% EC @ 0.5 ml per litre of water with highest crop yield (1.99 t/ha) followed by the plot treated with Imidacloprid 17.8% @ 0.5 ml per litre of water with damage percent of 5.73 producing grain yield of 1.94 t/ha. The highest damage (16.69 %) was observed in control plot with lower yield (0.76 t/ha). Similarly, results of germplasm screened against stem borer in glass house condition revealed that range of visual score at vegetative stage was 2-4.6, whereas 2-4 was scored at tasseling stage. Thus, majority of genotypes were tolerant against maize stem borer scored (2-3 score) except RML-95, RML-96, RML-86 and RML-17. Damage percent was noticed almost same at knee height (9-30%) and tasseling stage (8-30%). Average tunnel length was found (2-4 cm) whereas average number of exit hole was recorded 0.3-0.9 cm.

Among the tested botanicals, Bojho rhizome dust @10 g/kg of maize seed was found effective against weevil and on the other part, Super grain bag and PICS (Purdue Improved Crop Storage) bag was found superior against maize weevil at both 12% and 15% level of moisture, kept for a period of six months. On a trial conducted for the management of armyworm (*Mythimna separata*), Spinosad @ 0.5ml/l of water was found most effective against. A higher damage of armyworm was observed before tasseling compared to knee height stage in a survey carried out in farmers' field.

Pathology

Maize genotypes were screened against major diseases as gray leaf spot (GLS), northern leaf blight (NLB), southern leaf blight (SLB), banded leaf and sheath blight (BLSB) and ear rot in summer and winter during 2016/17 across the disease hot spot of the country under replicated conditions both on hybrids and OPVs. Among the tested genotypes for GLS resistant, seven genotypes as ZM-627, ZM-401, 05SADVI, 07SADVI, TLBRS07F16, BGBYPOP and RAMPUR-21 reacted resistant/moderately resistant reactions. For TLB, BLSB and SLB diseases, BGBYPOP, RAMPUR-33, RAMPURS03F08, ZM-627, P501SRCO/ P502SRCO, RML-76/RL-105, RML-55/RL-105, RML-5/RL-105, RML-87/RL-105, RML-55/RL-105, RL-36/RL-197, RAMPUR-27, RML-95/RML-96 05SADVI, TLBRS07F16 / RML-32/RML-17 genotypes were found resistant/moderately resistant.

Maize crop showed highly susceptible reaction to the stalk rot complex disease at western belts of Dang and susceptible reaction was marked in Chitwan, Nawalparasi and Surkhet districts while the disease effect was mild at Banke district.

The result of field experiment conducted in Dang showed that all the treatments had significant effect on percent disease index (PDI) and crop yield over farmers practice to control maize stalk rot. The higher percent disease control (52.36 %) and yield increase (40.29 %) were recorded from the plot sprayed with Streptocyclin @ 2 g/l and insecticide (Cypermethrin + Chloropyrifos @ 2.5 ml/l of water during knee height and subsequent spray after 15 days interval as compared to farmers practice. Out of 30 genotypes, Rampur Composit, Arun 2, Rampur 34, RamS03F08, TLBRS07F16 and Rampur 24 were found resistant against stalk rot complex with higher yield at Rampur, Chitwan.

Outreach research

In Coordinated Farmers Field Trial (CFFT) of hybrid maize, CAH-151 produced significantly higher grain yield (12.3 t/ha) followed by CP-808 (11.6 t/ha) and CAH 1515 (11.1 t/ha). These genotypes were at par with the pipline genotype RML-95/RML-96 (10.7 t/ha). In CFFT of early maize, the higher plant height (176 cm), ear height (88 cm) and grain yield (7.2 t/ha) was recorded in S03TEY-IN. Among the genotypes of the full season set, HG-AB produced the higher grain yield of 5.5 t/ha. Likewise, SO3 TLYQ-AB-O2 produced the higher grain yield (5.5 t/ha) followed by Poshilo Makai 1 (5.4 t/ha) in the coordinated farmers' field trial on QPM.

In CFFT on normal rice, all the tested genotypes differed significantly in flowering days, maturity days, plant height, number of hills/m^2 and grain yield. HUA 565 and NR 2157-122-1-2-1-1-1 flowered in 82 days and matured in

124 days, and thus, were earlier whereas NR 2167-48-5-1-2-1-1 required more days (105 days) for flowering and maturity (132 days). All the improved rice genotypes were found insignificant to each other but IR 87615-9-3-1-3 gave significantly higher grain yield (5.24 t/ha) as compare to the farmers' local (4.32 t/ha). Likewise, in CFFT on fine and aromatic rice, grain yield of farmers' popular variety was comparatively higher (4.0 t/ha) but found insignificant to the other improved fine and aromatic rice genotypes except for grain yield (1.5 t/ha) of black rice. Among the improved rice genotypes, comparatively higher grain yield (3.9 t/ha) was obtained in Samba Masuli Sub -1 and IR 83377-B-B-105-4 followed by TOX322-6-5-2-2-2-2 (3.8 t/ha). On the other hand, the highest grain yield (4.3 t/ha) was recorded in IR83754-B-B-40-2 and IR 70210-39-CPA-7-1 followed by Radha-4 (4.1 t/ha) in CFFT early rice.

In coordinated farmers' field trial on wheat, all the improved wheat genotypes were statistically at par, however they were superior to farmer's variety. The higher grain yield (3.6 t/ha) was found in NL-1164.

In maize and vegetable intercropping trial conducted at different locations of outreach sites of NMRP, Rampur, the maize genotype Rampur hybrid-4 yielded non-significant result but the vegetable cucumber and sponge gourd produced significantly higher yield i.e. 8.88 t/ha and 8.07 t/ha, respectively whereas the higher gross income was obtained from maize and cucumber intercropping (Rs. 453900/ha) followed by maize and bitter gourd (Rs. 407100/ha).

Collaborative experiments

Wheat

In FY 2073/74, altogether four varietal trials and one disease related trial was conducted. Among varietal trials, in IET 30 genotypes were evaluated. Among them, NL1324 (4.17 t/ha) and NL1312 (4.10 t/ha) gave the highest yield. Similarly, in CVT out of tested 20 varieties, NL1253 (4.73 t/ha) and NL1254 (4.62 t/ha) produced the highest yield. Likewise, in dry tolerant set SOKOLL/WBLL 1, ALTIGO and AERSO/5/ were high yielders among the tested 100 genotypes. Out of 43 genotypes tested in wheat varietal display (WVD), the good yielders were Rohini (6.53 t/ha) , Annapurna-4 (6.34 t/ha) , Triticale (6.28 t/ha) and Munal (6.21 t/ha).

Rice

In FY 2073/74, three different varietal trials and one disease related trial were conducted. In case of varietal trial in CVT-normal, 24 rice varieties were included. Result of early maturing rice varieties showed that IR55423-01 (4.94 t/ha), HHZ10-DT7-Y1 (4.67 t/ha), IR10L 151 (4.61 t/ha), IR11N400 (4.57 t/ha) and IR88965-39-16-4 (4.40 t/ha) gave the higher yield. Similarly, in fine and aromatic set, HHZ10-DT5-L11-L1i (4.40 t/ha), NR2188-3-2-4-1

(4.20 t/ha), HHZ24-DT11-L1-L1 (4.00 t/ha), NR2124-43-3-1-1-1 (4.05 t/ha) gave the highest yield. In CVT normal, IR96321-558-64-B-4-1-1 (4.41 t/ha) IR96322-34-202-13-2-1-2 (4.31 t/ha) gave high yield.

Lentil

In lentil CVT conducted at NMRP, Rampur during 2016/17, cultivars Black masuro (2.39 t/ha), ILL 3338 (2.39 t/ha), ILL 10265 (2.02 t/ha), ILL 6819 (2.00 t/ha) and WBL 77 (2.00 t/ha) were the high yielding compare to standard check Shital (1.57 t/ha). Similarly in PRVT, the high yielding lentil genotypes were ILL 8006 (2.78 t/ha), Black masuro (2.40 t/ha), ILL 7164 (2.40 t/ha), ILL 6467 (2.35 t/ha) and ILL 7723 (2.00 t/ha) than standard check Sagun (1.30 t/ha)

Seed production

In FY 2073/74, 53.43 tons of maize seed was produced. In case of Rampur Composite, 7.37 ton breeder seed and 13.02 ton foundation seed was produced. In case of Arun-2, 1.34 ton breeder seed and 3.93 ton foundation seed was produced. Similarly, in case of Manakamana-3, 3.19 ton breeder seed and 11.10 ton foundation seed; in case of Deuti, 1.24 ton breeder seed and 2.60 ton foundation seed was produced. Similarly, 0.06 ton breeder seed and 0.11 ton foundation seed of Poshilo Makai-1 was produced In case of, foundation seed production in rice, wheat and sun hemp was 43.99 ton, 3.10 ton and 0.15 ton, respectively.

Maintenance

Grid selection was applied in Rampur Composite and Deuti. Half sib family selection was used in Arun-2, Manakamana-3 and Poshilo Makai-1, and 3 kg, 4 kg and 3.5 kg nucleus seed of these varieties, respectively was produced.

Special Projects

Agriculture and Food Security Project (AFSP)

Three thousand kg breeder seed and 2600 kg foundation seed of maize was produced at NMRP Rampur. In the evaluation of promising genotypes, RML-95/RML-96 produced the highest grain yield (8.72 t/ha) followed by Across 9942/Across 9944 (7.68 t/ha) and Pro-Vitamin-A (7.12 t/ha). The participants of the exposure visit ranked ZM 627 as the best genotype followed by Rampur S10F20 and Rampur S03F04.

Kisan ka lagi Unnat Biu bijan Karyakram (KUBK)

Rice foundation seed production program is ongoing in 5 ha each in Salyan (Ramdhan) and Pyuthan (Sabitri) districts. A total of 1.5 ton breeder seed of Rampur Composite and 1.5 ton breeder seed of Manakamana-3 was produced. Foundation seed production program of Rampur Composite is on-going in 5 ha

in each of Gulmi and Arghakhachi district. One ton foundation seed of Gautam was produced. One PVS of rice, 10 PVS of maize and 2 PVS of wheat was conducted in the KUBK districts. NL 1179 produced the highest yield (4.51 t/ha) followed by NL 1231 (4.37 t/ha) and WK 2430 (3.93 t/ha).

Multinational company hybrid (MNCH)

The highest grain yield was recorded on P 3377 (12 t/ha) followed by PPS 4291 and KMH 1311 (11.7 t/ha) at RARS Parwanipur in set I. Similarly, at Rampur and Parwanipur LG 3405 (12.29 t/ha) and at Tarahara NK 7720 (10.14 t/ha) were found the highest yielded multinational company hybrids in set II during 2016/17. Based on two years multi-location trials, 13 multinational company hybrids (PL-3300, HP-222, PL-3331, 9784, 951 Super, P -3533, JM-4, JM-1, LG 33.01(LG 32.71) , Bisco Jumbo 65, JKMH 502, Corn King 9522(M9292), Suprim 9063 (Bikas)) were registered in NSB in 2074.

1. WORKING CONTEXT

Introduction

The National Maize Research Program (NMRP) was evolved as a part of the Rapti Valley Development Project (RVDP) in the year 2013 B.S. (1956 AD) with a view to rehabilitate the flood victims of 2011 B.S. (1954 AD) and to test, develop and recommend a package of farming system technologies to newly settled farmers. However, the systematic research activities were initiated from the year 2020 B.S. (1963). With the inception of commodity research program in 2029 B.S. (1972 AD), this office was mandated for the research and development of maize and maize based cropping system. After the establishment of Nepal Agricultural Research Council (NARC) in 2048 B.S. (1991 AD), this station was renamed as the National Maize Research Program (NMRP) and mandated to develop appropriate maize and maize based technologies for various agro-ecological zones of the country. NMRP, Rampur is located about 10 km west of Bharatpur, the district headquarter of Chitwan, in inner terai (Siwalik Dun Valley) region of Nepal. The geographical location is 27° 40'N latitude, 84° 19' E longitude at an altitude of 228 meter above sea level.

Goal

Increase production and productivity of maize and maize based cropping system in sustainable manner for improving national food, feed and nutritional security.

Objectives

- To collect, characterize, utilize and conserve different local and exotic maize germplasms.
- To develop high yielding, disease and insect resistant early, extra early and full season OPVs of maize suitable for different agro-environments
- To develop high yielding disease and insect tolerant single cross, double cross and top cross hybrids for terai and foot hill valleys
- To undertake basic, applied and adaptive research work on maize and maize based cropping system
- To conduct different outreach research activities on maize based cropping system in three districts Chitwan, Makawanpur and Nawalparasi with active participation of related stakeholders.
- To develop/test different agriculture implements/machineries in order to increase maize production with reduced cost and drudgery.
- To generate maize based conservation agriculture technologies for improving soil health/fertility and increasing maize productivity in a sustainable manner.

- To work as national institute for research, training and education in maize and maize based cropping system.
- To work as repository of information on maize and maize based technologies.
- To disseminate maize and maize based technologies to the different stakeholders through electronic media, booklets, folders, leaflets and posters
- To establish and strengthen national and international linkages for e×change of knowledge, research materials and collaborative research works
- To produce source seeds of maize (BS, FS), rice and wheat (FS) and distribute to different clients according to their demands (balance sheet of NSB)
- To publish research findings, recommend verified technologies and collaborate with disseminating partners for its wider dissemination

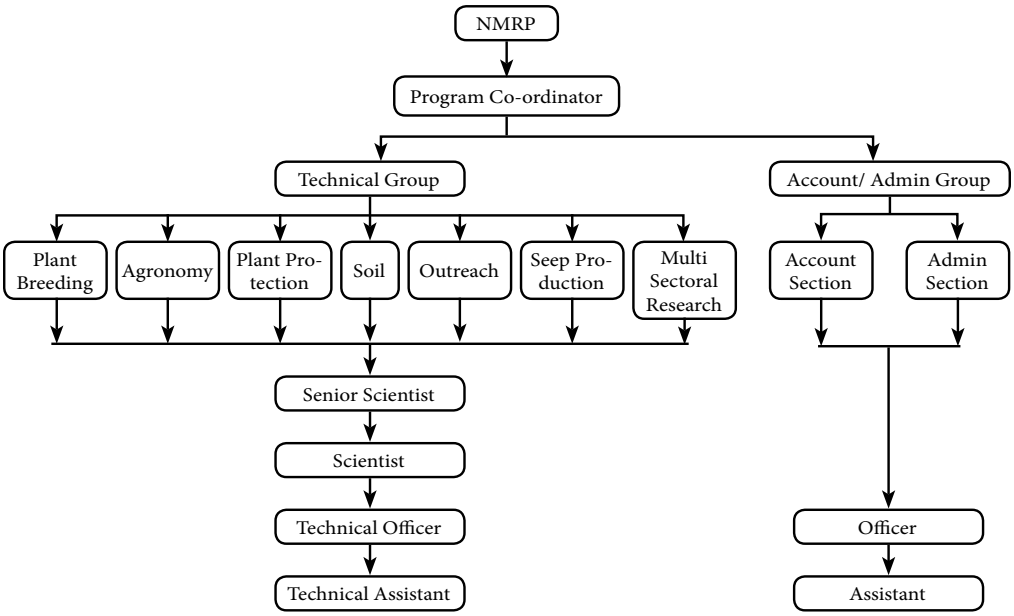
Geography and climate

The geographical location of National Maize Research Program (NMRP), Rampur, Chitwan is 27˚40' N latitude, 84˚19' E longitude at an altitude of 228 meter above sea level. It has humid and subtropical climate with cool winter and hot summer. The soil is generally acidic (pH 4.6-5.7), light textured and sandy loam. The average total annual rainfall of 16 years (2000-2016 AD) was 2215.30 mm with a distinct monsoon period (>75% of annual rainfall) from mid-June to mid-September. The command area covers Chitwan and Siwalik valley of Nawalpur and Makawanpur districts. The main objective of outreach research is to reduce the yield gap between on-station and on-farm in maize.

Infrastructure and facilities

The farm has total area of 101 ha., of which 25 ha. was utilized by Natioanl Cattel Reasearch Porgram Rampur. Out of 76 ha. approximately 2 ha is occupied by office buildings, residences, thressing floor, polyhouses, guardhouse, seed buildings, garage and roads. Around 40 ha. lands of farm have partial irrigation facilities with 5 deep boring and government irrigation canal. Farm has also the facilities of laboratories for pathology, entomology, soil science and equipped seed processing unit for seed section.

Organizational Structure of NMRP



2. RESEARCH HIGHLIGHT

2.1 PLANT BREEDING

2.1.1 Hybrid Maize Research and Development 2016/17

Maize (*Zea mays* L.) is the second staple food crop of Nepal and the principal food, feed, fodder, fuel crop and source of energy in hills and Terai. It is widely grown in all three agro eco-zones of Nepal: Terai and Inner Terai (below 900 masl), mid hills (900-1800 masl) and high hills (above 1800 masl). Hybrid maize technology has made significantly yield advances and increased profitability, and to some extent provided employment opportunity and supported in national economy. There is demand of nationally developed hybrids. National Maize Research Program has so far released and registered seven single cross hybrids. However, among them "Gaurav" could not reach to farmers' field due to non-synchronization of male and female parent hindering F1 seed production. Hybrids namely Rampur Hybrid-2, Rampur Hybrid-4, Rampur Hybrid-6, Khumal Hybrid-2, Rampur Hybrid-8 and Rampur Hybrid-10 are being popular among farmers. Some seed companies have initiated seed production and marketing of these hybrids. Farmers are demanding F1 seeds and a number of multinational hybrids are being marketed every year across the Terai and Inner Terai regions and to some extent in accessible areas of foot hills and mid hills of Nepal. Farmers are being cheated every year by local dealers from these multinational hybrid seed companies based in India while purchasing hybrid seeds due to open boarder. National Maize Research Program has been conducted hybrid research and development activities to develop locally adapted, disease resistant and high yielding maize hybrids. A number of inbreds and hybrids were evaluated in a series of experiments during 2016/17 (Table 1). The objective of the study was to develop and identify suitable best inbred lines and high yielding, disease and pest resistant/tolerant hybrids for Terai and Inner Terai region of Nepal.

2.1.1.1 Evaluation, characterization and seed production of inbred lines

Total 260 fixed inbreds were evaluated for diseases, insects and *per se* performance as well as seed production for maintenance and crossing applying controlled pollination at Rampur during winter season. The selected promising inbreds were ZL126632, CML-451, VL109126, CAL1421, CZL0718, CAL1465, CAL1412, NML-1, NML-2, NML-3, NML-4, NML-5, RML-5, RML-6, RML-7, RML-8, RML-18, RML-19, RML-20, RML-32, RML-36, RML-57, RL-174, RML-62, RML-86, RML-95, RML-96, RML-97, RML-118, RML-119, RL-100, RL-105, RL-107, RL-140, CLA-12, CLA-83, CLA-105, CLA-111, CLA-44 and CLA-160.

Table 1: Hybrid maize experiments conducted during 2016/17

SN	Experiments	Location	No. of genotype	Planting area, design and replication
1	Fixed Inbred testing, evaluation, characterization and seed production	Rampur	260	6 rows of 5 m length
2	Advancement and evaluation of S2-S6 inbred lines	Rampur	740	2 rows of 5 m length
3	Inbred evaluation Trial	Tarahara	15	2 rows of 5 m length with RCBD, 2 replications
4	Observation nursery on hybrid maize (OBNH-1)	Rampur and Parwanipur	25	2 rows of 3 m length with RCBD, 2 replications
5	Evaluation of test cross hybrids-1	Rampur	36	2 rows of 3 m length with RCBD, 2 replications
6	Evaluation of test cross hybrids-2	Rampur	24	2 rows of 3 m length with RCBD, 2 replications
7	Evaluation of test cross hybrids-3	Rampur	25	2 rows of 3 m length with RCBD, 2 replications
8	Evaluation of test cross hybrids-4	Rampur	25	2 rows of 3 m length with RCBD, 2 replications
9	Evaluation of test cross hybrids-5	Rampur	40	2 rows of 3 m length with RCBD, 2 replications
10	Coordinated varietal trial on hybrid maize (CVTH)-Terai set	Rampur, Belachhapi, Tarahara, Parwanipur and Nepalgunj	15	4 rows of 5 m length with RCBD, 3 replications
11	Coordinated varietal trial on hybrid maize-hill set (CVTH)	Khumaltar, Kabre, Dailekh, Pakhribas, Salyan	9	2 rows of 3 m length with RCBD, 3 replications
12	Coordinated farmer's field trial on hybrid (CFFTH)	Rampur, Belachapi, Pakhribas, Tarahara, Khumaltar and Salyan	6, 7	6 rows of 5 m length, farmer as a replication
13	Seed production of released inbred lines in large plots	Rampur	7	10 rows of 5 m length
14	Evaluation of CIMMYT hybrid trials (HTMA)	Rampur and Nepalgunj	530	1-3 rows of 4 m length
15	Evaluation of best-bet HTMA hybrids in on-farm (MLTs)	Rampur, Dang, Madi and Sagarnath	15 and 20 (winter and spring)	8-10 rows of 10 m length

2.1.1.2 Advancement and evaluation of S2-S6 inbred lines

Inbred lines consisted of 740 entries were planted in two rows. Diseased, insect infested and lines showing poor *per se* performance were discarded. Approximately 10% poor lines were discarded and other good to fair lines were selfed to advance the cycle. Some crosses were made with S5 and S6 lines using NMRP developed testers.

2.1.1.3 Evaluation of inbred lines

In this experiment, 15 promising and pipeline inbred lines were evaluated under replicated trials at Tarahara for grain yield and *per se* performance evaluation. Most of the tested genotypes yielded <1 t/ha grain yield. Only four genotypes namely NML-2, RML-17, RML-96 and RML-45 produced grain yield more than 1 t/ha (Table 2).

2.1.1.4 Observation nursery on hybrid maize (OBNH)

This experiment was conducted at NMRP Rampur and RARS Parwanipur, and consisted of 25 single cross hybrids. Plot size was 2 rows of 3 m long and replicated twice. Highly significant results were observed for grain yield, anthesis, silking and plant height, and rest of the traits were found non significant among the tested genotypes at Rampur (Table 3). Significantly highest grain yield was obtained from CP-808 (15.1 t/ha) followed by RML-4/RL-111 (11.9 t/ha), RML-87/RL-105 (10.9 t/ha) and NML-2/RMl-17 (11.1 t/ha), respectively. At Parwanipur, except grain yield and ear aspect all other traits were non significant (Table 4). Rampur hybrid-6 produced significantly highest grain yield (10.5 t/ha) followed by CP-808 (9.7 t/ha), Rampur hybrid-4 (9.1 t/ha) and RML-57/RL-105 (8.2 t/ha), respectively.

2.1.1.5 Test crosses

Five different test cross experiments consisting of 36, 24 25, 25 and 40 entries were conducted. Five testers namely RML-17, RML-96, NML-2, RL-111 and RL-105 identified by NMRP were crosses with different heterotic partners and these hybrids were evaluated at NMRP Rampur (Table 5-8). In test cross-1, significant differences were observed for grain yield among the tested hybrids. Rajkumar produced the highest grain yield (11.52 t/ha) and was ar par with GRGT s1 6-4-3-1-2-3-2-2-1/RML–17 (10.5 t/ha) and Bioseed s1-5-1-4-2-1-1-1-3-2/RML–17 (10.16 t/ha) (Table 5). In test cross-2, three way cross Rampur Hybrid-6 × RML-96 produced significantly highest grain yield (10.1 t/ha) and rest of the crosses also produced grain yield >5 t/ha (Table 6). Among the crosses evaluated in Test cross-3, significant differences were recorded for grain yield where Rajkumar produced highest grain yield (14.8

t/ha) followed by Rc s1-9-4-3-1-2-1-1-2-2/NML–2 (13.3 t/ha) and Bioseed s1-5-1-4-2-2-2-1-2-2/NML–2 (10.2 t/ha), respectively (Table 7). Similarly, in Test coss-4, again Rajkumar produced significantly highest grain yield (14.2 t/ha) followed by Pioneer s1-2-3-1-1-2-4-3-2-2 /RL–111 (13.1 t/ha) and A2 s1-10-1-2-2-1-2-2-1-1/RL–111 (10.7 t/ha) (Table 8). Table 9 shows the details of results of test cross-5. In this set all the tested entries were at par statistically for grain yield

Table 2: Mean grain yield and other characters of inbred lines tested at RARS Tarahara, 2016/17

SN	Genotypes	Days to		Height, cm		Aspect (1-5)		Grain yield, t/ha
		Anthesis	Silking	Plant	Eear	Plant	Ear	
1	RML-2	61	63	151	77	3.5	3.5	1.27
2	RML-45	60	63	104	47	4.0	4.0	0.65
3	RML-32	57	60	115	46	4.5	4.5	0.75
4	RML-17	62	64	133	62	3.5	3.5	1.05
5	RML-95	59	61	140	62	3.0	3.0	0.89
6	RML-86	63	65	127	58	3.5	3.5	0.77
7	RML-96	57	60	154	75	3.0	3.5	1.31
8	RML-105	61	64	120	45	2.8	3.9	0.41
9	RML-111	62	65	150	59	3.0	3.0	0.35
10	RML-140	59	61	124	57	4.0	4.0	0.70
11	RML-45	60	64	163	67	3.0	3.5	1.09
12	RML-87	61	64	150	68	4.0	4.0	0.47
13	RML-180	62	64	60	63	3.0	2.5	0.91
14	RML-68	62	66	98	45	4.5	4.5	0.33
15	RML-76	56	55	132	71	4.5	4.5	0.36
	Mean	60	62	128	60	3.6	3.7	0.75
	F-test	*	**	*	**	*	ns	Ns
	CV (%)	2.7	3.2	18.9	12.4	14.9	15.4	44.7
	LSD(0.05)	3.5	4.2	52	16	1.2	1.2	0.7

Table 3: Mean yield and other characters of tested hybrids in observation nursery (OBNH) at NMRP Rampur 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E.tur*	Aspects (1-5)		
			Anthesis	Silking	Plant	Ear	(1-5)	Plant	Ear	Husk cover
1	RML - 57 / RL - 105	10.7	63	66	235	105	1.8	2.3	1.5	1.8
2	RL -105/RL-176	8.9	65	68	275	135	2.0	2.8	2.3	2.3
3	RML-4/RL-111	11.9	65	68	218	118	2.3	1.5	1.8	2.5
4	RL-36/RL-105	7.1	67	70	198	116	2.8	2.0	2.0	2.5
5	RL-21/RL-101	9.1	62	66	250	128	2.3	2.0	1.8	2.5
6	RML-83/RL-197	10.2	63	66	223	115	2.5	2.3	2.3	3.0
7	RML-57/RL-174	8.7	64	67	320	140	2.0	2.0	1.8	1.5
8	HK-1-1344/HK-1-1387	9.8	67	71	200	125	1.5	2.0	2.0	2.0
9	RML-5/RL-105	3.3	63	67	220	115	2.0	2.3	1.5	1.5
10	RML-5/RML-8	9.8	64	67	213	100	2.3	2.0	1.8	2.3
11	RL-153/RL-105	6.0	63	67	275	126	2.8	2.5	1.8	2.8
12	RL-151/RML-18	8.9	61	64	218	103	2.5	2.5	2.0	2.3
13	RML-55/RL-105	8.7	64	67	233	138	2.3	2.5	2.0	2.5
14	RL-84/RML-62	7.6	62	66	235	160	2.0	2.3	2.3	2.8
15	RML-87/RL-105	10.9	66	69	225	115	2.3	2.3	1.5	2.0
16	RL-125/RML-18	9.7	62	67	215	115	2.0	2.0	1.5	1.5
17	RL-151/RL-111	10.4	61	64	285	125	2.0	2.0	1.5	2.0
18	RML-5/RL-101	9.7	65	69	250	106	1.8	2.0	1.8	2.3
19	CML-451/CML-286	5.1	70	74	210	120	1.8	2.0	2.3	2.0
20	NML-2/RML17	11.1	64	66	260	140	1.8	2.0	1.8	1.5
21	RML-17/NML-2	8.8	66	69	210	120	2.3	2.5	1.8	2.3
22	Rampur Hybrid-6	9.4	66	69	215	110	2.3	2.0	1.8	1.5
23	Rampur Hybrid-4	8.4	64	67	185	90	1.5	2.5	2.0	1.8
24	Rampur-2	2.6	65	68	205	115	1.5	1.8	2.0	1.5
25	CP-808	15.1	62	65	230	148	1.5	2.0	1.5	1.8
	Mean	8.9	64	67	232	121	2.1	2.2	1.8	2.1
	F-test	**	**	**	*	ns	ns	ns	Ns	ns
	CV (%)	19.8	2.6	2.5	13	16.1	19.2	24	16.2	23.5
	LSD(0.05)	3.6	3.4	3.5	62.3	-	-	-	-	-

Table 4: Mean yield and other characters of hybrids in observation nursery (OBNH) tested at RARS Parwanipur 2016/17 winter

SN	Genotype	Grain yield, t/ha	Height, cm		Aspect (1-5)			Insect score (1-5)
			Plant	Ear	Plant	Ear	Husk cover	
1	RML-57/RL-105	8.2	200	87	2.5	2.5	2.0	0.0
2	RL-105/RL-176	5.9	165	67	2.0	1.5	1.0	2.5
3	RML-4/RL-111	7.0	160	67	1.0	1.0	1.0	2.5
4	RL-36/RL-105	3.5	136	67	1.5	1.5	1.5	6.0
5	RL-21/RL-101	1.4	138	81	2.0	2.0	1.5	7.5
6	RML-83/RL-197	5.3	174	77	2.0	2.0	1.5	2.5
7	RML-57/RL-174	1.3	150	60	2.5	2.0	2.0	2.5
8	HK-1-1344/HK-1-387	2.3	145	67	2.5	2.0	2.0	2.5
9	RML-5/RL-105	1.6	74	27	1.5	1.0	0.5	0.0
10	RML-5/RML-8	6.6	163	77	1.5	1.5	1.0	5.0
11	RL-153/RL-105	3.8	158	61	1.5	2.0	2.0	0.0
12	RL-151/RML-18	6.1	183	80	2.5	1.0	1.5	10.0
13	RML-55/RL-105	6.4	176	87	2.0	2.0	2.0	0.0
14	RL-84/RML-62	3.4	151	54	2.0	2.0	1.5	5.0
15	RML-87/RL-105	5.8	187	79	2.5	2.0	1.5	2.5
16	RL-125/RML-18	3.8	177	79	1.5	1.0	1.5	5.0
17	RL-151/RL-111	5.0	161	66	2.0	1.0	1.0	5.0
18	RML-5/RL-101	3.6	83	34	1.0	0.5	0.5	5.0
19	CML-451/CML-286	5.9	142	58	1.5	1.5	1.5	2.5
20	NML-2/RML-17	5.7	161	67	2.0	1.5	1.5	2.5
21	RML-17/NML-2	5.9	175	80	2.0	1.5	1.5	7.5
22	Rampur Hybrid-6	10.5	175	68	1.5	1.0	1.5	2.5
23	Rampur Hybrid-4	9.1	181	83	2.0	2.0	1.5	0.0
24	Rampur-2	3.8	148	73	2.5	1.0	1.0	2.5
25	CP-808	9.7	182	71	2.0	1.0	1.0	2.5
	Mean	5.23	158	68	1.9	1.5	1.4	3.3
	F-test	**	ns	ns	ns	*	ns	ns
	CV (%)	58.5	22.2	26.6	39.5	30.9	43	
	LSD(0.05)	6.3	-	-	-	0.96	-	-

Table 5: Mean yield and other characters of test cross Hybrid-1 (TCH-1)) evaluated at NMRP Rampur 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. tur.* (1-5)	Aspect (1-5)		
			Anthesis	Silking	Plant	Ear		Plant	Ear	Husk cover
1	Rc s1-9-4-3-1-2-1-1-2-2/RML-17	6.7	63	66	185	78	2.8	2.5	2.0	2.5
2	Pioneer 30G10 2-4-1-2-1-2-1-2-3-1-1/RML–17	8.25	66	69	210	103	2.3	2.3	2.3	2.5
3	Bioseed 96 81 s1-5-1-4-2-2-2-1-2-2/RML-17	9.19	65	68	185	93	2.3	2.3	2.5	1.8
4	Bioseed s1-5-3-4-2-2-2-1-1-1/RML–17	8.85	63	66	185	95	2.0	2.0	2.0	2.0
5	Rc s1-1-1-1-1-1-1-2-3-2/RML–17	8.5	61	64	198	100	2.3	2.3	1.5	2.0
6	Rc s1-1-1-1-1-1-1-2-1-2/RML–17	7.3	65	68	205	105	2.0	2.5	2.0	1.8
7	RL-205/RML–17	7.99	63	66	185	88	2.5	2.0	2.0	1.8
8	A 2-s1-10-1-2-2-1-1-1-1-1-2/RML–17	7.52	66	69	195	100	2.3	2.0	2.5	2.3
9	Bioseed-s1-5-3-4-1-1-1-2-3-1/RML–17	9.64	67	70	180	90	2.3	2.3	2.0	1.8
10	Pineer s1-10-2-3-1-2-4-1-1-2/RML–17	8.74	62	65	198	108	2.3	2.3	2.0	1.8
11	GRGT733s1-6-2-2-2-1-1-2-1-2/RML–17	7.67	67	71	200	105	2.3	2.8	2.0	2.8
12	Pioneer s1-10-2-3-1-2-4-3-1-2/RML–17	7.8	65	67	190	90	2.0	1.8	2.0	1.5
13	Rc s1-9-1-2-2-2-2-1-1-2/RML–17	7.77	61	65	208	110	2.5	3.0	2.3	1.8
14	Bioseed s1-5-1-4-2-1-1-1-3-2/RML – 17	10.16	61	65	170	68	2.5	1.8	2.3	2.3
15	Bioseed s1-5-1-4-2-1-1-1-1-2/RML–17	7.37	65	68	183	80	2.0	2.0	2.3	1.5
16	Rc s1-1-1-1-1-1-4-1-1-1/RML–17	9.64	62	65	193	90	2.3	2.5	1.8	2.0
17	GRGT s1 6-4-3-1-2-3-2-2-1/RML–17	10.5	65	68	193	93	2.0	2.0	2.3	2.0
18	GRGT s1-6-1-2-1-1-1-1-1-1/RML–17	6.65	67	70	210	118	2.8	2.3	2.3	2.0
19	Rc s1-2-2-2-2-1-3-1-2-1/RML–17	8.36	61	64	200	80	2.3	2.3	1.5	2.5
20	Bioseed s1-5-3-4-2-2-2-1-1-2/RML–17	8.1	65	68	188	100	2.0	2.5	2.5	2.3
21	Rc s1-9-1-2-2-1-2-2-1-2/RML–17	5.38	63	67	210	103	2.5	2.5	2.5	2.0
22	Pioneer s1-8-1-4-2-2-3-1-2/RML–17	6.01	64	67	183	90	2.3	2.5	2.8	2.0
23	A2 s1-10-4-4-2-1-4-1-2-1/RML-17	7.86	64	68	193	78	1.8	2.0	2.3	2.5
24	Rc s1-1-1-1-1-2-2-2-2-1/RML-17	6.83	64	68	225	115	2.5	2.3	1.8	2.8
25	Rc s1-1-1-1-1-2-2-1-1-2/RML-17	6.71	67	71	208	123	17.0	2.8	1.5	2.0
26	Pioneer s1-10-2-3-1-2-4-1-1-1/RML – 17	8.92	61	65	185	90	2.5	1.8	2.0	1.8
27	Arun 2 s1-10-1-4-2-1-4-1-1-1/RML-17	9.39	64	67	198	100	1.5	1.8	2.0	1.8
28	Rc s1-7-2-1-2-4-1-1-2-1/RML-17	6.64	63	66	215	123	2.8	4.0	2.0	2.0
29	Bioseed s1-5-2-4-1-2-1-1-1-1/RML-17	9.05	60	63	190	93	2.0	1.8	2.3	1.8
30	Rc s1-7-2-1-2-4-1-1-2-2/RML-17	4.81	65	69	200	113	2.3	3.3	2.5	2.5
31	Rc s1-9-1-2-2-2-1-1-1-2/RML-17	6.1	62	65	195	83	2.8	3.3	2.0	2.0
32	Pioneer s1-8-1-4-2-1-2-3-1-1/RML-17	8.37	66	69	228	118	2.5	2.5	2.5	1.8
33	Rc s1-2RML-2-2-2-1-2-1-1-2-1/RML-17	6.13	63	66	218	110	2.5	2.8	2.0	2.0

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. tur.* (1-5)	Aspect (1-5)		
			Anthesis	Silking	Plant	Ear		Plant	Ear	Husk cover
34	Rampur Hybrid-4	7.43	66	69	165	75	2.0	2.0	2.8	1.8
35	Rampur Hybrid-6	9.23	65	68	168	90	2.0	2.0	2.0	1.5
36	Rajkumar	11.52	66	70	200	88	2.0	2.3	2.3	1.8
	Mean	7.9	64	67	195	97	2.7	2.3	2.1	2
	F-test	*	**	**	**	ns	ns	ns	ns	ns
	CV (%)	19.2	2.5	2.6	6.7	-	-	-	-	-
	LSD(0.05)	3.1	3.2	3.5	26.6	32.5	7.3	1.2	1	1

Table 6: Mean grain yield and other characters of test cross hybrid-2 (TCH-2)) evaluated at NMRP Rampur 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Ear	Plant	Ear	Husk cover
1	Bioseed s1-5-1-5-3-4-2-2-2-1-1-2/RML-96	6.4	65	67	210	108	1.8	1.8	1.5
2	Rc s1-7-5-2-2-3-1-1-2-1/RML–96	8.9	62	64	225	125	2.8	1.5	1.5
3	Rc s1- 1-1-1-1-1-4-1-1-1/RML–96	8.4	62	66	223	133	2.8	1.5	1.5
4	Rc s1-2-3-4-2-1-2-2-3-1/RML–96	7.8	63	65	210	120	2.5	2.0	1.5
5	Rc s1-1-1-1-1-1-1-2-2-2-2/RML–96	7.3	62	65	203	115	2.0	2.0	2.5
6	Rc s1-9-1-2-2-2-2-1-1-2/RML–96	9.0	62	65	218	105	2.5	1.8	1.8
7	Pioneer s1-1-1-1-1-2-2-1-1-2/RML–96	7.4	61	63	230	118	2.3	1.5	2.8
8	Pioneer s1-5-1-4-1-1-1-2-2-1/RML–96	6.6	65	68	253	93	2.5	2.5	2.3
9	Pioneer s1-2-4-1-2-1-3-1-1-2/RML–96	8.9	62	65	195	98	1.8	1.5	1.8
10	Hpy s1-10-1-1-2-1-1-2/RML-96	7.2	62	65	205	95	2.0	2.0	1.8
11	RL-233/RML-96	8.1	64	67	255	115	2.3	1.8	2.0
12	Bioseed s1-6-1-2-1-1-1-1-1-1/RML-96	9.0	63	66	250	143	2.3	2.5	1.5
13	Rc s1-7-2-1-2-4-1-1-1-2/RML-96	5.4	63	65	208	93	2.0	2.0	2.0
14	Pioneer s1-10-1-4-2-1-1-2-1-2/RML-96	7.7	61	64	230	100	2.0	1.8	1.8
15	Hpy s1-7-3-1-1-1-3-1/RML-96	3.5	62	65	185	98	2.5	2.3	1.8
16	Rc s1-2-2-2-1-3-1-1-3-1/RML-96	7.7	60	63	208	108	3.0	2.0	1.5
17	Pioneer s1-10-2-3-1-2-4-1-1-2/RML-96	9.8	61	64	190	88	1.8	1.5	2.0
18	(RML-95/RML-96) × RML–17	8.2	68	71	188	93	1.8	2.3	2.0
19	Rampur Hybrid-2 × RML–17	8.2	66	69	175	88	1.8	1.5	2.0
20	Rampur Hybrid-4 × RML-96	8.0	63	65	200	113	2.5	2.0	1.5
21	Rampur Hybrid-6 × RML-96	10.1	63	66	220	123	2.0	2.0	2.3
22	Rampur Hybrid-4	7.2	63	65	215	115	2.0	2.5	2.5
23	Rampur Hybrid-6	8.4	67	70	200	100	1.8	2.0	2.3

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Ear	Plant	Ear	Husk cover
24	Rajkumar	10.0	63	66	195	95	2.0	2.0	1.5
	Mean	7.9	63	66	212	107	2.2	1.9	1.9
	F-test	*	**	**	ns	ns	ns	*	ns
	CV (%)	18.9	2	2.3	11.3	19.4	23.7	16.9	22.4
	LSD(0.05)	3.1	2.6	3.2	49.6	43	1.1	0.7	0.9

Table 7: Mean grain yield and other characters of test cross hybrid-3 (TCH-3)) tested at NMRP Rampur 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Ear	Plant	Ear	Husk cover
1	Bioseed s1-5-1-4-2-2-2-1-2-2/NML–2	10.2	63	66	225	115	1.8	2.0	2.0
2	Rc s1-7-2-1-2-4-1-1-2-2/NML–2	9.2	64	67	245	130	1.8	1.5	2.0
3	Bioseed s1-5-3-4-2-2-2-1-1-2/NML–2	8.3	67	70	178	93	2.8	2.5	2.3
4	A2 s1-10-1-4-2-1-1-1-1-2/NML–2	8.5	65	68	215	115	2.5	1.8	1.5
5	Rc s1-9-1-2-2-2-1-1-1-1/NML–2	8.9	67	69	203	95	2.0	1.8	1.8
6	A2 s1-9-1-5-1-1-1-1-1-1/NML–2	5.5	67	70	203	118	2.5	2.3	2.0
7	TPY s1-6-4-1-2-1-1-2 / NML–2	4.7	67	70	223	125	2.8	1.8	1.5
8	Across9331 s1-4-2-1-1-4-2-1/NML–2	8.9	64	67	190	100	3.0	1.8	3.8
9	GRGT s1-6-2-2-2-1-1-2-1-2 / NML–2	4.6	68	72	225	110	2.5	2.0	2.0
10	Rc s1-9-4-3-1-2-1-1-2-2/NML–2	13.3	65	68	160	78	1.8	1.5	2.3
11	Rc s1-7-2-1-2-4-1-1-1-2 / NML–2	9.6	64	67	215	88	2.3	1.5	2.0
12	Pioneer s1-2-3-1-1-2-4-3-2-2/NML–2	8.8	66	69	220	105	2.3	2.3	2.3
13	Pioneer s1-10-2-3-1-2-4-3-3-1-2/NML–2	5.9	67	69	208	105	1.8	2.0	2.0
14	pioneer s1-8-1-4-2-1-1-2-2-2/NML–2	7.6	66	69	210	123	2.3	2.3	2.0
15	Rc s1-2-2-2-2-1-3-1-2-1/NML–2	7.4	65	68	180	78	2.8	2.0	2.0
16	Pioneer s1-2-4-1-2-1-2-3-1-1/ NML–2	6.7	66	69	170	83	1.8	2.5	3.3
17	A2 s1-9-1-5-1-1-1-1-1-2/NML–2	7.3	68	71	188	88	2.8	1.8	2.0
18	Rc s1-2-3-4-2-1-2-2-3-1/NML–2	9.7	65	68	183	83	2.3	1.5	2.0
19	Rc s1-9-1-2-2-2-1-1-1-2/NML–2	6.6	67	70	200	98	2.3	1.5	2.0
20	A2 s1-10-1-4-2-1-4-1-2-1/NML–2	6.9	66	69	208	93	2.5	1.8	2.3
21	Rc s1-2-2-2-2-1-3-1-2-1/NML–2	4.1	67	70	133	68	3.5	4.5	3.0
22	Rc s1-9-1-2-2-2-1-1-1-2/NML–2	8.6	64	68	215	125	2.0	2.3	2.5
23	Rampur Hybrid-4	8.1	67	69	188	80	2.0	1.8	1.5
24	Rampur Hybrid-6	7.8	67	70	188	88	2.0	2.0	2.3

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Ear	Plant	Ear	Husk cover
25	Rajkumar	14.8	65	68	193	90	2.3	1.5	2.0
	Mean	8.08	66	69	198	99	2.3	2	2.2
	F-test	*	**	*	*	ns	ns	**	ns
	CV (%)	26.4	1.7	1.8	10.5	19.4	36.7	17.9	34.1
	LSD(0.05)	4.4	2.3	2.6	43	-	-	0.7	-

Table 8: Mean grain yield and other characters of test cross hybrid-4 (TCH-4)) evaluated at NMRP Rampur 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Eart	Plant	Ear	Husk cover
1	Rc s1-2-2-2-1-3-1-1-3-1/RL-111	9.2	66	69	250	133	2.8	1.8	2.0
2	A2 s1-10-1-2-2-1-2-2-1-1/ RL-111	10.7	64	67	225	115	2.0	2.3	2.3
3	Across9331 s1-4-2-1-1-2-1-1/RL-111	10.4	64	66	210	93	2.0	1.5	2.0
4	Rc s1-2-3-4-2-1-2-2-1-1/RL-111	9.2	64	66	225	120	2.5	1.8	1.5
5	Rc s1-2-3-4-2-1-2-2-3-1/RL-111	9.2	64	66	203	108	2.5	1.8	1.5
6	A2 s1-10-1-4-2-1-4-1-2-1/RL-111	7.5	66	68	225	100	2.0	2.3	2.0
7	Rc s1-1-1-1-1-1-1-2-1-2- /RL-111	6.4	66	69	195	113	2.5	2.0	2.5
8	Rc s1-2-2-2-1-3-1-1-3-2/RL-111	7.4	66	69	233	125	3.5	2.3	1.5
9	Pioneer s1-2-3-1-1-2-4-3-2-2/RL-111	13.1	65	68	235	108	2.3	2.3	2.0
10	Bioseed s1-5-3-4-2-2-2-1-1-2/RL-111	9.0	66	70	245	140	3.3	1.5	2.3
11	Rc s1-9-4-3-1-2-3-2-1-2/RL-111	7.5	64	67	255	115	2.8	2.3	3.0
12	Pioneer s1-10-2-3-1-2-4-1-1/RL-111	9.6	66	69	220	105	2.5	2.5	2.0
13	pioneer s1-5-1-4-1-1-1-2-2-1/RL-111	8.4	66	69	228	115	4.0	2.5	3.3
14	Rc s1-1-1-1-1-1-1-1-4-3-2/RL-111	7.0	66	68	260	140	3.5	2.0	2.5
15	Rc s1-1-1-1-1-1-1-4-1-1-1/RL-111	7.2	65	67	230	120	2.0	1.8	1.5
16	GRGT s1-6-4-3-1-2-3-1-2-1/ RL-111	7.2	66	69	240	115	3.3	2.3	2.5
17	Rc s1-9-1-2-2-2-1-1-1-1/RL-111	5.7	66	69	223	93	2.8	2.0	2.0
18	A2 s1-10-1-4-1-1-4-2-2-1/RL-111	7.2	65	68	208	93	2.3	2.5	1.8
19	GRGT s1-6-2-2-2-1-1-2-1-1/RL-111	10.0	67	70	225	103	3.3	2.0	3.5
20	A2 s1-10-1-4-2-1-1-1-1-1-2/RL-111	7.4	64	66	188	105	2.3	1.8	2.5
21	Rc s1-2-2-2-1-3-1-1-3-1/RL-111	8.1	64	66	210	118	3.5	2.0	2.5
22	Rc s1-9-1-2-2-2-2-1-1-2/RL-111	7.6	65	68	245	123	3.0	2.5	2.0
23	Rampur Hybrid-4	7.3	66	69	175	73	2.8	2.5	1.8
24	Rampur Hybrid-6	8.7	68	71	175	98	1.8	1.8	1.8
25	CP 808	14.2	65	67	230	105	1.8	1.8	1.5

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Eart	Plant	Ear	Husk cover
	Mean	8.6	65	68	222	111	2.7	2.1	2.1
	F-test	**	ns	*	**	**	ns	ns	Ns
	CV (%)	11.6	2.1	1.9	6.9	11.8	24	17.9	31.3
	LSD(0.05)	2.1	-	2.7	31.8	27	-	-	-

Table 9: Mean grain yield and other characters of test cross hybrid-5 (TCH-5) evaluated at NMRP Rampur 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Ear	Plant	Ear	Hush cover
1	Pioneer s1-2-4-1-2-1-3-1-1-2/RL–105	5.9	65	68	223	108	2.5	2.3	2.5
2	A2 s1-9-1-5-1-1-1-1-1-1/RL–105	4.9	67	70	220	115	1.8	2.0	1.8
3	Rc s1-1-1-1-1-1-1-2-2-2-2/RL–105	8.3	64	68	215	113	2.3	2.8	2.5
4	20-29 s1-1-2-1-3-1-1-2/RL–105	7.0	66	68	185	88	2.0	1.8	1.5
5	20-29 s1-2-4-2-1-1-1-1/RL–105	7.0	63	67	200	100	2.3	1.5	2.0
6	Rc s1-7-2-1-2-4-1-1-2-2/RL–105	9.4	66	69	228	130	2.8	1.5	1.8
7	20-29 s1-2-4-2-1-2-2-2/RL–105	6.0	68	71	203	105	2.0	1.8	2.0
8	20-29 s1-1-4-2-3-1-3-1/RL–105	8.8	67	70	220	115	1.8	8.3	2.3
9	20-29 s1-2-4-1-3-2-1-2/RL–105	7.9	66	68	208	98	2.0	2.5	1.5
10	Hpy s1-9-4-2-2-1-1-1/RL–105	9.8	66	70	205	100	2.5	1.8	1.5
11	Rc s1-1-1-1-1-1-1-2-1-2/- RL–105	4.6	66	69	203	95	2.0	2.0	1.5
12	20-29 s1-2-4-2-1-2-1-2/RL–105	9.0	66	69	210	110	1.8	1.5	2.0
13	20-29 s1-1-2-1-1-1-2-2/RL–105	9.5	68	72	195	95	1.8	1.5	1.8
14	Rc s1-9-4-3-1-2-3-2-1-1/RL–105	5.5	68	70	165	75	2.3	1.5	2.0
15	20-29 s1-2-4-2-1-2-1-1/RL–105	9.7	67	69	208	105	2.0	1.8	2.0
16	75-27 s1-1-1-1-4-1-1-2/RL–105	8.1	64	67	205	115	2.0	2.5	2.0
17	20-29 s1-2-4-1-2-1-1-1/RL–105	6.3	64	67	220	108	2.0	2.3	1.8
18	Gurave s1-1-3-2-3-2-1-2/RL–105	7.3	66	69	208	103	2.0	1.5	1.5
19	20-29 s1-1-2-1-1-1-2-1/RL–105	7.2	67	70	203	93	2.0	1.8	2.0
20	GRGT s1-6-1-2-1-1-1-1-1-1/RL–105	8.2	64	67	213	103	2.3	1.5	2.8
21	20-29 s1-1-4-2-1-1-1-1/RL–105	7.9	65	68	188	90	2.5	2.3	2.5
22	Rc s1-1-1-1-1-1-1-2-3-2/RL–105	9.6	65	67	213	105	2.5	1.8	1.5
23	20-29 s1-1-2-1-1-1-2-2/RL–105	7.9	67	69	193	93	2.8	1.8	2.5
24	Rc s1-1-1-1-1-1-4-1-1-1/RL–105	7.1	65	68	195	103	2.3	2.3	1.8
25	Rc s1-7-5-2-3-1-1-2-1/RL–105	11.1	64	67	223	113	2.3	2.0	1.8

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Ear	Plant	Ear	Hush cover
26	Bioseed s1-5-3-4-2-2-2-1-1-1/RL–105	8.7	68	72	193	75	2.5	1.8	2.0
27	20-29 s1-1-4-2-3-1-3-2/RL–105	7.8	68	72	183	95	2.0	2.0	2.3
28	Pioneer s1-10-2-3-1-2-4-3-1-2/RL–105	9.5	66	70	203	103	2.0	1.8	2.5
29	Rc s1-1-1-1-1-1-1-2-1-1/RL–105	10.5	65	67	225	125	2.3	2.0	1.5
30	Rc s1-2-3-4-2-1-2-2-1-1/RL–105	8.9	66	69	208	115	2.0	2.0	2.3
31	Pioneer s1-2-4-1-2-1-2-3-1-1/RL–105	7.4	67	69	240	115	2.3	2.5	1.8
32	A2 s1-10-1-4-2-1-4-1-3-1/RL–105	8.2	67	70	200	98	2.3	2.3	2.0
33	Pioneer s1-10-1-4-2-1-1-2-1-2/RL–105	9.4	65	66	105	113	1.5	1.8	1.8
34	Rc s1-7-5-2-3-1-1-2-1/RL–105	8.8	67	70	220	115	2.8	2.0	1.5
35	RML-115/RL–105	7.0	67	70	193	95	2.0	1.5	1.8
36	RML-89/RL–105	9.6	67	69	198	93	2.8	1.8	2.0
37	Rampur Hybrid-4	7.9	65	68	205	103	2.0	2.0	1.8
38	Rampur Hybrid-6	9.6	67	70	158	80	2.5	2.3	1.8
39	Rampur Hybrid-2	7.1	65	68	215	108	2.3	2.5	2.0
40	CP 808	9.9	66	68	205	93	1.8	2.0	1.8
	Mean	8.1	66	69	202	102	2.2	2.1	1.7
	F-test	ns	*	**	ns	ns	ns	ns	ns
	CV (%)	26.5	2	1.7	12.8	16	24.3	74	24.1
	LSD(0.05)	-	2.6	2.4	-	-	-	-	-

2.1.1.6 Coordinated hybrid trial (CVTH)-Terai set

This experiment was conducted across the TeraiTerai region of Nepal including RARS Tarahara, ARS Belachapi, RARS Parwanipur, NMRP Rampur and RARS Nepalgunj. Results presented in this report are only from three locations hence we could not receive data from RARS Nepalgunj and ARS Belachapi. The result from Rampur showed significant differences for grain yield (Table 10). Highest grain yield was observed in CP-808 (9.5 t/ha) followed by CAH-153 (8.7 t/ha) and CAH-1515 (8.4 t/ha), respectively. Under Parwanipur condition too, CP-808 produced significantly highest grain yield (11.2 t/ha) followed by CAH-1515 (9.8 t/ha) and Rampur hybrid-4 (8.1 t/ha), respectively (Table 11). At Tarahara, relatively lower grain yield (<3 t/ha) was obtained from the tested genotypes and it might be because of poor site selection and poor management of the experiment (Table 12).

Table 10: Mean grain yield and other traits of genotypes in coordinated hybrid trial (CHT) at NMRP Rampur 2016/17 winter

SN	Genotype	Grain yield t/ha	Days to		Height, cm		*E.tur* (1-5)	Aspect (1-5)		
			Anthesis	Silking	Plant	Ear		Plant	Ear	Husk cover
1	CAH-1515	8.4	61	64	200	117	9.3	2.0	1.5	1.5
2	CAH-158	5.8	65	68	310	143	1.8	2.8	1.8	2.5
3	RML-4/RML-62	7.4	64	66	234	136	2.0	2.3	1.8	1.5
4	RML-85/RL-105	4.8	66	68	250	127	2.5	2.3	1.8	2.7
5	RML-76/ RL-105	6.5	66	69	253	140	2.0	2.3	1.5	2.2
6	RML-68/ RL-105	4.8	62	65	327	150	2.0	2.5	2.5	2.7
7	RML-95/ RL-105	6.6	64	67	230	130	2.2	2.5	2.0	2.5
8	RL-180/RML-5	7.6	62	65	218	110	1.7	1.8	1.5	1.7
9	CAH-1521	7.5	66	68	220	100	1.8	1.8	2.3	1.7
10	CAH-153	8.7	62	65	209	105	1.7	1.5	1.8	1.7
11	CAH-151	7.6	60	63	213	102	2.5	1.7	1.5	2.2
12	Rampur Hybrid-6	7.2	65	68	223	125	1.7	1.8	1.8	2.0
13	Rampur Hybrid-4	7.2	63	66	210	113	1.8	1.7	1.8	1.8
14	Rampur Hybrid-2	4.1	65	68	205	116	1.8	2.0	1.8	2.2
15	CP-808	9.5	61.0	63.3	237	131	2.0	1.7	1.5	1.5
	Mean	6.9	63.0	66.0	236.0	123.0	2.5	2.1	1.8	2.0
	F-test	**	**	**	**	**	ns	ns	ns	**
	CV (%)	22.5	1.9	1.8	11.1	7.9	143.0	25.4	21.4	16.8
	LSD(0.05)	2.6	2.0	1.9	43.7	16.3	-	-	-	0.6

Table 11: Mean grain yield and other traits of genotypes tested in coordinated hybrid trial (CHT) at RARS Parwanipur 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, in cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Ear	Plant	Ear	Husk cover
1	CAH–1515	9.8	104	108	176	66	2.7	2.0	1.3
2	CAH-158	3.5	116	119	192	88	2.0	1.3	1.7
3	RML-4/RML-62	7.7	111	114	173	78	1.3	2.0	1.3
4	RML-85/RL-105	4.3	115	118	164	61	2.7	2.0	2.0
5	RML-76/RL-105	6.2	114	118	157	56	2.3	2.0	2.0
6	RML-68/RL-101	3.6	109	114	171	57	3.3	1.7	2.3
7	RML-95/RL-105	6.0	107	111	155	65	2.3	2.0	2.0
8	RL-180/RML-5	7.3	113	118	176	70	1.7	1.7	2.7

SN	Genotype	Grain yield, t/ha	Days to		Height, in cm		Aspect (1-5)		
			Anthesis	Silking	Plant	Ear	Plant	Ear	Husk cover
9	CAH-1521	2.7	114	117	174	67	2.7	2.0	1.7
10	CAH-153	6.7	109	115	154	52	2.0	2.0	1.7
11	CAH-151	7.3	112	116	178	69	1.3	1.7	1.3
12	Rampur Hybrid-6	7.6	110	115	169	74	1.7	1.3	1.3
13	Rampur Hybrid-4	8.1	108	112	164	65	2.3	1.7	2.7
14	Rampur Hybrid-2	2.9	114	117	159	58	3.0	2.3	1.7
15	CP-808	11.2	109	114	172	61	1.3	1.0	1.0
	Mean	6.3	111	115	169	66	2.2	1.8	1.8
	F-test	**	**	**	ns	*	**	ns	**
	CV (%)	20.5	2.2	2.1	10	16.2	25.9	26.2	27.4
	LSD(0.05)	2.2	4.1	4	-	17.8	0.9	-	0.8

Table 12: Mean grain yield and other traits of genotypes evaluated in coordinated hybrid trial (CHT) at RARS Tarahara 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm	
			Anthesis	Silking	Plant	Ear
1	CAH–1515		67	69	184	80
2	CAH-158	1.51	67	69	212	104
3	RML-4/RML-62	1.93	67	69	190	100
4	RML-85/RL-105	2.73	72	70	189	90
5	RML-76/RL-105	1.71	68	71	181	78
6	RML-68/RL-101	1.30	67	69	186	78
7	RML-95/RL-105	1.71	65	67	201	107
8	RL-180/RML-5	2.33	66	71	197	91
9	CAH-1521	2.48	67	69	171	83
10	CAH-153	1.60	67	70	171	72
11	CAH-151	1.70	67	69	194	93
12	Rampur Hybrid-6	1.56	68	70	190	92
13	Rampur Hybrid- 4	2.16	66	68	181	92
14	Rampur Hybrid-2	2.66	68	66	175	82
15	CP-808	1.23	66	68	192	90
	Mean	3.23	67	69	188	89
	F-test	ns	ns	ns	ns	*
	CV (%)	40.8	3.9	3.7	7.5	13
	LSD(0.05)	-	-	-	-	19.3

2.1.1.7 Coordinated hybrid trial (CVTH)-Foot hill and hill set

Single cross hybrids were evaluated in coordinated trials in summer season at Dailekh, Pakhribas, Khumaltar, Kabre and Salyan for identification of superior high yielding, disease and insect resistant/tolerant genotypes for the hills of Nepal. A total of 15 genotypes including checks were evaluated under RCBD in three replications. At Pakhribas the tested genotypes differed significantly for grain yield (Table 13). P3533produced the highest grain yield (9.03 t/ha) followed by RML-98/RL-105 (7.6 t/ha) and JM-8 (7.57 t/ha), respectively. The result from Dailekh showed that all the tested genotypes differed significantly . Most of the tested genotypes produced grain yield more than 8 t/ha (Table 14). The highest grain yield was recorded from RML98/RL-105 (11.7 t/ha). Table 15 showed the results of the tested genotypes at Khumaltar. At this location, grain yield of the tested genotypes was at par statistically, however relatively lower productivity was observed than other locations (<4 t/ha). The highest grain yield was recorded in JM-4 (3.48 t/ha) followed by RML-98/RL-105 (3.36 t/ha). At Salyan, all the traits among the tested genotypes differed significantly. Grain yield was recoded relatively higher as compared to other locations (Table 16). Again P3533 was superior for grain yield (12.6 t/ha) followed by JM-8 (10.5 t/ha) and RML-76/RL-105 (10.4 t/ha), respectively. Likewise, at Kabre all the tested genotypes were at par for grain yield (Table 17) and produced more than 6 t/ha. JM-4 out yielded (9.78 t/ha) the tested genotypes. The combined results of above locations revealed significant differences for genotypes and locations but interaction between genotypes and locations was insignificant for grain yield (Table 18). From grain yield production point of view P3533 seems stable over the locations (8.59 t/ha) followed by RML-98/RL-105 (8.13 t/ha) and JM-4 (7.51 t/ha), respectively.

Table 13: Mean grain yield and other characteristics of genotypes tested in coordinated hybrid trial (CHT) at ARS Pakhribas 2016/17 summer

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Dis. Sev. (1-5)		Aspect(1-5)	
			Anthesis	Silking	Plant	Ear	GLS	*E.tur*	Plant	Ear
1	RML-76/RL-105	6.57	69	71	201	95	1.5	1.7	2.7	2.3
2	RML-87/RL-105	5.10	70	72	191	101	1.3	1.8	2.3	2.5
3	RML-180/RL-105	6.13	65	67	211	117	1.5	2.3	2.7	2.0
4	RML-95/RL-105	6.33	65	68	213	115	1.5	1.8	2.2	2.7
5	RML-153/RL-105	6.80	66	68	211	111	1.7	1.8	2.0	2.5
6	RML-98/RL-105	7.60	68	71	212	112	1.5	2.2	2.3	2.3
7	RM-L5/RL-105	6.97	68	70	213	113	1.5	2.3	2.5	2.7
8	RML-85/RL-105	6.47	70	73	221	113	2.0	2.5	2.3	2.7
9	RML-57/RL-174	6.77	69	72	243	132	1.8	1.8	2.3	2.3

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Dis. Sev. (1-5)		Aspect(1-5)	
			Anthesis	Silking	Plant	Ear	GLS	*E.tur*	Plant	Ear
10	RML-36/RL-197	4.70	64	67	232	123	1.8	2.5	3.2	2.3
11	JM-4	5.63	63	64	231	105	1.8	2.5	3.3	2.7
12	JM-7	5.23	62	65	174	76	2.0	2.7	3.2	2.7
13	JM-8	7.57	63	66	231	118	1.7	2.2	3.0	2.0
14	P3533	9.03	62	64	245	117	1.7	2.8	3.0	2.2
15	Rampur Hybrid-2	5.87	70	72	195	110	2.0	2.7	2.2	2.2
	Mean	6.45	66	69	215	111	1.7	2.2	2.6	2.4
	F-test	**	**	**	**	**	ns	*	*	ns
	CV (%)	15.5	1.5	15	6.7	9.7	17.7	17.4	17.1	16.3
	LSD(0.05)	1.7	1.7	1.7	24.2	17.9	-	0.7	0.7	-

Table 14: Mean grain yield and other traits of genotypes tested in coordinated hybrid trial (CHT) at ARS Dailekh 2016/17 summer

SN	Genotype	Grain yield, t/ha	Days to		Height, cm	
			Anthesis	Silking	Plant	Ear
1	RML-76/RL-105	8.9	76	78	246	137
2	RML-87/RL-105	8.0	80	82	235	143
3	RML-180/RL-105	8.8	72	74	247	143
4	RML-95/RL-105	8.4	74	76	252	146
5	RML-153/RL-105	9.1	73	75	254	145
6	RML-98/RL-105	11.7	75	77	246	127
7	RML-5/RL-105	8.5	78	80	258	143
8	RML-85/RL-105	8.3	78	80	262	156
9	RML-57/RL-174	8.6	78	80	272	160
10	RML-36/RL-197	9.0	73	75	250	143
11	JM-4	9.3	70	72	254	123
12	JM-7	9.1	71	73	224	104
13	JM-8	9.0	69	71	249	120
14	P3533	11.3	70	72	252	134
15	Rampur Hybrid-2	8.5	74	76	225	144
	Mean	9.4	74	76	248	138
	F-test	**	**	**	**	**
	CV (%)	10.9	2.6	2.5	4.4	6
	LSD(0.05)	1.7	3.2	3.2	18.4	13.9

Table 15: Mean grain yield and other characteristics of genotypes tested in coordinated hybrid trial (CHT) at ABD Khumaltar 2016/17 summer

SN	Genotype	Grain yiels, t/ha	Days to		Height, cm		Disease sev. (1-5)			Aspect (1-5)		
			Anthesis	Silking	Plant	Ear	BLSB	NLB	GLS	Plant	Ear	Husk cover
1	RML-76/RL-105	2.30	65	68	194	88	1.8	2.8	1.5	2.7	2.5	1.0
2	RML-87/RL-105	3.19	68	70	174	81	2.2	3.0	1.5	2.7	2.7	1.3
3	RL-180/RL-105	2.10	63	65	195	95	1.8	3.2	1.5	2.5	2.5	1.3
4	RML-95/RL-105	2.53	66	68	186	88	1.8	2.7	1.5	2.7	2.8	1.7
5	RL-153/RL-105	2.67	65	67	181	80	1.7	3.2	1.5	2.8	2.8	1.3
6	RML-98/RL-105	3.36	66	68	185	80	2.0	2.8	1.5	3.0	2.8	1.5
7	RML-5/RL-105	3.27	66	68	189	88	1.8	2.8	1.5	2.7	2.6	2.1
8	RML-85/RL-105	2.73	67	70	189	78	1.7	3.2	1.5	2.8	2.5	1.5
9	RML-57/RL-174	3.03	68	71	207	89	2.3	3.0	1.5	3.2	3.0	1.2
10	RL-36/RL-197	2.87	63	65	196	94	1.7	3.0	1.5	2.8	2.3	1.5
11	JM-4	3.48	61	63	193	82	2.2	3.5	1.5	3.5	3.3	1.3
12	JM-7	2.13	62	64	170	73	2.2	3.5	1.3	3.7	3.2	2.1
13	JM-8	2.43	63	65	196	82	1.5	2.7	1.3	2.8	2.5	1.3
14	P-3533	2.73	63	65	195	90	1.9	3.2	1.3	3.0	2.5	1.3
15	Rampur Hybrid-2	2.41	67	70	150	62	2.2	3.5	1.5	3.5	3.2	1.7
	Mean	2.60	65	67	187	83	1.9	3.1	1.5	3	2.7	1.5
	F-test	ns	**	**	**	ns	ns	ns	ns	*	ns	ns
	CV (%)	36.6	2.8	2.9	7.2	15.2	20.5	12.2	8.1	14.5	16.4	26.9
	LSD(0.05)	-	3	3.2	22	-	0.6-	-	-	0.72	-	-

Table 16: Mean grain yield and other characteristics of genotypes in coordinated hybrid trial (CHT) at GRP Salyan 2016/17 summer

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		GLS (1-5)
			Anthesis	Silking	Plant	Ear	
1	RML-76/RL-105	10.4	73	76	254	137	3.7
2	RML-87/RL-105	8.6	77	80	234	135	2.7
3	RL-180/RL-105	7.6	71	74	235	140	2.3
4	RML-95/RL-105	8.8	73	75	238	144	2.7
5	RL-153/RL-105	10.1	71	74	240	143	3.0
6	RML-98/RL-105	10.3	74	77	241	137	3.7
7	RML-5/RL-105	9.6	72	76	248	152	3.7
8	RML-85/RL-105	9.2	76	79	253	162	3.3
9	RML-57/RL-174	10.0	73	78	273	146	2.7
10	RL-36/RL-197	9.9	70	72	243	140	2.7

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		GLS (1-5)
			Anthesis	Silking	Plant	Ear	
11	JM-4	9.0	66	70	267	132	5.0
12	JM-7	4.3	66	69	215	99	8.0
13	JM-8	10.5	67	71	251	135	3.0
14	P-3533	12.6	69	72	285	144	4.0
15	Rampur Hybrid -2	7.5	76	78	232	142	4.3
	Mean	9.2	72	75	247	139	3.6
	F-test	**	**	**	*	**	**
	CV (%)	17.3	2.2	1.9	7.8	6.6	35.9
	LSD(0.05)	2.7	2.6	2.4	32.3	15.4	2.2

Table 17: Mean grain yield and other characteristics of tested genotypes in coordinated hybrid trial (CHT) tested at HCRP Kabre 2016/17 summer

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E.tur* (1-5)	Aspect (1-5)		
			Anthesis	Silking	Plant	Ear		Plant	Ear	Husk cover
1	RML-76/RL-105	6.66	85	90	222	113	2.0	2.0	3.4	1.0
2	RML-87/RL-105	6.23	83	89	227	113	1.7	1.7	2.7	2.0
3	RL-180/RL-105	4.61	77	81	188	103	2.0	2.0	3.3	1.0
4	RML-95/RL-105	6.83	79	84	241	138	2.0	2.0	2.7	1.0
5	RL-153/RL-105	6.40	77	82	222	122	2.3	2.7	3.0	2.7
6	RML-98/RL-105	6.28	80	85	224	127	2.3	3.0	3.3	2.7
7	RML-5/RL-105	7.31	77	82	243	138	2.3	2.7	3.0	2.7
8	RML-85/RL-105	6.06	80	85	210	146	3.0	2.7	3.0	1.0
9	RML-57/RL-174	7.57	80	84	284	165	1.7	3.3	3.0	1.0
10	RL-36/RL-197	6.22	73	80	227	134	2.3	2.7	3.3	1.3
11	JM-4	9.78	69	73	237	116	3.0	2.7	2.0	1.0
12	JM-7	7.88	71	73	216	96	2.0	3.0	2.7	1.0
13	JM-8	8.61	69	74	258	135	2.0	2.3	1.7	1.0
14	P-3533	8.62	74	78	258	132	4.7	4.0	2.3	1.0
15	Rampur Hybrid-2	6.46	78	85	212	118	3.0	3.0	3.0	1.0
	Mean	7.03	77	82	231	126	2.4	2.6	2.8	1.4
	F-test	ns	**	**	ns	*	**	ns	ns	*
	CV (%)	40.5	1.7	2.3	13.5	15.7	29.1	32.9	34.4	58.4
	LSD(0.05)	-	2.2	3.1	-	33.2	1.2	-	-	1.4

Table 18: Combined mean grain yield and other characteristics of genotypes tested in coordinated hybrid trial (CHT) across the hill stations 2016/17 summer

SN	Genotype	Grain yield, t/ha	Days to		Height, cm	
			Anthesis	Silking	Plant	Ear
1	RML-76/RL-105	6.67	74	77	222	114
2	RML-87/RL-105	6.10	76	79	212	116
3	RL-180/RL-105	6.09	70	72	218	120
4	RML-95/RL-105	6.48	72	74	229	127
5	RL-153/RL-105	6.82	71	73	224	121
6	RML-98/RL-105	8.13	73	76	222	115
7	RML-5/RL-105	6.92	73	76	232	125
8	RML-85/RL-105	6.37	75	78	229	130
9	RML-57/RL-174	6.93	75	77	256	141
10	RL-36/RL-197	6.35	69	72	231	127
11	JM-4	7.51	66	69	234	110
12	JM-7	6.68	67	70	201	91
13	JM-8	7.32	67	69	236	115
14	P-3533	8.59	68	70	240	121
15	Rampur Hybrid-2	6.36	72	76	202	115
	Mean	6.89	71	74	226	119
	Genotype (G)	**	**	**	**	**
	Location (L)	**	**	**	**	**
	G X L	ns	**	**	ns	ns
	CV (%)	26.4	2.3	2.4	8.6	11.7
	LSD(0.05)	-	2.6	2.9	-	-

2.1.1.8 Farmer's Field Trial on Hybrid Maize (CFFT-H)

Two groups of promising single cross hybrids; one for Terai consisted of 7 genotypes and another for hills with 6 genotypes were formulated for testing on-farm conditions. At Rampur, single replication was planted and CAH-153 was recorded superior for grain yield (8.84 t/ha) followed by Rampur hybrid-6 (6.87 t/ha) (Table 19). In the hills six genotypes with checks were tested in different farmers' field conditions. At Salyan in farmers' field P3533 produced the highest grain yield (12.9 t/ha) followed by RML-4/RML-17 (9.8 t/ha) (Table 20). In Kabre, the same hybrid P3533 produced the highest grain yield (11.9 t/ha) followed by RML-4/RML-17 (9.6 t/ha) (Table 21). However, at Dailekh RML-86/RML-96 was found superior for grain yield (9.4 t/ha) followed by RML-4/RML-17 (9.2 t/ha) (Table 22). The combined results over hills revealed that P3533 was superior for grain yield production (11.03 t/ha) followed by RML-4/RMl-17 (9.53 t/ha) (Table 23).

Table 19: Mean grain yield and other characteristics of hybrids evaluated in coordinated farmers' field trial (CFFT) at NMRP Rampur 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		Score/Aspect (1-5)			*E.tur* (1-5)
			Anthesis	Silking	Plant	Ear	Husk cover	Plant	Ear	
1	RML-95/RML-96	6.81	68	72	200	120	2.5	2.0	1.5	2.0
2	CAH-1521	6.41	67	70	190	80	1.5	1.5	1.5	1.5
3	CAH-151	6.16	68	72	240	120	3.5	2.5	2.0	1.5
4	CAH-153	8.84	62	66	150	70	1.5	1.5	1.5	1.5
5	CAH-1515	4.90	65	69	210	110	2.5	2.5	2.0	2.5
6	Rampur Hybrid-6	6.87	66	69	190	105	2.0	2.0	1.5	2.0
7	CP-808	6.46	65	68	220	110	2.0	2.0	1.5	2.5

Table 20: Average grain yield and other characteristics of hybrids tested in coordinated farmers' field trial (CFFT) at Salyan 2016/17 summer

SN	Genotype	Grain yield, t/ha	Days to		Height, cm	
			Anthesis	Silking	Plant	Ear
1	RML-95/RML-96	8.6	68	71	184	120
2	RML-86/RML-96	7.9	74	77	188	117
3	RML-32/RML-17	7.8	70	74	179	102
4	RML-4/RML-17	9.8	72	74	190	113
5	P 3533	12.9	70	71	249	129
6	Rampur Hybrid-2	7.4	73	76	201	123
	Mean	9.1	71	74	198	117
	F-test	ns	ns	ns	**	**
	CV (%)	28.7	6.2	5.8	1.5	1.8
	LSD(0.05)	-	-	-	7.4	5.3

Table 21: Average grain yield and other characteristics of hybrids evaluated in coordinated farmers' field trial (CFFT) at Kabre Dolakha 2016/17 summer

SN	Genotype	Grain yield, t/ha	Days to		Height, cm	
			Anthesis	Silking	Plant	Ear
1	RML-95/RML-96	4.3	64	68	220	138
2	RML-86/RML-96	4.9	67	71	234	132
3	RML-32/RML-17	7.6	62	65	225	121
4	RML-4/RML-17	9.6	65	68	230	141
5	P3533	11.9	57	61	286	152
6	Rampur Hybrid-2	6.0	59	63	223	135
	Mean	7.4	62	66	236	136
	F-test	**	**	**	**	ns
	CV (%)	13.6	2	1.2	18.6	6.2
	LSD(0.05)	2.6	3.3	20	3.1	-

Table 22: Average grain yield and other characteristics of hybrids experimented in coordinated farmers' field trial (CFFT) at Dailekh 2016/17 summer

SN	Genotype	Grain yield, t/ha	Days to		Height, cm	
			Anthesis	Silking	Plant	Ear
1	RML-95/RML96	8.3	59	61	261	148
2	RML-86/RML-96	9.4	63	65	258	143
3	RML-32/RML-17	7.2	62	64	260	145
4	RML-4/RML-17	9.2	63	65	266	131
5	P3533	8.3	65	67	320	167
6	Rampur Hybrid-2	8.2	61	63	254	150
	Mean	8.4	62	64	270	148
	F-test	ns	**	**	**	ns
	CV (%)	11.6	1.3	1.2	3	11.9
	LSD(0.05)	1.8	1.4	1.4	14.5	31.8

Table 23: Combined results over locations on grain yield and other characteristics of hybrids experimented in coordinated farmers' field trials (CFFT) at 2016/17 summer

SN	Genotype	Grain yield, t/ha	Days to		Height, cm	
			Anthesis	Silking	Plant	Ear
1	RML-95/RML-96	7.07	64	67	222	135
2	RML-86/RML-96	7.40	68	71	227	131
3	RML-32/RML-17	7.53	65	68	221	123
4	RML-4/RML-17	9.53	67	69	229	128

SN	Genotype	Grain yield, t/ha	Days to		Height, cm	
			Anthesis	Silking	Plant	Ear
5	P3533	11.03	64	66	285	149
6	Rampur Hybrid-2	7.20	64	67	226	136
	Mean	8.29	65	68	235	134
	F-test	ns	ns	ns	**	**
	CV (%)	20.1	4.1	4	2.5	4.8
	LSD(0.05)	-	-	-	10.7	11.6

Based on the results of experiments conducted at various locations under OBN the following hybrids should be promoted to coordinated hybrid trials: RML-4/RL-111, RML-57/RL-105, RML83/RL-197, RML-87/RL-105, RL-151/RL-111, RML-83/RL-197, RML-5/RL-101 and NML-2/RML-17. Results from different test crosses showed that the following crosses produced grain yield more than 8 t/ha and should be promoted to OBN in next season. The crosses were as follows: Bioseed 96 81 s1-5-1-4-2-2-2-1-2-2/RML–17, Bioseed-s1-5-3-4-1-1-1-2-3-1/RML–17,Bioseeds1-5-1-4-2-1-1-1-3-2/RML–17, Rc s1-1-1-1-1-1-4-1-1-1/RML–17, GRGT s1 6-4-3-1-2-3-2-2-1/RML–17, Rc s1-2-2-2-2-1-3-1-2-1/RML–17,Bioseeds1-5-3-4-2-2-2-1-1-2/RML–17,Pioneer s1-10-2-3-1-2-4-1-1-1/RML–17, Arun 2 s1-10-1-4-2-1-4-1-1-1/RML–17, Bioseed s1-5-2-4-1-2-1-1-1-1/RML–17, Rc s1-7-5-2-2-3-1-1-2-1/RML–96, Rc s1- 1-1-1-1-1-4-1-1-1/RML–96, Rc s1-9-1-2-2-2-2-1-1-2/RML–96, Pioneer s1-2-4-1-2-1-3-1-1-2/ RML–96, RL-233/ RML–96, Bioseed s1-6-1-2-1-1-1-1-1-1/RML–96, Pioneer s1-10-2-3-1-2-4-1-1-2/ RML–96, Bioseed s1-5-1-4-2-2-2-1-2-2/ NML–2, Rc s1-7-2-1-2-4-1-1-2-2/ NML–2, Rc s1-9-4-3-1-2-1-1-2-2/ NML–2, Rc s1-7-2-1-2-4-1-1-1-2/NML– 2, Pioneer s1-2-3-1-1-2-4-3-2-2/NML–2, Rc s1-2-3-4-2-1-2-2-3-1/NML–2, Rc s1-9-1-2-2-2-1-1-1-2/NML–2, Rc s1-2-2-2-1-3-1-1-3-1/RL– 111, A2 s1-10-1-2-2-1-2-2-1-1/RL–111, Across9331 s1-4-2-1-1-2-1-1/RL–111, Rc s1-2-3-4-2-1-2-2-1-1/RL–111, Rc s1-2-3-4-2-1-2-2-3-1/RL– 111, Pioneer s1-2-3-1-1-2-4-3-22/RL–111, Bioseed s1-5-3-4-2-2-2-1-1-2/ RL– 111, Pioneer s1-10-2-3-1-2-4-1-1/ RL– 111, pioneer s1-5-1-4-1-1-1-2-2-1/RL–111, GRGT s1-6-2-2-2-1-1-2-1-1/RL–111, Rc s1-2-2-2-1-3-1-1-3-1/RL–111, Rc s1-1-1-1-1-1-1-2-2-2-2/RL–105, Rc s1-7-2-1-2-4-1-1-2-2/RL–105, 20-29 s1-1-4-2-3-1-3-1/RL–105, Hpy s1-9-4-2-2-1-1-1/RL–105, 20-29 s1-2-4-2-1-2-1-2/RL–105, 20-29 s1-1-2-1-1-1-2-2/RL–105, 20-29 s1-2-4-2-1-2-1-1/RL–105,75-27s1-1-1-1-4-1-1-2/RL–105,Rcs1-1-1-1-1-1-1-2-3-2/ RL– 105, Rc s1-7-5-2-3-1-1-2-1/RL– 105, Rc s1-7-5-2-3-1-1-2-1/ RL–105 and RML-89/RL–105. Some three-way crosses as (RML-95/RML-96) × RML–17, Rampur Hybrid- 2 × RML-17, Rampur Hybrid-4 × RML-96, Rampur Hybrid-6 × RML-96 were also found promising and produced >10 t/ha grain yield and should be tested under advanced yield trials in next season. From the result

of CVT-TeraiTerai set some promising single cross hybrids were CAH–1515, RML-4/RML-62, RL-180/RML-5, CAH-153, CAH-151 and RL-180/RML-5 and these hybrids should be promoted to CFFT in next year for more verifications under farmers' conditions. From CVT-hill set the promising single cross hybrids were RML-98/RL-105, RML-76/RL-105, RML-87/RL-105, JM-4, JM-8 and RL-153/RL-105 and these hybrids should be promoted to CFFT in the hilly areas for further verifications. Similarly, from CFFT some out-standing hybrids selected for large plot demonstration and candidates for release are RML-95/RML-96, RML-86/RML-96, CAH-153, CAH-151 and CAH-1515, respectively.

2.1.2 Evaluation of maize genotypes for heat resilient 2016/17

In order to identify heat stress resilient maize genotypes under high temperature and optimum season, maize genotypes were evaluated at NMRP Rampur and RARS Nepalgunj in spring season in replicated trials and in farmers' field of Sarlahi, Chitwan and Dang under optimum conditions. The details of material and methods are presented in below Table 24.

Table 24: List of HTMA trials conducted during 2016/17

SN	Trial code	No. genotype	Rep.	Plot size	Spacing	Planting date	Harvesting date	Location	Environment.
1	HSH-I-121	70	2	1R5ML	60 x 25CM		4-Jul-17		
2	HSH-II-124	70	2	2R5ML	60 x 25CM		7-Jul-17		
3	HSH-II-224	30	2	1R5ML	60 x 25CM	7-Mar-17	8-Jul-17	Rampur	Optimum
4	HSH-II-424	20	2	2R5ML	60 x 25CM		9-Jul-17		
5	HSH-III-124	30	2	2R5ML	60 x 25CM		10-Jul-17		
6	MLT-NEP3	15	2	4R5ML	60 x 25CM	6-Mar-17	27-Jun-17	Madi	
7	MLT-NEP4	15	2	4R5ML	60 x 25CM	6-Mar-17	27-Jun-17		
8	MLT-1	20	1	10R10ML	60 x 25CM	1-Dec-16	20-May-17	Sagarnath	
9	MLT-2	20	1	10R10ML	60 x 25CM	1-Dec-16	21-May-17	Sagarnath	Optimum
10	MLT-3	20	1	10R10ML	60 x 25M	17-Dec-16	29-May-17	Narayanpur	
11	MLT-4	20	1	10R10ML	60 x 25CM	1-Dec-16	29-Apr-17	Madi	
12	MLT-5	20	1	10R10ML	60 x 25M	1-Dec-16	22-May-17	Rampur	

SN	Trial code	No. genotype	Rep.	Plot size	Spacing	Planting date	Harvesting date	Location	Environment.
13	HSH-I-120	70	2	1R5ML	60 x 25CM	21-Mar-17	19-Jul-17		
14	HSH-I-210	20	2	1R5ML	60 x 25CM	21-Mar-17	19-Jul-17		
15	HSH-II-123	70	2	2R5ML	60 x 25CM	21-Mar-17	19-Jul-17		
16	HSH-II-223	30	2	1R5ML	60 x 25CM	21-Mar-17	19-Jul-17		
17	HSH-II-315	30	2	1R5ML	60 x 25CM	21-Mar-17	19-Jul-17	Nepalgunj	Heat
18	HSH-II-423	20	2	2R5ML	60 x 25CM	21-Mar-17	19-Jul-17		
19	HSH-II-510	20	2	1R5ML	60 x 25M	21-Mar-17	19-Jul-17		
20	HSH-III-123	30	2	2R5ML	60 x 25CM	21-Mar-17	19-Jul-17		
21	HSH-III-215	20	2	1R5ML	60 x 25M	21-Mar-17	19-Jul-17		
22	MLT-NEP-2	15	2	4R5ML	60 x 25CM	28-Mar-17	21-Jul-17	Dang	

2.1.2.1 On-station Results

Rampur

At NMRP Rampur a total of five HTMA experiments consisted of 220 genotypes were planted in replicated trials. The experiment HSH-I-121 consisted of 70 genotypes including two checks. Out of tested genotypes, ZH178 produced significantly highest grain yield (8.47 t/ha) followed by ZH17165 (7.95 t/ha) and ZH17126 (7.52 t/ha), respectively (Table 25). In HSH-II-124, there were 70 genotypes and the highest grain yielder was RL-95/RML-96 (8.76 t/ha) followed by ZH1770 (7.97 t/ha) and ZH16946 (7.92 t/ha) (Table 26). Similarly in HSH-II-224 a total of 30 genotypes were evaluated where significantly highest grain yield was produced by ZH16445 (9.23 t/ha) followed by ZH16767 (8.37 t/ha) and ZH16598 (8.09 t/ha), respectively (Table 27). In HSH-II-424, 20 genotypes were experimented and the genotype ZH16879 was significantly superior for grain yield (7.78 t/ha) followed by ZH16875 (7.76 t/ha) and ZH16881 (7.72 t/ha) (Table 28). Likewise, in HSH-III-124 there were 30 genotypes and the three superior genotypes for grain yield were VH131167 (8.4 t/ha), ZH1415192 (7.23 t/ha) and ZH141591 (7.04 t/ha) (Table 29).

Table 25: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-I-121 at Rampur 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH1759	6.96	7	62.8	2.6	172.3	90.6	0.52	2.2
2	ZH1760	4.31	58	62.3	2.6	234.1	121.8	0.51	1.9
3	ZH1777	5.36	38	61.3	2.1	160.0	93.5	0.61	2.4
4	ZH1778	3.66	63	65.0	3.2	197.3	117.7	0.59	3.0
5	ZH1779	5.24	41	62.2	2.6	174.8	132.7	0.79	1.9
6	ZH1780	6.11	18	63.0	2.1	205.2	122.8	0.60	2.1
7	ZH1782	4.80	46	63.5	2.7	187.8	102.1	0.54	2.2
8	ZH1783	8.47	1	61.6	2.2	226.4	135.3	0.60	1.9
9	ZH1784	4.64	48	63.8	1.7	223.1	137.2	0.62	2.4
10	ZH1789	2.77	70	60.8	2.6	203.0	116.5	0.56	2.9
11	ZH1790	6.06	19	63.1	1.6	224.5	131.9	0.59	1.9
12	ZH1791	6.79	9	62.4	2.6	233.4	145.9	0.62	1.9
13	ZH1792	6.63	13	64.3	2.1	234.1	141.8	0.60	2.1
14	ZH1793	3.45	64	63.0	3.1	196.3	108.2	0.55	1.8
15	ZH1796	6.52	14	63.0	2.0	238.2	134.5	0.56	2.3
16	ZH1797	6.63	12	64.3	2.1	201.1	115.2	0.56	1.9
17	ZH1798	5.82	28	62.0	3.7	207.3	117.7	0.56	2.2
18	ZH1799	5.47	34	63.0	3.1	201.3	108.2	0.54	3.1
19	ZH17100	4.59	51	63.7	1.5	187.2	113.5	0.60	2.3
20	ZH17101	6.67	11	62.1	2.7	180.9	105.8	0.58	2.0
21	ZH17104	5.17	43	60.9	2.1	200.4	109.3	0.54	2.2
22	ZH17105	5.70	30	64.2	2.6	186.7	114.0	0.60	2.6
23	ZH17107	4.45	56	62.6	2.2	180.9	115.8	0.63	2.5
24	ZH17108	3.40	65	61.7	2.0	182.9	109.4	0.59	2.1
25	ZH17109	4.46	55	61.2	2.1	202.6	135.7	0.66	1.9
26	ZH17111	5.61	31	62.2	2.1	203.8	111.0	0.55	2.3
27	ZH17113	4.06	60	64.7	1.6	221.9	129.7	0.59	2.1
28	ZH17114	5.20	42	60.5	1.6	204.0	132.5	0.64	2.7
29	ZH17115	5.38	36	63.5	3.1	187.0	99.1	0.53	2.1
30	ZH17116	4.28	59	64.1	2.6	203.3	121.6	0.60	2.1

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
31	ZH17117	6.93	8	63.5	2.7	211.6	121.8	0.57	2.0
32	ZH17118	6.26	16	62.7	2.1	214.8	127.7	0.58	2.2
33	ZH17119	6.05	21	60.3	2.6	240.3	127.2	0.52	2.1
34	ZH17120	5.38	37	61.0	2.1	195.9	108.7	0.55	2.4
35	ZH17121	6.06	20	63.5	2.6	210.9	123.7	0.58	1.9
36	ZH17122	5.87	27	64.9	2.6	230.4	149.3	0.64	1.7
37	ZH17123	7.01	5	62.5	3.2	208.5	128.0	0.61	2.5
38	ZH17124	6.05	22	62.7	2.7	200.7	104.4	0.53	1.9
39	ZH17126	7.52	3	63.7	1.7	214.5	124.0	0.58	1.7
40	ZH17127	5.35	39	62.0	2.5	224.4	124.8	0.55	2.0
41	ZH17128	6.23	17	62.5	2.0	248.2	134.5	0.54	1.8
42	ZH17129	7.43	4	62.7	2.2	195.7	104.4	0.54	1.9
43	ZH17132	5.94	26	62.9	1.7	214.2	128.9	0.59	2.5
44	ZH17133	4.78	47	62.2	2.5	222.9	119.4	0.52	2.3
45	ZH17134	4.44	57	61.8	2.6	218.0	126.5	0.57	2.7
46	ZH17136	3.00	69	65.3	3.5	221.5	122.5	0.55	2.6
47	ZH17137	5.47	35	60.6	2.0	193.6	110.3	0.56	1.9
48	ZH17138	3.40	66	64.6	2.1	185.6	97.3	0.53	2.6
49	ZH17139	3.92	62	61.8	2.7	188.8	103.1	0.55	2.4
50	ZH17141	4.54	52	62.0	2.6	170.2	97.8	0.57	2.4
51	ZH17142	6.72	10	59.6	3.2	185.2	94.9	0.51	2.4
52	ZH17143	5.14	44	64.5	2.0	159.4	79.8	0.51	2.3
53	ZH17146	5.60	33	64.4	2.0	178.9	115.4	0.64	2.3
54	ZH17147	5.10	45	61.0	2.6	214.7	133.4	0.62	1.7
55	ZH17148	4.47	54	64.1	2.5	177.5	98.6	0.56	2.5
56	ZH17150	5.97	25	64.9	2.5	204.6	121.3	0.59	1.8
57	ZH17151	6.00	24	62.3	2.2	188.1	107.2	0.57	2.2
58	ZH17152	5.61	32	63.1	3.1	208.3	116.6	0.56	1.9
59	ZH17153	4.63	49	60.7	2.6	181.0	103.1	0.56	2.1
60	ZH17154	5.76	29	63.8	2.6	200.0	103.5	0.52	2.1
61	ZH17155	3.93	61	62.3	2.6	195.3	132.2	0.68	2.1
62	ZH17156	4.48	53	62.4	2.5	199.6	121.3	0.60	2.8

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
63	ZH17157	3.31	67	60.9	1.5	200.1	115.7	0.59	2.3
64	ZH17162	6.02	23	62.9	2.6	197.7	125.0	0.63	1.9
65	ZH17163	3.08	68	63.4	2.6	181.6	99.7	0.54	2.1
66	ZH17164	5.33	40	63.9	2.5	190.8	116.6	0.61	1.8
67	ZH17165	7.95	2	63.1	2.7	197.1	126.2	0.63	2.2
68	ZH17166	4.61	50	65.3	2.0	191.5	102.5	0.53	2.3
69	RML-95/RML-96	6.98	6	63.1	2.7	216.4	125.3	0.58	2.4
70	RML-86/RML-96	6.28	15	61.5	2.6	214.7	123.4	0.57	2.2
	Mean	5.39	36	62.8	2.4	202.2	117.4	0.58	2.2
	F-test	***		ns	ns	**	**	ns	**
	LSD (0.05)	2.15	20	-	-	37.7	27.5	-	0.8
	CV (%)	18.51		3.4	23.6	9.2	11.6	10.85	17.1
	Heritability	0.67	1	-	0.3	0.5	0.5	0.09	0.3

Table 26: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-II-124 at Rampur 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH161005	5.66	48	58.2	4.3	239	126	0.54	2.5
2	ZH161003	5.19	58	57.5	2.8	229	129	0.57	2.0
3	ZH1639	7.51	7	58.4	2.8	189	98	0.53	2.5
4	ZH1640	6.27	28	58.2	2.8	180	94	0.53	2.3
5	ZH1655	6.23	30	58.7	2.8	203	111	0.56	1.5
6	ZH1673	7.27	10	57.3	2.8	218	120	0.56	1.8
7	ZH141592	6.29	27	59.6	2.9	236	113	0.48	2.0
8	ZH1673	6.37	26	57.6	3.4	213	124	0.59	1.5
9	ZH1650	6.08	33	59.4	2.9	227	137	0.61	1.8
10	ZH1652	6.65	20	57.7	2.8	216	135	0.64	1.8
11	ZH15266	6.22	31	59.6	2.3	219	121	0.56	2.5
12	ZH1630	6.25	29	60.8	1.9	212	113	0.54	2.3
13	ZH16911	5.75	43	59.2	2.9	223	123	0.56	1.8
14	ZH137413	5.84	40	61.4	3.0	204	121	0.60	2.0
15	ZH16952	7.16	14	58.5	3.0	251	143	0.57	2.5
16	ZH16878	7.77	5	57.2	2.8	239	141	0.60	1.8

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
17	ZH1655	5.84	40	57.9	1.9	208	112	0.55	2.0
18	ZH1623	5.43	52	58.2	2.9	241	128	0.54	2.0
19	ZH16817	6.46	24	60.7	2.5	229	117	0.51	1.5
20	ZH161027	5.01	60	58.4	2.9	223	106	0.48	1.5
21	ZH16840	6.49	23	59.3	2.4	235	120	0.51	2.5
22	ZH16955	3.80	68	61.5	2.8	232	110	0.48	1.8
23	ZH16942	2.41	70	59.1	2.5	205	112	0.55	1.8
24	ZH16903	5.09	59	60.6	3.0	172	82	0.47	2.5
25	ZH16949	7.88	4	59.4	3.3	258	154	0.61	1.8
26	ZH16843	6.68	19	57.3	4.4	250	130	0.53	2.0
27	ZH1770	7.97	2	57.9	3.9	227	123	0.55	2.0
28	ZH16930	7.09	16	60.4	2.9	225	123	0.55	1.5
29	ZH16902	4.44	64	57.8	2.4	212	118	0.56	1.8
30	ZH16869	7.11	15	56.2	3.3	235	139	0.60	1.5
31	ZH16934	5.44	51	59.4	2.3	208	109	0.53	2.5
32	ZH16972	5.30	54	58.4	2.8	223	109	0.50	2.3
33	ZH16974	7.22	13	59.8	2.5	239	147	0.62	1.8
34	ZH16834	4.30	66	59.4	3.4	192	92	0.48	2.0
35	ZH1617	6.06	34	60.0	2.4	188	101	0.54	1.8
36	ZH163	5.31	53	57.1	3.3	229	121	0.54	2.0
37	ZH1635	4.02	67	57.7	2.8	209	114	0.56	2.3
38	ZH1645	7.26	11	60.4	2.8	206	94	0.47	2.3
39	ZH1644	5.89	37	56.7	2.9	186	108	0.59	2.3
40	ZH1623	4.37	65	57.1	2.5	207	115	0.56	1.8
41	ZH16953	6.10	32	58.4	2.8	194	99	0.52	2.3
42	ZH1619	5.93	36	58.8	3.4	219	127	0.58	2.0
43	ZH16963	5.67	47	57.7	2.9	228	129	0.57	1.8
44	ZH16934	4.48	63	61.8	2.3	211	110	0.53	2.3
45	ZH15445	5.62	49	58.9	1.8	227	115	0.51	1.8
46	ZH16929	7.33	8	56.3	3.0	232	136	0.59	2.0
47	ZH16848	6.59	21	58.1	3.0	203	112	0.55	2.3
48	ZH16946	7.92	3	58.1	3.0	200	112	0.56	1.8
49	ZH16849	7.62	6	57.2	3.8	199	109	0.56	2.3
50	ZH1770	6.90	18	57.1	2.5	227	122	0.54	1.8
51	ZH1771	5.98	35	58.6	2.4	231	118	0.52	2.0

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
52	ZH16931	7.28	9	58.7	4.3	252	130	0.53	1.5
53	ZH16928	7.26	12	59.0	2.4	233	134	0.58	1.8
54	ZH16929	3.73	69	59.0	2.8	214	121	0.58	2.0
55	ZH16918	5.28	55	61.5	2.9	228	129	0.59	2.3
56	ZH16914	5.27	56	60.4	2.4	222	133	0.61	2.0
57	ZH16910	6.44	25	60.5	2.9	253	131	0.52	2.0
58	ZH1672	5.70	46	57.7	2.4	186	105	0.57	2.3
59	ZH1652	5.71	45	59.1	2.3	202	110	0.55	2.3
60	ZH1624	5.75	43	58.8	1.8	198	110	0.57	2.3
61	ZH1644	5.86	39	58.7	2.5	192	116	0.61	2.0
62	ZH16900	5.88	38	57.3	3.3	213	115	0.55	2.0
63	ZH16899	5.20	57	58.6	2.8	222	130	0.59	2.3
64	ZH16897	4.90	61	58.1	4.0	230	112	0.49	1.8
65	RML-95/96	5.62	49	59.1	2.3	230	154	0.68	2.3
66	RML-86/96	6.54	22	59.0	2.8	233	120	0.52	1.8
67	RH-4	5.75	42	58.8	3.0	239	141	0.59	2.5
68	RH-6	6.91	17	57.2	2.5	209	127	0.61	1.8
69	CP808	8.76	1	57.9	3.3	254	134	0.53	2.0
70	RC	4.72	62	58.8	3.0	212	126	0.60	1.8
	Mean	6.03	35	58.7	2.8	219.0	120.0	0.55	2.0
	F-test	*		ns		**	***	*	*
	LSD0.05	2.54	20	-	1.3	39.4	26.2	0.09	0.6
	CV (%)	19.24		3.4	22.4	8.9	10.8	8.54	15.9
	Heritability	0.49	1		0.3	0.5	0.6	0.37	0.4

Table 27: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-II-224 at Rampur 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH16467	6.00	23	57.1	2.0	209.7	127.3	0.60	2.5
2	ZH16485	7.79	5	53.2	3.0	224.3	147.0	0.65	1.8
3	ZH16445	9.23	1	56.7	2.5	189.3	117.0	0.61	2.3
4	ZH16598	8.09	3	56.3	2.5	201.1	121.9	0.60	2.0
5	ZH16605	7.55	6	56.9	2.0	225.7	126.5	0.56	2.0

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
6	ZH16277	6.16	22	57.3	2.5	221.1	136.9	0.61	2.0
7	ZH16767	8.37	2	55.0	2.5	183.0	117.4	0.62	2.5
8	ZH16760	7.21	7	57.3	2.5	241.1	151.9	0.63	2.0
9	ZH16761	5.90	24	59.7	2.5	207.2	111.6	0.51	2.3
10	ZH16620	6.21	21	55.1	2.5	242.6	162.0	0.66	1.8
11	ZH16639	3.77	30	58.5	2.0	218.0	152.4	0.69	2.0
12	ZH16772	6.83	12	58.1	2.0	204.7	117.3	0.56	2.5
13	ZH16778	6.45	17	57.7	3.0	202.2	131.6	0.62	2.3
14	ZH16122	5.85	25	55.0	2.0	213.0	127.4	0.58	2.5
15	ZH1683	6.71	15	56.2	2.5	216.4	147.3	0.68	2.0
16	ZH1695	6.33	19	55.3	2.0	224.0	141.6	0.63	2.0
17	ZH16271	5.70	26	54.1	7.5	217.6	132.0	0.59	2.0
18	ZH16282	6.78	13	56.8	2.0	209.0	126.6	0.60	2.3
19	ZH16297	4.02	29	55.1	2.0	214.7	137.3	0.63	2.3
20	ZH16294	7.00	10	55.2	3.0	229.3	147.0	0.63	2.3
21	ZH16307	6.35	18	56.9	2.5	220.7	136.5	0.62	2.0
22	ZH16310	6.78	14	55.4	3.5	200.7	126.5	0.63	1.8
23	ZH16313	7.14	8	54.8	2.5	226.1	141.9	0.63	2.5
24	ZH16386	4.61	28	56.7	2.0	231.4	142.3	0.61	1.8
25	RML-95/96	6.90	11	55.3	2.0	224.0	136.6	0.61	2.3
26	RML-86/96	6.55	16	58.2	2.5	237.2	146.6	0.61	1.8
27	RH-4	6.22	20	55.2	2.0	212.2	116.6	0.53	2.3
28	RH-6	7.02	9	57.2	2.0	201.4	132.3	0.65	2.5
29	CP-808	8.07	4	55.6	2.5	222.6	137.0	0.60	1.8
30	RC	5.22	27	55.6	2.5	219.7	127.3	0.57	2.3
	Mean	6.56	16	56.2	2.6	216.3	134.1	0.61	2.1
	F-test	*		ns	ns	+	ns	ns	Ns
	LSD (0.05)	2.42	9	4.3	3.1	30.2	28.9	0.10	0.7
	CV (%)	15.98		3.6	59.5	6.7	10.3	7.70	16.0
	Heritability	0.61	1	0.0	-0.1	0.5	0.4	0.25	0.2

Table 28: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-II-424 at Rampur, 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH16822	6.20	11	58.6	1.9	210.0	120.0	0.58	1.8
2	ZH15281	5.11	17	56.9	2.4	220.0	120.0	0.55	2.0
3	ZH16875	7.76	2	60.9	2.0	220.0	140.0	0.64	1.7
4	ZH16879	7.78	1	57.8	1.9	205.0	130.0	0.64	1.9
5	ZH16881	7.72	3	58.2	2.4	235.0	145.0	0.62	1.3
6	ZH16887	5.80	14	55.9	2.9	220.0	130.0	0.59	1.3
7	ZH16930	7.18	5	57.1	2.6	230.0	130.0	0.57	1.8
8	ZH16868	7.01	7	57.0	2.4	230.0	140.0	0.61	1.4
9	ZH16873	7.20	4	56.7	2.6	230.0	125.0	0.55	1.8
10	ZH1775	5.11	18	57.6	1.9	180.0	95.0	0.53	2.3
11	ZH16856	5.09	19	57.1	3.0	205.0	115.0	0.56	1.5
12	ZH16851	6.58	9	57.9	2.0	205.0	110.0	0.54	2.0
13	ZH1776	5.84	13	55.0	2.8	170.0	90.0	0.53	2.2
14	ZH16161	5.42	15	58.6	2.8	190.0	110.0	0.58	2.0
15	ZH16114	4.80	20	56.0	2.5	200.0	110.0	0.55	2.0
16	ZH16135	5.93	12	55.8	2.4	195.0	115.0	0.59	1.9
17	ZH16322	5.29	16	57.1	2.1	215.0	125.0	0.59	2.6
18	RML-95/96	6.39	10	57.8	2.0	210.0	130.0	0.63	2.0
19	RML-86/96	6.68	8	57.7	2.0	215.0	130.0	0.61	1.9
20	RH-4	7.16	6	59.8	1.4	190.0	105.0	0.56	1.8
	Mean	6.30	11	57.5	2.3	208.8	120.8	0.58	1.9
	F-test	*		ns	ns	**	*	ns	**
	LSD (0.05)	1.84	6	4.8	1.3	28.2	25.2	0.10	0.5
	CV (%)	13.66		4.0	27.0	6.5	10.0	7.90	12.3
	Heritability	0.62	1	-		0.7	0.7	0.13	0.8

Table 29: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-III-124 at Rampur, 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH141592	7.04	3	59.0	3.2	205.0	110.5	0.56	2.5
2	ZH15279	6.23	13	59.0	2.7	195.0	88.2	0.48	3.0
3	ZH137413	6.42	8	59.5	2.2	205.0	103.6	0.53	2.5
4	ZH15422	5.97	15	55.5	2.7	185.0	98.2	0.57	2.5
5	ZH141592	7.23	2	59.0	2.2	205.0	98.6	0.51	2.3
6	ZH15421	6.00	14	59.0	2.5	205.0	103.6	0.51	2.3
7	ZH15410	6.24	12	58.0	2.6	195.0	79.0	0.43	2.8
8	ZH15400	5.67	20	59.0	2.1	200.0	111.3	0.58	2.8
9	ZH1619	4.97	28	58.0	3.1	185.0	93.2	0.52	2.3
10	ZH137087	5.82	18	56.5	2.6	185.0	90.9	0.51	3.0
11	ZH1679	5.90	17	60.0	2.7	155.0	83.6	0.62	2.8
12	ZH15416	6.85	5	61.5	2.1	225.0	119.0	0.56	2.3
13	VH142085	6.46	7	60.5	2.2	235.0	130.5	0.58	2.3
14	ZH15267	5.69	19	57.5	2.0	190.0	88.6	0.48	2.8
15	VH131167	8.40	1	61.0	3.1	215.0	111.3	0.54	1.8
16	ZH15381	4.93	29	60.5	2.2	190.0	105.5	0.58	3.0
17	ZH15327	5.03	27	58.0	2.1	185.0	100.9	0.57	3.0
18	ZH15329	5.91	16	59.0	2.1	190.0	111.3	0.61	3.0
19	ZH15324	4.93	30	59.0	2.2	185.0	102.8	0.57	3.0
20	ZH15331	6.36	10	56.5	2.1	192.5	108.2	0.57	2.8
21	ZH15333	6.41	9	58.0	2.1	205.0	100.9	0.51	2.8
22	VH113014	5.60	21	61.0	2.6	185.0	86.3	0.49	2.8
23	ZH138088	7.00	4	63.0	2.2	160.0	73.2	0.51	1.8
24	ZH1622	5.29	25	57.5	2.1	195.0	103.2	0.54	2.8
25	ZH16878	6.62	6	60.5	2.7	210.0	123.2	0.63	2.3
26	ZH15433	5.34	24	58.0	2.1	190.0	98.2	0.53	3.0
27	ZH1756	5.40	23	57.0	2.2	185.0	92.8	0.52	2.5
28	RML-95/96	5.12	26	57.0	2.0	195.0	118.6	0.62	2.5
29	RML-86/96	5.49	22	59.0	2.2	200.0	112.8	0.58	2.8
30	RH-4	6.28	11	59.5	2.6	185.0	104.0	0.60	2.0
	Mean	6.02	16	58.9	2.4	194.6	101.7	0.54	2.6
	F-test	ns		ns	*	ns	ns	ns	*
	LSD (0.05)	-	9	-	0.8	-	-	-	0.8
	CV (%)	16.34		5.0	15.5	9.8	15.3	13.91	14.5
	Heritability	0.24	1		0.4	0.3	0.3		0.5

2.1.2.2 RARS, Nepalgunj

Total nine HTMA experiments with 310 genotypes were evaluated under heat stress conditions at RARS Nepalgunj. The trials at this location were very poor due to poor site selection which resulted lower grain yield as compared to other locations. The details of results are presented in Tables 30 to 38. The experiment HSH-I-120 included 70 genotypes and the genotype ZH17113 produced 3.71 t/ha followed by ZH17107 (3.57 t/ha) and ZH1783 (3.29 t/ha). In HSH-I-210 out of 20 genotypes, ZH1761 produced the highest grain yield (4.68 t/ha) followed by ZH1788 (2.79 t/ha) and RML-95/RML-96 (2.61 t/ha). From HSH-II-123 RML-95/RML-96 produced 4.19 t/ha followed by ZH1655 (4.13t/ha) and ZH15445 (4.09 t/ha), respectively. The result from HSH-II-223, HSH-II-315 and HSH-II423 revealed that only the genotype ZH16467, ZH16175 and ZH16881 produced grain yield more than 4 t/ha . In HSH-II510 all the genotypes gave grain yield less than national averafe of 2.5 t/ha. However from HSH-III-13, ZH1619 produced 4.2 t/ha. Genotypes ZH138098 (5.61 t/ha) and ZH15366 (5.03t/ha) in HSH-III-215 and ZH137119 produced the highest grain yield of 6.21 t/ha and 5.61 t/ha, respectively.

Table 30: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-I-120 at RARS, Nepalgunj 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)
						Plant	Ear	
1	ZH1759	2.12	13	80.6	5.5	132.4	34.0	0.26
2	ZH1760			85.3	11.5	110.0	41.5	0.42
3	ZH1777	1.94	15	87.7	6.5	90.5	48.0	0.53
4	ZH1778			91.0		119.0	23.6	0.21
5	ZH1779			86.9	7.5	122.9	43.5	0.36
6	ZH1780			88.0	6.5	108.9	41.5	0.38
7	ZH1782			86.3		119.4	33.0	0.29
8	ZH1783	3.29	3	81.5	6.0	141.4	57.0	0.39
9	ZH1784			85.4	13.5	106.0	20.5	0.18
10	ZH1789	3.16	4	79.6	7.5	121.9	56.5	0.49
11	ZH1790			89.0		102.4	48.5	0.33
12	ZH1791	1.58	21	82.8	7.5	133.4	67.0	0.49
13	ZH1792	2.86	6	84.0	7.5	112.0	36.0	0.34
14	ZH1793	1.99	14	84.9	9.5	129.0	44.5	0.35
15	ZH1796			88.6	8.0	96.0	52.0	0.57
16	ZH1797	0.70	36	88.2	10.5	102.4	45.5	0.45
17	ZH1798			84.3	7.0	106.5	45.5	0.43
18	ZH1799			86.3	9.5	131.4	54.5	0.35
19	ZH17100			85.2	14.5	114.4	49.5	0.44

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)
						Plant	Ear	
20	ZH17101	2.17	11	77.2	11.5	173.9	47.0	0.27
21	ZH17104			87.6	9.5	119.9	52.5	0.44
22	ZH17105			86.6	8.5	119.9	38.5	0.32
23	ZH17107	3.57	2	81.4	13.5	133.0	52.0	0.40
24	ZH17108	2.13	12	79.9	7.0	146.4	61.5	0.42
25	ZH17109			80.2	19.5	94.9	28.5	0.30
26	ZH17111			91.7	10.5	121.5	44.5	0.37
27	ZH17113	3.71	1	81.1	7.5	142.5	45.5	0.32
28	ZH17114			86.4	14.0	159.9	40.0	0.27
29	ZH17115			79.3	11.5	106.9	48.5	0.30
30	ZH17116			86.8	14.5	116.9	37.5	0.32
31	ZH17117	1.70	19	88.5	8.5	134.9	46.0	0.35
32	ZH17118			86.4	12.0	155.9	71.5	0.46
33	ZH17119	0.27	40	82.2		118.0	43.5	0.36
34	ZH17120	1.72	17	82.9	8.5	121.4	56.0	0.47
35	ZH17121	0.44	38	86.6	8.5	130.9	62.0	0.48
36	ZH17122	0.66	37	86.6	7.5	135.4	36.0	0.27
37	ZH17123			82.8	9.5	165.4	47.5	0.29
38	ZH17124	1.40	25	86.3	8.5	134.9	44.5	0.35
39	ZH17126	0.71	35	83.1	7.5	107.9	46.5	0.43
40	ZH17127	1.81	16	83.9	9.5	144.9	65.5	0.45
41	ZH17128			84.9	11.5	115.5	49.5	0.43
42	ZH17129	0.90	32	81.5	7.5	128.0	57.5	0.39
43	ZH17132	0.17	41	90.0	9.0	154.4	35.5	0.23
44	ZH17133			86.6	7.5	149.8	26.6	0.19
45	ZH17134			80.4	10.5	113.8	45.6	0.41
46	ZH17136			95.4	8.5	95.4	48.5	0.50
47	ZH17137	1.15	27	84.0	7.5	124.0	57.6	0.47
48	ZH17138	2.25	9	79.3	9.5	131.0	49.5	0.37
49	ZH17139			88.3	15.5	133.8	37.6	0.29
50	ZH17141	1.72	18	82.0	9.5	132.5	41.5	0.34
51	ZH17142	1.34	26	81.1	9.0	109.5	41.5	0.39
52	ZH17143			87.4		120.8		
53	ZH17146	0.09	42	88.7	7.5	120.0	50.0	0.41
54	ZH17147	2.76	7	79.9		110.4	60.0	0.56
55	ZH17148	1.03	29	85.4	12.5	112.0	49.5	0.43
56	ZH17150			95.2		98.8	54.6	0.56

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)
						Plant	Ear	
57	ZH17151	0.76	34	85.7	10.5	105.9	40.5	0.39
58	ZH17152	1.63	20	89.0	10.5	118.9	56.0	0.49
59	ZH17153	2.55	8	82.7	9.5	107.9	46.5	0.39
60	ZH17154	0.96	31	83.7	10.0	129.9	34.0	0.26
61	ZH17155	1.45	23	79.3	9.5	126.9	46.0	0.37
62	ZH17156	1.43	24	84.7	10.0	146.0	47.0	0.31
63	ZH17157	1.09	28	81.7	10.5	91.5	41.0	0.47
64	ZH17162	1.01	30	79.6	9.5	111.4	52.5	0.46
65	ZH17163	0.84	33	85.2	7.5	107.9	46.5	0.43
66	ZH17164			86.9	7.5	91.4	36.5	0.32
67	ZH17165	2.91	5	78.3	6.5	132.9	45.0	0.34
68	ZH17166	0.34	39	85.5	8.5	150.0	57.0	0.38
69	RML-95/RML-96	1.49	22	86.0	9.5	164.0	52.5	0.31
70	RML-86/RML-96	2.22	10	84.4	6.5	127.5	55.5	0.43
	Mean	1.62	22	84.8	9.5	123.5	46.6	0.38
	F-test	ns		ns	ns	ns	ns	ns
	CV (%)	86.16		5.5	27.5	23.1	34.6	31.84
	Heritability	-	1	0.2	0.5	-0.1	-0.3	0.04

Table 31: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-I-210 at RARS, Nepalgunj 2016/17 spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH1761	0.79	6	75.1	4.8	151.5	72.2	0.41	2.8
2	ZH1762	0.25	13	72.3	1.4	150.5	46.0	0.22	2.3
3	ZH1781	0.14	15	85.9	5.0	125.2	61.0	0.41	2.0
4	ZH1785	0.28	12	73.8	6.9	130.0	45.0	0.28	3.8
5	ZH1786	0.02	16	85.1	4.8	132.0	47.7	0.32	3.0
6	ZH1787	0.26	20	84.8	11.2	142.0	66.3	0.43	
7	ZH1788	2.79	2	70.4	2.7	135.5	71.0	0.50	2.0
8	ZH1794	0.25	19	85.4	14.7	139.0	52.5	0.34	
9	ZH1795	0.70	8	75.4	9.7	142.0	42.0	0.27	4.0
10	ZH17103	0.28	11	79.8	6.4	149.5	60.0	0.33	3.8
11	ZH17110	0.50	10	78.3	6.1	130.0	57.3	0.40	3.8
12	ZH17131	0.57	9	86.8	5.1	113.0	82.3	0.55	3.0

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
13	ZH17135	0.12	18	73.6	3.8	142.5	49.7	0.29	2.8
14	ZH17140	0.17	14	76.3	7.9	177.0	65.0	0.29	2.5
15	ZH17144	0.04	17	75.6	4.5	147.5	55.5	0.34	2.5
16	ZH17145	1.40	4	76.3	9.4	162.0	60.0	0.29	3.3
17	ZH17149	1.26	5	73.6	3.8	135.0	60.2	0.40	2.5
18	ZH1761	4.68	1	71.6	3.5	134.5	67.5	0.49	1.8
19	RML-95/RML-96	2.61	3	75.8	1.1	135.0	69.3	0.47	2.8
20	RML-86/RML-96	0.71	7	77.6	5.8	149.5	60.2	0.34	3.3
	Mean	0.82	11	77.7	5.9	141.2	59.5	0.37	2.9
	F-test	*		ns	ns	ns	ns	ns	ns
	CV (0.05)	91.12		6.0	51.9	16.5	25.5	22.72	28.8
	LSD (0.05)	1.94							
	Heritability	0.82	1	0.6	0.6			0.54	0.2

Table 32: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-II-123 at RARS, Nepalgunj 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH161005	2.08	40	69.5	3.9	124.8	32.1	0.26	3.9
2	ZH161003	2.00	42	66.3	3.2	126.1	41.2	0.35	2.8
3	ZH1639	2.94	13	65.7	6.0	117.7	52.6	0.45	1.6
4	ZH1640	2.60	20	68.2	-0.1	135.5	47.1	0.36	1.9
5	ZH1655	2.79	18	71.1	5.9	142.3	58.1	0.42	1.9
6	ZH1673	0.95	69	71.5	6.9	126.3	41.6	0.33	3.7
7	ZH141592	2.26	34	74.0	7.3	139.4	68.2	0.50	2.8
8	ZH1673	1.90	44	70.6	4.9	129.3	47.1	0.38	3.4
9	ZH1650	1.32	60	74.5	9.3	121.2	38.1	0.33	3.9
10	ZH1652	3.21	10	66.5	3.3	115.6	49.6	0.45	2.4
11	ZH15266	2.33	31	65.4	3.2	127.7	50.2	0.40	2.1
12	ZH1630	1.12	64	73.1	9.7	112.9	33.7	0.31	3.6
13	ZH16911	1.37	58	68.1	7.5	117.1	35.4	0.32	2.7
14	ZH137413	2.47	22	70.4	2.3	126.7	55.7	0.45	2.3
15	ZH16952	0.97	68	68.6	5.5	140.5	60.6	0.43	2.2

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
16	ZH16878	3.73	6	71.9	2.7	132.5	70.7	0.57	1.8
17	ZH1655	4.13	2	72.4	3.9	120.1	49.1	0.43	1.4
18	ZH1623	2.09	38	73.8	5.5	115.6	41.0	0.36	3.0
19	ZH16817	1.45	57	80.8	6.2	146.6	37.2	0.27	4.2
20	ZH161027	1.36	59	73.9	7.3	112.5	32.6	0.31	3.4
21	ZH16840	2.86	14	66.7	3.5	133.9	56.5	0.42	2.2
22	ZH16955	1.12	62	72.3	5.0	135.7	43.1	0.31	2.9
23	ZH16942	1.06	65	71.2	5.6	111.4	35.2	0.34	3.3
24	ZH16903	1.68	51	68.4	4.8	113.7	48.1	0.44	2.9
25	ZH16949	2.34	29	74.7	7.9	145.0	52.1	0.37	3.4
26	ZH16843	1.99	43	72.6	8.4	158.3	57.1	0.37	4.2
27	ZH1770	3.06	12	75.8	5.0	138.2	44.6	0.33	2.4
28	ZH16930	2.27	33	80.0	8.8	125.2	45.1	0.38	2.9
29	ZH16902	3.74	5	68.7	5.1	126.9	40.7	0.34	1.5
30	ZH16869	0.99	67	75.0	7.5	157.7	55.1	0.34	4.2
31	ZH16934	3.61	7	69.7	5.7	154.8	38.6	0.27	1.2
32	ZH16972	1.59	52	71.9	6.4	120.7	40.6	0.35	3.6
33	ZH16974	1.71	50	78.9	7.9	124.1	53.6	0.44	4.2
34	ZH16834	2.20	35	76.2	4.9	135.0	46.6	0.35	2.4
35	ZH1617	1.49	55	72.9	7.6	134.0	42.2	0.33	3.6
36	ZH163	2.07	41	71.4	10.1	127.0	50.7	0.43	3.3
37	ZH1635	1.58	54	67.0	3.6	103.7	56.3	0.63	3.5
38	ZH1645	1.79	46	71.8	4.9	131.2	45.6	0.35	3.1
39	ZH1644	2.53	21	65.2	3.8	111.0	42.7	0.40	1.8
40	ZH1623	2.40	27	72.0	6.6	134.2	62.3	0.50	2.2
41	ZH16953	1.17	61	66.6	4.8	116.9	43.2	0.38	4.3
42	ZH1619	2.13	37	75.8	6.1	126.8	39.2	0.34	2.6
43	ZH16963	2.13	36	68.1	3.2	122.1	47.6	0.42	1.8
44	ZH16934	1.76	49	70.2	5.5	124.7	48.1	0.39	2.4
45	ZH15445	4.09	3	71.3	2.2	146.6	53.2	0.38	1.3
46	ZH16929	2.41	26	70.0	5.8	136.1	48.6	0.37	2.4
47	ZH16848	2.33	30	66.1	4.5	113.0	45.6	0.41	2.2

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
48	ZH16946	2.79	17	72.3	8.8	128.0	40.1	0.33	3.1
49	ZH16849	1.46	56	75.3	6.2	174.1	45.7	0.29	3.3
50	ZH1770	2.79	16	75.7	6.8	134.0	55.7	0.41	2.4
51	ZH1771	1.77	48	71.7	5.8	109.0	42.2	0.40	2.8
52	ZH16931	3.86	4	69.1	5.1	151.2	49.7	0.35	1.8
53	ZH16928	2.45	24	76.1	6.8	148.8	58.1	0.41	2.4
54	ZH16929	2.62	19	73.7	7.9	97.9	33.5	0.35	3.0
55	ZH16918			83.4	7.9	139.5	43.9	0.33	
56	ZH16914	2.31	32	73.1	12.5	105.4	53.2	0.53	4.3
57	ZH16910	1.78	47	75.8	6.9	159.7	55.1	0.35	3.1
58	ZH1672	2.46	23	71.8	5.2	119.0	42.2	0.37	2.3
59	ZH1652	1.01	66	73.2	7.7	87.4	46.7	0.58	3.1
60	ZH1624	1.12	63	73.4	7.4	113.6	53.6	0.49	2.2
61	ZH1644	1.58	53	67.8	2.8	118.0	37.6	0.33	2.4
62	ZH16900	2.86	15	69.1	3.9	134.1	61.2	0.46	2.6
63	ZH16899	3.51	8	68.0	4.9	141.8	63.6	0.45	2.4
64	ZH16897	2.08	39	69.7	4.8	135.8	54.1	0.42	3.1
65	RML-95/RML-96	4.19	1	65.9	4.5	128.9	58.6	0.46	1.4
66	RML-86/RML-96	1.80	45	77.1	7.7	117.9	45.2	0.41	3.5
67	Rampur Hybrid-4	3.09	11	72.2	5.8	115.8	34.1	0.32	2.4
68	Rampur Hybrid--6	2.44	25	75.6	9.6	151.1	67.6	0.48	3.3
69	CP-808	3.41	9	73.1	4.4	143.8	38.4	0.28	1.1
70	Rampur Composite	2.37	28	69.6	6.7	132.6	48.6	0.39	2.3
	Mean	2.25	35	71.7	5.9	128.9	47.9	0.39	2.7
	F-test	***		**	+	*	ns	ns	**
	CV (%)	28.85		5.2	40.5	12.8	23.6	25.30	27.1
	LSD (0.05)	1.52	20	7.7	5.0	34.3	-	-	1.5
	Heritability	0.70	1	0.5	0.4	0.4	0.2	0.10	0.6

Table 33: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-II-223 at RARS, Nepalgunj 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH16467	4.34	1	71.2	8.7	129.0	55.5	0.42	2.2
2	ZH16485	2.67	13	73.3	9.0	133.0	50.0	0.37	2.7
3	ZH16445	1.61	27	70.8	7.9	129.0	53.5	0.41	4.2
4	ZH16598	2.55	14	71.1	7.6	135.0	40.5	0.30	2.9
5	ZH16605	1.67	26	71.5	8.4	157.5	60.5	0.38	3.5
6	ZH16277	2.04	21	72.5	7.9	125.0	51.5	0.40	3.2
7	ZH16767	1.80	25	76.8	10.5	135.0	45.5	0.36	3.1
8	ZH16760	2.36	18	70.8	5.0	133.5	43.0	0.32	3.5
9	ZH16761	3.23	5	76.8	5.7	125.5	58.5	0.47	3.1
10	ZH16620	3.47	3	72.8	4.2	130.5	72.0	0.56	1.9
11	ZH16639	2.52	15	72.5	7.4	127.5	45.0	0.35	2.7
12	ZH16772	1.84	24	73.1	5.6	118.0	49.5	0.43	2.4
13	ZH16778	1.85	23	80.3	8.0	104.0	48.0	0.46	3.1
14	ZH16122	3.96	2	68.8	3.2	125.0	47.0	0.39	1.9
15	ZH1683	3.12	6	70.8	6.0	125.5	48.5	0.38	2.0
16	ZH1695	2.78	9	72.3	8.0	134.0	55.0	0.40	2.2
17	ZH16271	2.32	19	70.6	6.1	121.0	49.0	0.41	1.9
18	ZH16282	2.15	20	76.0	3.9	132.0	65.0	0.49	1.9
19	ZH16297	1.27	30	74.5	8.4	122.0	47.5	0.38	2.4
20	ZH16294	2.69	12	72.2	3.7	135.0	50.0	0.36	2.2
21	ZH16307	2.47	16	71.8	7.5	137.5	44.0	0.31	3.2
22	ZH16310	1.93	22	84.8	6.0	135.0	51.0	0.37	3.4
23	ZH16313	2.76	10	71.1	5.1	138.0	54.0	0.39	1.9
24	ZH16386	1.40	29	70.0	6.4	121.5	53.0	0.43	2.9
25	RML-95/RML-96	2.94	7	71.8	6.5	148.5	58.5	0.40	1.9
26	RML-86/RML-96	2.46	17	69.1	4.1	130.0	52.5	0.41	1.9
27	Rampur Hybrid-4	3.28	4	72.7	9.7	120.5	47.5	0.38	1.8
28	Rampur Hybrid-6	1.57	28	78.3	8.5	110.5	50.0	0.45	3.7
29	CP-808	2.70	11	72.8	8.5	173.5	41.0	0.24	2.3
30	Rampur Composite	2.85	8	69.1	5.6	127.5	48.5	0.37	2.6
	Mean	2.48	16	73.0	6.8	130.7	51.2	0.39	2.6
	F-test	ns		*	ns	ns	ns	ns	ns
	CV (%)	37.02		4.6	38.6	15.7	17.7	15.95	32.3
	LSD (0.05)	2.24	9	7.0	5.5	41.8	18.5	0.13	1.8
	Heritability	0.22	1	0.5	0.1		0.1	0.45	0.2

Table 34: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-II-315 at RARS, Nepalgunj 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH16107	1.50	20	73.0	4.4	131.7	43.8	0.33	3.5
2	ZH16128	3.37	4	70.0	3.2	130.2	48.6	0.38	2.0
3	ZH16131	1.16	25	73.5	5.2	119.6	49.3	0.43	2.8
4	ZH1688	1.06	26	72.5	4.2	114.6	36.3	0.33	2.3
5	ZH1689	1.88	16	72.0	5.2	114.7	42.6	0.38	1.8
6	ZH1690	2.25	14	70.4	6.6	148.6	37.2	0.26	2.3
7	ZH16168	3.24	5	66.0	3.9	126.7	41.0	0.33	2.3
8	ZH16175	4.42	1	67.0	4.7	115.2	45.1	0.40	1.8
9	ZH16191	2.86	7	69.5	2.7	123.2	47.6	0.39	1.8
10	ZH16341	1.47	21	77.6	5.6	147.6	39.4	0.28	4.5
11	ZH16296	-0.03	30	80.7	9.4	119.6	39.2	0.34	4.2
12	ZH16311	2.40	13	69.0	4.7	130.1	42.8	0.34	2.3
13	ZH16418	2.77	9	72.5	5.4	140.7	53.5	0.38	2.3
14	ZH16483	1.65	19	72.6	3.8	128.7	52.9	0.42	2.3
15	ZH16731	1.65	18	71.1	7.6	113.1	38.1	0.32	2.3
16	ZH16757	0.45	27	78.7	7.4	140.1	67.7	0.49	3.0
17	ZH16866	1.33	22	69.0	3.6	107.1	45.7	0.43	1.5
18	ZH16857	3.12	6	72.1	3.2	128.6	47.2	0.38	1.8
19	ZH16153	1.32	23	74.1	7.3	122.7	47.4	0.41	2.8
20	ZH16162	0.15	29	74.4	6.3	119.2	43.0	0.37	2.5
21	ZH16150	1.24	24	68.4	5.3	111.7	41.5	0.38	1.7
22	ZH16199	2.58	12	73.0	4.4	126.7	48.3	0.38	2.3
23	ZH16234	1.72	17	70.4	4.8	115.2	46.0	0.39	2.3
24	ZH16333	2.79	8	69.0	8.4	139.7	51.0	0.40	2.5
25	ZH16422	2.63	11	72.1	3.2	129.1	46.2	0.37	2.0
26	ZH16410	0.34	28	78.0	5.4	119.7	39.3	0.33	4.3
27	ZH16530	2.19	15	75.1	4.6	138.6	46.4	0.34	3.3
28	RML-95/RML-96	2.72	10	73.1	8.2	148.6	56.2	0.39	2.8
29	RML-86/RML-96	3.41	3	72.9	4.8	121.7	55.5	0.45	2.8
30	Rampur Hybrid- 4	3.98	2	73.1	5.8	153.7	65.4	0.44	2.5
	Mean	2.05	16	72.3	5.3	127.6	46.8	0.37	2.5
	F-test	***		**	ns	ns	**	ns	*
	CV	32.50		3.4	52.7	11.0	13.0	16.26	28.3
	LSD (0.05)	1.58	9	5.4	-	-	12.9	-	1.6
	Heritability	0.82	1	0.7		0.4	0.7	0.23	0.6

Table 35: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-II-423 at RARS, Nepalgunj 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH16822	3.23	2	73.0	8.3	124	56	0.45	2.5
2	ZH15281	1.24	11	70.5	9.3	122	38	0.32	2.8
3	ZH16875	2.20	6	77.5	8.9	130	49	0.38	2.3
4	ZH16879	2.70	3	75.0	8.1	113	45	0.40	3.5
5	ZH16881	4.32	1	75.0	5.4	107	50	0.47	2.2
6	ZH16887	-0.46	20	77.0	10.4	108	34	0.32	3.7
7	ZH16930	0.57	15	82.5	7.7	128	40	0.31	2.7
8	ZH16868	0.47	16	71.5	7.8	135	41	0.30	3.3
9	ZH16873	0.30	18	75.5	6.9	139	45	0.33	2.7
10	ZH1775	0.02	19	79.0	6.4	82	34	0.43	3.2
11	ZH16856	0.75	13	74.0	8.6	97	31	0.32	3.8
12	ZH16851	2.19	7	73.0	9.0	147	48	0.35	2.8
13	ZH1776	0.32	17	73.0	7.0	118	36	0.31	2.5
14	ZH16161	0.70	14	70.5	5.1	111	42	0.38	2.8
15	ZH16114	1.59	9	67.0	3.3	122	44	0.36	3.0
16	ZH16135	1.45	10	69.0	6.7	140	46	0.33	2.3
17	ZH16322	1.15	12	69.0	2.7	120	36	0.30	3.8
18	RML-95/RML-96	2.44	5	70.5	4.6	117	52	0.45	2.3
19	RML-86/RML-96	2.66	4	73.0	5.8	122	51	0.42	2.5
20	Rampur Hybrid-4	1.98	8	75.5	7.0	105	39	0.37	3.0
	Mean	1.49	11	73.6	7.0	119	43	0.36	2.9
	F-test	**			**	ns	ns	ns	ns
	CV (%)	44.83		5.1	21.5	15.5	18.2	18.14	28.2
	LSD (0.05)	1.64	6	7.8	3.3	-	-	-	-
	Heritability	0.85	1	0.5	0.7	0.3	0.4	0.29	-0.2

Table 36: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-II-510 at RARS, Nepalgunj 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH16809	1.23	9	69.0	3.7	133.3	39.2	0.29	1.8
2	ZH16222	1.67	4	70.5	6.3	141.8	55.1	0.42	2.5
3	ZH16262	1.16	11	70.5	6.6	132.6	46.4	0.35	1.8
4	ZH16269	1.65	5	71.5	2.2	144.2	47.4	0.35	2.0
5	ZH16402	0.98	13	74.5	4.7	129.1	54.7	0.47	2.3
6	ZH16399	1.06	12	71.5	7.0	131.3	48.5	0.40	2.0
7	ZH16477	0.96	14	75.5	6.5	141.0	46.5	0.35	3.0
8	ZH16524	0.89	15	77.0	6.2	129.5	43.7	0.38	2.8
9	ZH16334	0.60	17	67.0	2.7	114.3	45.2	0.42	3.5
10	ZH16779	0.54	18	75.5	8.1	123.1	34.9	0.30	3.0
11	ZH16782	0.65	16	76.5	8.8	125.5	57.1	0.48	2.3
12	ZH16718	1.63	6	70.5	4.9	126.1	60.6	0.49	2.0
13	ZH16855	1.89	2	73.0	4.5	119.1	33.0	0.30	1.8
14	ZH16163	0.38	19	70.5	4.4	124.3	48.0	0.39	3.5
15	ZH16139	0.38	20	71.5	16.2	118.1	40.2	0.36	3.5
16	ZH16532	1.91	1	70.5	2.0	148.3	51.5	0.37	1.8
17	RML-95/RML-96	1.46	7	73.0	4.2	124.0	59.2	0.52	2.3
18	RML-86/RML-96	1.73	3	78.0	4.8	104.6	55.5	0.54	3.5
19	Rampur Hybrid-4	1.17	10	71.5	6.9	118.8	63.0	0.53	2.5
20	Rampur Hybrid-6	1.27	8	82.0	6.6	113.3	64.4	0.60	2.8
	Mean	1.16	11	73.0	5.9	127.1	49.7	0.41	2.5
	F-test	ns		*	*	ns	ns	ns	*
	CV (%)	47.51		4.5	43.9	13.6	20.1	22.07	20.2
	LSD (0.05)	-	6	6.9	5.6	-	-	-	1.1
	Heritability	0.37	1	0.6	0.6	-0.2	0.4	0.47	0.7

Table 37: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-III-123 at RARS, Nepalgunj 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH141592	2.86	7	74.9	8.8	129.8	42.5	0.31	3.7
2	ZH15279	2.63	10	71.7	9.8	121.4	47.9	0.35	2.4
3	ZH137413	3.08	5	72.7	8.5	127.5	49.0	0.36	2.4
4	ZH15422	1.06	24	75.1	7.6	103.0	26.0	0.24	3.8
5	ZH141592	3.48	3	74.0	7.6	127.6	47.0	0.35	3.4
6	ZH15421	1.81	15			100.3	32.1	0.30	4.1
7	ZH15410	2.61	11	76.1	6.6	123.5	48.0	0.37	3.3
8	ZH15400	2.76	9	70.9	5.3	130.8	54.1	0.38	1.9
9	ZH1619	4.12	1	72.4	7.0	100.4	37.5	0.35	1.6
10	ZH137087			76.1	9.8	73.1	29.9	0.40	
11	ZH1679	1.37	20	73.5	9.0	124.4	38.9	0.28	3.9
12	ZH15416					161.8	52.1	0.32	
13	VH142085	0.66	27	75.4	5.0	130.1	48.9	0.37	4.4
14	ZH15267	1.41	19	73.9	7.3	98.8	36.1	0.33	2.9
15	VH131167	3.29	4	74.0	10.1	136.6	46.5	0.32	2.6
16	ZH15381	0.64	28	74.9	13.3	109.3	39.0	0.33	4.0
17	ZH15327	1.19	21	75.7	8.8	102.8	41.5	0.37	4.0
18	ZH15329	3.05	6	68.5	9.0	124.1	55.5	0.41	2.7
19	ZH15324	1.42	18	75.4	5.5	124.4	55.5	0.43	3.6
20	ZH15331	1.95	14	73.0	9.6	124.1	56.0	0.42	3.4
21	ZH15333	0.99	26	74.7	9.8	106.3	44.0	0.38	3.8
22	VH113014	2.78	8	72.3	7.1	110.9	31.0	0.28	2.3
23	ZH138088	1.05	25	72.1	9.1	79.5	31.0	0.38	3.6
24	ZH1622	1.15	22	70.2	6.5	107.5	38.0	0.33	3.4
25	ZH16878	1.71	16	76.1	7.8	123.7	49.0	0.39	3.7
26	ZH15433	1.07	23	74.9	10.8	98.3	36.5	0.35	3.5
27	ZH1756	1.50	17	70.0	8.1	122.6	32.5	0.25	3.4
28	RML-95/RML-96	2.44	12	73.6	3.3	120.2	52.5	0.42	2.5
29	RML-86/RML-96	3.73	2	72.0	7.0	122.6	54.0	0.40	2.7
30	Rampur Hybrid-4	2.10	13	74.8	8.1	91.9	34.0	0.36	2.3
	Mean	2.07	15	73.5	8.1	115.2	42.9	0.35	3.2
	F-test	+		ns	ns	**	**	*	ns
	CV (%)	46.35		3.3	34.7	9.5	15.5	11.90	-
	LSD (0.05)	2.20	8	-	-	26.2	15.3	0.10	1.8
	Heritability	0.53	1	0.3	0.0	0.8	0.7	0.64	0.5

Table 38: Mean grain yield and other attributes of heat stress resilient hybrids tested in HSH-III-215 at RARS, Nepalgunj 2016/17 Spring

SN	Genotype	Grain yield, t/ha	Rank	Days to Anthesis	ASI	Height, cm		Ear position (0-1)	Ear aspect (1-5)
						Plant	Ear		
1	ZH15390	3.95	10	68.7	3.0	166.0	56.5	0.34	3.0
2	ZH15432	4.76	4	68.7	5.5	144.0	69.6	0.48	2.3
3	ZH15422	0.94	20	73.3	8.5	107.0	51.2	0.44	3.5
4	ZH137119	6.21	1	68.6	4.5	162.5	75.3	0.45	1.5
5	ZH138119	3.83	13	69.5	8.5	140.0	54.8	0.37	2.3
6	ZH138069	3.88	12	66.8	6.0	136.5	61.0	0.43	3.3
7	ZH138098	5.61	2	66.4	4.5	148.0	50.6	0.32	2.3
8	VH112887	2.05	18	69.4	5.0	119.0	53.3	0.44	2.5
9	ZH16981	3.90	11	62.9	4.0	121.0	58.4	0.47	2.0
10	ZH15370	3.65	14	66.7	3.5	117.5	57.1	0.47	2.0
11	ZH15366	5.03	3	69.5	7.5	140.0	69.3	0.47	2.5
12	ZH16979	2.44	16	64.1	4.0	119.0	72.6	0.62	2.3
13	ZH15317	3.20	15	70.1	3.0	155.0	75.4	0.47	2.5
14	ZH142040	4.66	5	69.5	5.5	147.5	70.7	0.46	1.8
15	ZH111755	2.22	17	70.8	7.5	146.5	64.5	0.42	1.5
16	CAH155	4.33	6	72.1	7.5	125.0	60.5	0.47	2.0
17	ZH1619	4.10	9	68.9	4.5	146.5	69.7	0.45	2.8
18	ZH1757	2.01	19	73.0	9.5	143.0	61.4	0.42	3.5
19	RML-95/RML-96	4.18	8	69.0	3.0	126.5	65.4	0.55	2.3
20	RML-86/RML-96	4.19	7	69.0	5.5	161.5	69.5	0.42	2.0
	Mean	3.75	11	68.8	5.5	138.6	63.3	0.45	2.4
	F-test	*		***	ns	*	ns	Ns	*
	CV%	29.36		2.4	38.8	10.3	18.2	25.08	21.1
	LSD (0.05)	2.31	6	3.6	4.5	30.0	24.8	0.24	1.0
	Heritability	0.64	1	0.8	0.4	0.6	-0.1	-0.52	0.6

2.1.2.3 On-farm testing and demonstration of HTMA hybrids

Selected 15 and 20 HTMA hybrids including two and four checks were evaluated in farmers' field of Sarlahi, Chitwan and Dang districts, and one set at NMRP Rampur. Plot size was 10 rows of 5 m longper each entry. Tested genotypes performed differently over the locations. Details of the results are presented in Table 39 –47. Two sets; MLT-NEP-3 and MLT-NEP-4 were evaluated at Madi, Chitwan under replicated conditions. From the both experiments the selected promising genotypes were ZH1615 (7.3 t/ha), RML-86/RML-96 (7.24 t/ha), ZH15405 (7.07 t/ha), VH121062 (9.25 t/ha) and VH112944 (7.07

t/ha), respectively. The same set at Dang as MLT-NEP-2 was planted and two genotypes namely ZH141592 (6.2 t/ha) and ZH15405 (5.8 t/ha) were found selected based on grain yieldand other agronomic traits. In another set which consisted of 20 entries was planted as single replication in various farmers' field. At Rampur, two genotypes ZH15445 (8.31 t/ha) and ZH138098 (8.83 t/ha) out yielded than rest of the tested genotypes. At Sagarnath, Sarlahi, 2 sets were evaluated and identified promising genotypes were VH121062 (12.57 t/ha), ZH138038 (11.25 t/ha), ZH1611 (8.27 t/ha) and ZH111948 (7.98 t/ha), respectively. At Narayanpur, the highest grain yield was obtained from ZH138098 (4.63 t/ha) and ZH1615 (4.62 t/ha). Similarly at Madi, the promising genotypes were ZH120 (8.36 t/ha) and VH121062 (7.93 t/ha). The combined results over the locations concluded that ZH138098 (7.57 t/ha) and VH121062 (7.21 t/ha) were stable for grain yield.

Table 39: Mean grain yield and other agronomic characters of selected HTMA hybrids tested at Madi, Chitwan (MLT-NEP3) 2016/17 spring

SN	Genotype	Grain yield, t/ha	Rank	Height, cm		Ear position (0-1)
				Plant	Ear	
1	ZH15272	5.65	12	146.1	60.2	0.41
2	ZH1610	5.80	10	182.5	73.3	0.41
3	ZH1611	6.12	7	179.1	81.1	0.46
4	CAH151	6.17	6	183.5	80.2	0.44
5	ZH15405	7.07	3	153.1	61.3	0.41
6	ZH15445	6.64	5	197.7	80.9	0.41
7	ZH141592	5.73	11	159.7	62.7	0.39
8	ZH138061	6.12	7	168.2	68.8	0.41
9	VH112944	5.99	9	165.1	68.3	0.42
10	VH121062	6.81	4	143.6	61.1	0.43
11	ZH15383	5.17	14	167.0	81.0	0.49
12	ZH1615	7.30	1	162.2	55.3	0.35
13	VH123050	5.22	13	161.0	60.3	0.38
14	RML-95/RML-96	4.50	15	153.0	73.2	0.48
15	RML-86/RML-96	7.24	2	178.7	70.2	0.40
	Mean	6.10	8	166.7	69.2	0.42
	F-test	ns		***	*	*
	CV (%)	14.46		4.4	9.6	6.85
	LSD (0.05)	-	4	16.6	14.9	0.06
	Heritability	0.40	1	0.9	0.7	0.70

Table 40: Mean grain yield and other agronomic characters of selected HTMA hybrids tested at Madi, Chitwan (MLT-NEP4) 2016/17 spring

SN	Genotype	Grain yield, t/ha	Rank	Height, cm		Ear position (0-1)	SN
				Plant	Ear		
1	ZH15272	5.42	14	160.5	59.0	0.37	0.99
2	ZH1610	5.97	12	168.5	66.5	0.40	0.98
3	ZH1611	6.17	10	172.5	80.0	0.47	1.00
4	CAH151	6.84	4	189.5	74.0	0.39	1.11
5	ZH15405	6.35	8	159.5	61.5	0.39	0.98
6	ZH15445	6.27	9	194.0	75.0	0.39	1.14
7	ZH141592	6.37	7	170.5	64.5	0.38	1.04
8	ZH138061	6.11	11	186.5	73.5	0.40	1.04
9	VH112944	7.07	3	152.5	60.5	0.40	1.07
10	VH121062	9.25	1	174.0	66.5	0.38	1.18
11	ZH15383	5.73	13	181.0	77.5	0.43	1.06
12	ZH1615	6.41	6	167.0	55.0	0.33	0.94
13	VH123050	5.14	15	173.0	65.5	0.38	1.04
14	RML-95/RML-96	6.47	5	173.5	75.5	0.43	1.04
15	RML-86/RML-96	7.26	2	156.0	57.5	0.37	1.00
	Mean	6.45	8	171.9	67.5	0.39	1.04
	F-test	ns		ns	ns	ns	ns
	CV (%)	12.92		11.3	19.9	13.11	9.06
	Heritability	0.62	1	-	-	-	-

Table 41: Mean grain yield and other agronomic characters of selected HTMA hybrids tested at Ghorahi, Dang (MLT-NEP2) 2016/17 spring

SN	Genotype	Grain yield t/ha	Days to anthesis	ASI	Plant height, cm	Ear height, cm
1	ZH15272	4.1	61.5	4.0	163.0	73.5
2	ZH1610	3.6	65.5	4.0	193.0	79.0
3	ZH1611	5.0	62.5	3.0	177.5	93.5
4	CAH151	4.5	61.5	4.0	199.5	89.5
5	ZH15405	5.8	62.0	3.5	145.5	60.5
6	ZH15445	5.1	64.5	4.0	194.5	78.5
7	ZH141592	6.2	63.0	4.0	157.0	55.0
8	ZH138061	4.8	67.5	3.5	177.5	71.5
9	VH112944	3.3	68.0	4.0	173.5	79.0
10	VH121062	3.9	64.0	3.5	135.0	54.0
11	ZH15383	3.9	62.5	3.5	159.5	67.0

SN	Genotype	Grain yield t/ha	Days to anthesis	ASI	Plant height, cm	Ear height, cm
12	ZH1615	2.2	71.0	4.0	152.0	48.5
13	VH123050	4.6	67.0	3.5	166.0	58.0
14	RML-95/RML-96	3.3	69.5	3.5	173.5	83.5
15	RML-86/RML-96	3.8	65.5	4.0	172.5	78.5
	Mean	ns	*	ns	*	**
	F-test	4.3	65.0	3.7	169.0	71.0
	CV (%)	26.8	4.0	15.8	6.6	13.2
	LSD(0.05)	-	5.6	-	23.9	20.1

Table 42: Mean grain yield and other agronomic characters of selected HTMA hybrids tested at NMRP Rampur (MLT-1) 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. Turcicum* (1-5)
			Anthesis	Silking	Plant	Ear	
1	VH112337	4.70	107	111	145	41	2.0
2	ZH141592	5.10	106	107	186	78	2.0
3	ZH1521	6.93	93	95	180	81	4.5
4	ZH1620	6.60	106	107	183	87	2.5
5	ZH138038	5.27	102	104	162	81	2.5
6	CAH153	7.69	107	109	192	85	1.5
7	ZH15445	8.31	111	114	230	114	3.0
8	ZH15381	6.82	97	100	206	102	3.5
9	ZH111948	6.08	111	114	222	110	2.0
10	ZH138098	8.83	108	109	203	95	1.5
11	ZH138061	6.71	97	100	166	76	2.0
12	CAH151	6.23	110	111	199	114	2.5
13	ZH1505	5.56	105	107	183	94	3.5
14	VH121062	4.47	96	99	127	57	3.5
15	ZH1611	5.12	103	104	193	100	4.0
16	ZH1615	5.73	111	113	168	78	1.5
17	P3533	3.20	107	109	181	86	4.0
18	P3535	6.33	104	106	256	120	4.0
19	RH-4	4.07	112	114	166	83	2.5
20	RH-6	7.71	111	114	165	90	2.5

Table 43: Mean grain yield and other agronomic characters of selected HTMA hybrids tested at Sagarnath, Sarlahi (MLT-2) 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. Turcicum (1-5)*
			Anthesis	Silking	Plant	Ear	
1	VH112337	8.68	106	109	195	89	1.5
2	ZH141592	9.46	107	110	230	122	1.5
3	ZH1521	9.90	95	97	225	118	3.0
4	ZH1620	10.74	105	108	204	93	2.0
5	ZH138038	11.25	100	104	166	87	2.0
6	CAH153	10.04	105	107	217	116	1.5
7	ZH15445	9.51	110	113	267	135	2.5
8	ZH15381	11.14	98	102	233	123	3.0
9	ZH111948	9.30	109	112	224	120	2.0
10	ZH138098	10.15	106	109	215	100	1.5
11	ZH138061	9.10	97	101	202	108	2.0
12	CAH151	10.10	111	115	240	125	2.0
13	ZH1505	10.92	107	110	225	116	3.0
14	VH121062	12.57	98	102	193	89	3.0
15	ZH1611	9.28	105	107	248	145	3.5
16	ZH1615	10.32	113	117	219	111	3.5
17	P3533	12.00	105	109	254	137	4.0
18	P3535	11.00	106	110	288	146	2.5
19	RH-4	7.48	110	113	190	100	2.5
20	RH-6	9.42	108	112	220	115	2.5

Table 44: Mean grain yield and other agronomic characters of selected HTMA hybrids tested at Sagarnath, Sarlahi (MLT-3) 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. Turcicum* (1-5)
			Anthesis	Silking	Plant	Ear	
1	VH112337	5.87	105	108	180	75	2.0
2	ZH141592	6.32	108	110	200	105	1.5
3	ZH1521	6.27	94	97	175	90	2.5
4	ZH1620	6.30	106	109	170	85	2.5
5	ZH138038	5.50	99	103	150	75	2.0
6	CAH153	6.23	104	107	190	95	1.5
7	ZH15445	4.56	109	112	204	105	2.0
8	ZH15381	4.76	99	103	190	102	3.5
9	ZH111948	7.98	109	113	205	105	2.0

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. Turcicum* (1-5)
			Anthesis	Silking	Plant	Ear	
10	ZH138098	6.75	107	110	195	75	1.5
11	ZH138061	5.55	99	103	170	80	2.5
12	CAH151	7.68	109	112	205	103	2.5
13	ZH1505	6.68	108	111	195	102	3.5
14	VH121062	7.23	100	103	170	80	2.0
15	ZH1611	8.27	104	107	195	110	3.0
16	ZH1615	6.62	112	116	180	90	3.0
17	P3533	9.37	106	110	210	110	4.5
18	P3535	8.09	107	110	230	120	3.5
19	RH-4	7.62	109	113	150	75	2.5
20	RH-6	5.41	107	110	185	95	2.5

Table 45: Mean grain yield and other agronomic characters of selected HTMA hybrids tested at Narayanpur, Chitwan (MLT-2) 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. Turcicum* (1-5)
			Anthesis	Silking	Plant	Ear	
1	VH112337	3.09	109	111	176	74	1.5
2	ZH141592	3.39	108	110	200	96	2.5
3	ZH1521	3.15	95	98	220	108	3.5
4	ZH1620	4.65	110	113	190	102	2.5
5	ZH138038	3.88	106	108	194	106	2.0
6	CAH153	4.32	109	112	214	118	1.5
7	ZH15445	4.67	115	118	228	118	3.5
8	ZH15381	3.22	101	104	210	126	3.0
9	ZH111948	3.59	116	120	204	118	2.5
10	ZH138098	4.63	112	114	200	104	2.0
11	ZH138061	3.37	101	105	258	142	2.5
12	CAH151	4.16	115	118	202	98	2.5
13	ZH1505	3.89	110	113	210	108	3.0
14	VH121062	3.83	101	106	180	82	3.5
15	ZH1611	4.61	107	111	246	142	2.5
16	ZH1615	4.62	114	117	250	130	1.5
17	P3533	4.33	113	118	262	150	3.5
18	P3535	2.82	113	117	260	136	4.5
19	RH-4	3.40	115	118	200	114	2.0
20	RH-6	4.17	113	116	160	116	2.5

Table 46: Mean grain yield and other agronomic characters of selected HTMA hybrids tested at Madi, Chitwan (MLT-5) 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. Turcicum* (1-5)
			Anthesis	Silking	Plant	Ear	
1	VH112337	3.54	106	109	136	46	2.0
2	ZH141592	5.03	106	108	164	76	2.5
3	ZH1521	7.36	95	98	166	73	3.0
4	ZH1620	8.36	108	110	170	75	2.5
5	ZH138038	6.90	102	104	188	107	2.5
6	CAH153	5.80	108	111	204	95	2.0
7	ZH15445	5.82	110	113	250	127	3.0
8	ZH15381	5.95	95	98	214	119	3.5
9	ZH111948	7.01	112	114	221	114	2.0
10	ZH138098	7.49	108	110	226	94	2.0
11	ZH138061	6.84	98	101	204	98	2.5
12	CAH151	6.77	108	111	230	112	2.5
13	ZH1505	7.63	105	107	197	95	2.5
14	VH121062	7.93	97	101	160	80	2.5
15	ZH1611	7.51	103	106	221	109	2.0
16	ZH1615	6.99	112	115	198	86	1.5
17	P3533	6.60	108	111	228	127	3.0
18	P3535	10.55	106	109	253	116	3.5
19	RH-4	5.23	111	114	171	87	2.0
20	RH-6	4.00	110	113	182	106	2.5

Table 47: Mean grain yield and other characters of selected HTMA hybrids tested over the locations 2016/17 winter

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. Turcicum* (1-5)
			Anthesis	Silking	Plant	Ear	
1	VH112337	5.18	107	110	166	65	1.8
2	ZH141592	5.86	107	109	196	95	2.0
3	ZH1521	6.72	94	97	193	94	3.3
4	ZH1620	7.33	107	109	183	88	2.4
5	ZH138038	6.56	102	105	172	91	2.2
6	CAH153	6.82	107	109	203	102	1.6
7	ZH15445	6.57	111	114	236	120	2.8
8	ZH15381	6.38	98	101	211	114	3.3
9	ZH111948	6.79	111	115	215	113	2.1
10	ZH138098	7.57	108	110	208	94	1.7

SN	Genotype	Grain yield, t/ha	Days to		Height, cm		*E. Turcicum* (1-5)
			Anthesis	Silking	Plant	Ear	
11	ZH138061	6.31	98	102	200	101	2.3
12	CAH151	6.99	111	113	215	110	2.4
13	ZH1505	6.94	107	110	202	103	3.1
14	VH121062	7.21	98	102	166	78	2.9
15	ZH1611	6.96	104	107	221	121	3.0
16	ZH1615	6.86	112	116	203	99	2.2
17	P3533	7.24	108	111	227	122	3.8
18	P3535	7.76	107	110	257	128	3.6
19	RH-4	5.56	111	114	175	92	2.3
20	RH-6	6.14	110	113	182	104	2.5
	Mean	6.7	106	109	201	102	2.2
	F-test	ns	**	**	**	**	**
	CV (%)	18.1	1.3	1.4	8.3	10.7	19.1
	LSD(0.05)	-	1.7	1.9	21.1	13.7	0.6

From different stage experiments tested at NMRP Rampur the selected genotypes for further verifications were ZH178, ZH17165, ZH17126, RL-95/RML-96, ZH1770, ZH16946, ZH16445, ZH16767, ZH16598, ZH16879, ZH16875, ZH16881, VH131167, ZH1415192 and ZH141591. The performance of genotypes tested at Nepalgunj did not show full expressions because of poor site selection and poor management. However, some genotypes as ZH1761, ZH1788 ZH1655 ZH15445 ZH16467, ZH16175 and ZH16881, ZH1619 and ZH137119 were found promising and should be tested further to verify their overall performance. From multilocation testing genotypes namely ZH1615, RML-86/RML-96, ZH15405, VH112944, ZH141592, ZH15405, ZH15445, ZH138038, ZH1611, ZH111948, ZH138098, and VH121062 were found promising and should be extensively tested in large plot demonstrations. Parental seeds of these hybrids will be requested to CIMMYT/Hyderabad for their use in our national breeding program.

2.1.3 Evaluation of Chinese hybrid at NMRP, Rampur

Chinese Hybrid Trial was conducted at NMRP Rampur (May to September, 2016). The plot size was 4 rows of 5 m length. The spacing was 60 x 25 cm. The design used was randomized complete block with three replications. Two seeds per hill were planted and thinned to a single plant per hill after first weeding. Fertilizers were applied at the rate of 180:60:40 kg/ha N: P_2O_5: K_2O, respectively along with 15 t farmyard manure per hectare. Half dose of N and full doses of P and K were applied basally and remaining half of N was applied as side dressing at knee-high stage. The plots were kept free of weeds

manually. Grain yield (t/ha) at 15% moisture content was calculated using fresh ear weight.

Table 48: Performance of Chinese Hybrids at NMRP Rampur 2016 Spring (May to September)

SN	Hybrid	Silk-ing	Tassel-ing	Plant height, cm	Ear height, cm	Days to maturity	Ear di-ameter, cm	Ear length, cm	Ker-nel/ row	Grain yield, t/ ha
1	LPM-151	52	49	183	78	118	4	12	27	6.30
2	LPM-152	58	56	203	85	154	5	15	34	9.07
3	LPM-153	56	54	209	82	154	5	15	31	8.62
4	LPM-154	56	54	209	100	154	5	15	34	10.52
5	LPM-155	55	54	218	88	154	5	14	31	10.19
6	LPM-156	56	54	207	85	154	5	15	33	10.16
7	LPM-157	56	53	208	90	154	5	14	30	9.71
8	LPM-158	56	54	191	92	154	5	14	30	9.68
9	LPM-159	54	53	215	87	154	5	14	30	9.74
10	LPM-160	45	44	171	75	109	4	12	29	4.89
11	Rampur hybrid-2	55	53	215	85	154	5	14	31	9.09
12	RML-95/RML-96	54	53	217	78	154	5	12	26	9.35
13	RML-32/RML-17	44	43	169	75	108	4	13	31	5.44
14	RML-4/RML-17	57	55	231	89	154	5	14	29	9.99
15	Rampur Compos-ite	71	68	219	113	165	5	17	35	10.57
	Grand mean	56	54	207	89	147	5	14	31	8.80
	F-test	**	**	**	**	**	**	**	**	**
	CV (%)	1.2	1.1	7.2	8.3	0.1	3.7	7.2	7.7	10.9
	LSD(0.05)	1.14	0.98	24.97	12.34	0.24	0.29	1.68	3.92	1.6

This trial was analyzed on the basis of 10 traits. The result of descriptive analysis showed that the highest variation was recorded for grain yield (10.9) and ear height (8.3). Among traits, maturity days had lowest variation (0.1) followed by tasseling days (1.1) and silking days (1.2). All the traits recorded among the tested genotypes were found highly significant. The mean value of silking, tasseling, plant height, ear height, days to maturity, ear diameter, ear length, number of kernels per row and grain yield (t/ha) were 56 days, 53 days, 206.9 cm, 89.3 cm, 146.77, 4.811, 14.08, 30.65 and 8.79 respectively. Among tested Chinese hybrids silking days varied from 71 days (Rampur Composite) to 44 days (RML-32/RML-17). Tasseling days varied from 68 (Rampur Composite) to 43 (RML-32/RML-17). The maximum plant height was recorded for RML-4/RML-17 (231 cm) and Rampur Composite (219 cm) and the shortest height for RML-32/RML-17 (169 cm) followed by LPM-160 (171 cm) and LPM-151 (183 cm). Similarly, maximum ear height was observed in Rampur Composite (113 cm) and

LPM-154 (100 cm), and shortest ear height for LPM-160 (75 cm) followed by RML-32/RML-17 (75 cm) and RML-95/RML-96 (78 cm). The longest period for physiological maturity was for Rampur Composite (165 days) and shortest for LPM-160 (109 days). The longer ear diameter in LPM-151 (4.07cm) and LPM-160 (4.35) was observed. The highest ear length was found in Rampur Composite (17.2) and minimum in LPM-151 (11.55cm). Likewise, LPM-154 (33.67) had maximum kernels per row and minimum for RML-95/RML-96 (26.2). The maximum grain yield was recorded in Rampur Composite (10.57 t/ha) followed by LPM-154 (10.52 t/ha) and LPM-155 (10.19 t/ha) and lowest grain yield in LPM-160 (4.89 t/ha) followed by RML-32/RML-17 (5.44 t/ha) and LPM-151 (6.30 t/ha) (Table 48).

2.1.4 Early and Extra Early Maturing Maize

A number of field experiments (IYTE,CVTE, CFFTE, Population improvement) were conducted at NMRP, Rampur field with the objective of to identify and develop high yielding, insect pest free, early maturing and matching to cropping system (as three crops for a year) maize varieties for hills, terai and inner terai of Nepal. In IYTE, the high yielding and earlier maturity genotypes were SO3TEY/LN (5.64 t /ha), 02SADVI (4.72 t/ha) and EEYC1 (4.49 t /ha) were promising and promoted to CVTE. Similarly, in CVTE spring, the high yielding and early maturing genotypes were SO3TEY/LN (5.88 t/ha), SO3TEY-LN/PP (5.77 t/ha) and EEYC1 (4.96 t/ha) were promising and promoted to CFFTE. In CFFTE spring, the genotypes SO3TEY/LN (5.16 t/ha), Across-9942 (4.71 t/ha), and Pool 16 (4.37 t/ha) were superior over the genotypes (Table 49).

Table 49: Mean grain yield and desirable traits of early maize in IYT at NMRP Rampur, 2016/17 spring.

Genotype	50% flowering (Days)		ASI	Plant height cm	Ear height cm	GY t/ha	Husk cover (1-5)	Plant aspect (1-5)	Ear aspect (1-5)
	Male	Female							
Across-2402	58	61	4	140	50	3.63	2	2	3
SO3TEY-SEQ	53	57	4	142	58	4.13	2	2	2
Early Katamani	52	57	5	150	74	3.36	2	2	3
SO3TEY/LN	57	61	4	138	66	5.64	3	1	3
Across-2401/Across-2402	55	58	3	150	50	4.37	2	2	3
02SADVI	52	57	5	145	54	4.72	2	2	3
P15QC7SRC1	53	57	4	130	55	3.19	2	2	2
SO3TEY-PO-BM	55	60	5	122	57	3.64	3	2	3
Farmer's Variety	56	59	4	162	63	2.44	1	2	2
Pop-445/Pop-446	52	56	4	145	58	3.32	2	2	2
EEYC1	53	57	4	162	68	4.49	2	2	3

Genotype	50% flowering (Days)		ASI	Plant height cm	Ear height cm	GY t/ha	Husk cover (1-5)	Plant aspect (1-5)	Ear aspect (1-5)
	Male	Female							
ZM-621/Pool-15	53	57	4	142	58	3.96	3	2	3
Arun-4 Std check	52	56	3	170	67	3.96	2	2	3
ZM-423	54	57	3	155	68	2.78	2	2	2
RC/Pool-17	52	55	3	155	53	4.27	2	2	3
Grand Mean	54	58	4	147	60	3.86	2.16	1.778	2.55
CV%	3	3.33	18.8	6.1	12.4	14.5	33.2	25.8	18.4
F Value	0.47	0.87	0.95	0.00	0.02	0.67	0.60	0.52	0.49
$LSD_{0.05}$	7.77	12.62	6.24	7.77	7.77	4.04	1.83	0.86	1.73

Table 50: Mean grain yield and desirable traits of early maize in CVTE at NMRP Rampur, 2016/17 spring

Genotype	50% flowering (Days)		ASI	Plant height cm	Ear height cm	GY (t/ha)	Husk cover (1-5)	No of Plant/plot	No of Ear/plot
	Male	Female							
Early Katamani	53	57	4	147	66	4.53	2	36	36
Rajahar Local	52	56	4	179	91	4.26	2	34	34
S97TEYGHAYB(3)	52	56	4	149	77	4.11	2	33	32
Pop-445/Pop-446	54	57	3	150	69	4.28	1	29	29
Pool-15	52	56	4	153	87	4.91	4	34	34
R.C/Pool-17	53	56	3	162	81	4.51	3	30	30
So3TEY/LN	55	59	4	156	83	5.88	2	34	36
Arun-4(std.Chk)	52	54	2	168	84	4.18	2	29	29
Arun-6	52	57	5	138	65	3.54	2	33	33
ZM-621/Pool-15	52	56	4	146	75	4.76	2	30	30
EECY1	52	55	3	153	78	4.96	1	36	37
So3TEY-LN/PP	56	61	5	161	82	5.77	3	33	33
SO3TEY-PO-BM	53	58	4	158	78	3.58	2	29	29
Across99402	53	58	5	168	84	4.68	2	36	33
Grand Mean	52.79	56.76	3.98	156.3	78.6	4.65	2.07	32.42	32.53
CV%	2.4	2.8	24.7	6.5	12.3	14.2	68.8	4.1	4.45
F Value	0.006	0.005	0.092	0.004	0.088	<.001	0.803	0.007	0.014
LSD (0.05)	2.16	2.65	1.64	17	16.27	1103.6	2.393	4.462	4.875

Table 51: Mean grain yield and desirable traits of early maize in FFT at NMRP Rampur, 2016/17 spring

Genotype	50% flowering (Days)		ASI	Plant height cm	Ear height cm	GY (t/ha)
	Male	Female				
Across-99402	56	60	4	162	86	4.71
SO3TEY-LN	55	59	4	172	86	5.16
Pool-16	53	56	3	164	90	4.27
SO3TEY SEQ	51	54	3	154	82	3.74
Arun-6 (Std.chk)	54	57	3	154	76	4.12
Farmer's Variety	56	60	4	158	77	3.27
Grand Mean	54	58	3.5	161	83	4.21

2.1.5 Evaluation of high value maize

2.1.5.1 Evaluation of pop corn maize

A field experiment was conducted to evaluate the suitable popcorn maize genotypes for higher yield and popping during winter season of 2016/17 in National Maize Research Program, Rampur Chitwan. Fifteen Genotypes of popcorn were evaluated in RCBD design with three replications and net harvest plot area was $6m^{2.}$ The findings of the experiment revealed that highly significant differences were achived in grain yield, days to flowering(anthesis and silking), days to maturity, plant height and ear height (Table 52).

Table 52: Mean grain yield and desirable traits of Pop corn maize at NMRP Rampur, 2016/17 winter

Genotype	Days to Flowering		Height cm		Plant/ plot	Ear/ plot	GY t/ ha	Husk cover (1-5)	Plant aspect (1-5)	Ear Aspect (1-5)	Days to maturity
	Male	Female	Plant	Ear							
Popcorn lumley	91	94	181	101	34	36	3.73	2	2	2	159
Popcorn lumle w	90	92	155	78	39	27	1.63	2	3	3	157
Popcorn-1	96	98	180	98	30	29	2.51	2	2	2	166
Popcorn-2	99	100	163	74	36	33	2.99	2	2	2	159
Popcorn gorkha-3	92	93	162	88	30	31	3.40	2	2	2	159
Khumal Pop Corn	91	92	184	88	34	34	2.53	2	3	2	157
Popcorn bodo kande	86	88	181	89	35	29	1.89	2	2	2	157
popcorn bodo kande w	83	85	175	89	28	25	2.08	2	3	2	159
popcorn jumle	81	82	183	85	31	35	2.47	2	3	2	156
PC madhye pahad rato kande	80	82	168	76	31	31	2.32	2	2	2	158

Genotype	Days to Flowering		Height cm		Plant/ plot	Ear/ plot	GY t/ ha	Husk cover (1-5)	Plant aspect (1-5)	Ear Aspect (1-5)	Days to maturity
	Male	Female	Plant	Ear							
popcorn madhye pahad rato	88	89	181	88	32	37	2.89	2	2	2	159
popcorn Y+W	86	85	143	53	30	36	2.03	2	3	2	159
popcorn rampur local	92	94	172	73	32	36	3.39	2	2	2	163
popcorn mangalpur	97	99	143	74	33	34	5.27	2	2	2	163
PC Australia-1 sanodana	87	89	148	66	32	32	1.49	2	3	2	158
Grand mean	89	91	168	81	32	32	2.71	2	2	2	159
F Value	<.001	<.001	<.001	<.001	0.848	0.74	<.001	0.313	0.002	0.181	<.001
CV %	4.3	4	1.5	2.4	19.6	22.5	22.6	14.2	18.8	20.7	1.2
LSD 0.05	6.40	6.10	4.26	3.27	10.60	12.1	1.02	0.38	0.70	0.71	3.22

2.1.5.2 Evaluation of sweet corn maize

A field experiment was conducted during the winter season of 2016/17 in the National Maize Research Program Rampur Chitwan, to evaluate the suitable sweet corn genotypes for higher yield and sweetness. The treatment consists of 9 genotypes of sweet corn with 2 local checks. The experiment was conducted in the Randomized Complete Block Design with three replications. The individual plot size was 6 m^2 with the spacing of 60 × 25 cm. The findings of the experiment revealed that the genotypes showed highly significant differences in days to male flowering, days to female flowering, field weight and disease resistance. Results have been summarized in Table 53.

Table 53: Performance of sweet corn value under field condition

Genotype	Flowering days		Height, cm		Sugary Test		Husk cover (1-5)	Plant Aspect (1-5)	Ear Aspect (1-5)	Disease (E. turcicum)	GY t/ ha
	Male	Female	Plant	Ear	TSS	Organoleptic					
ID7991-Y	92	93	170	70	14	7	2	2	2	2	9.63
ID8002-Y	89	91	148	59	15	7	2	3	3	3	10.12
ID8007-Y	88	90	155	67	14	7	2	3	3	3	11.57
ID7929W	97	98	153	59	14	6	2	3	3	3	7.02
ID7147W	94	96	174	77	15	6	2	3	2	3	8.36
ID7964-Y	88	86	160	68	15	6	2	3	3	3	9.01
ID9193W	93	96	174	89	13	6	2	3	2	2	17.85
ID8010Y	88	90	147	60	16	7	2	3	2	2	7.38
ID7964W	88	89	178	74	15	5	2	2	2	3	6.82
RC	92	94	152	78	13	7	2	3	2	2	18.33

Genotype	Flowering days		Height, cm		Sugary Test		Husk cover (1-5)	Plant Aspect (1-5)	Ear Aspect (1-5)	Disease (E. turcicum)	GY t/ha
	Male	Female	Plant	Ear	TSS	Organ-oleptic					
A-4	78	80	275	69	15	7	2	3	2	3	15.46
Grand Mean	90	91	171	70	14	6	2	3	2	2	11.05
F-Value	<.001	<.001	0.383	0.004	0.889	0.522	0.104	0.814	0.005	0.001	<.001
CV%	2.7	1.9	34	11.1	16.9	16.8	13.7	27	17.5	21.8	25.6
LSD 0.05	4.11	2.92	99.4	13.26	4.16	1.80	0.39	1.29	0.65	0.90	4.82

2.1.6 Development of quality protein maize genotypes for Terai and mid hills of Nepal

Initial yield trial (IYT) was conducted at Kabre and Lumle, coordinated varietal trial (CVT) at Khumaltar, Salyan, Dailekh, Surkhet, and Pakhribas and coordinated farmers' field trial (CFFT) at Khumaltar, Doti, Rampur, Madi and Pakhribas. The individual plot was 2 rows of 5 m length for IYT, 4 rows of 3 m length for for CVT and 4 rows of 3 m length for CFFT. The spaces between row to row and plant to plant were 75 and 25 cm, respectively. The design used was randomized complete block. Two seeds per hill were planted and thinned to a single plant per hill after first weeding. Fertilizers were applied at the rate of 120:60:40 kg/ha N:P_20_5:K_20, respectively in addition to 15 t farmyard manure per hectare. Half dose of N and full doses of P and K were applied basally and remaining half of N was applied as side dressing at knee-high stage. The plots were kept free of weeds manually. Same levels of inputs and cultural practices were provided at all the locations. Grain yield (t/ha) at 15% moisture content was calculated using fresh ear weight.

Table 54: Performance of QPM genotypes in IYT at ARS Pakhribas, 2016

SN	Genotype	Days to			Height, cm		Grain yield (t/ha)
		Tasseling	Silking	Maturity	Plant	Ear	
1	RampurS13FQ01	94	99	149	183	107	2.90
2	RampurS13FQ02	90	95	149	213	99	3.40
3	RampurS13FQ04	93	99	148	194	90	3.00
4	RampurS13FQ06	93	100	152	208	106	3.60
5	Rampur S13FQ08	89	94	149	198	102	2.65
6	RampurS13FQ010	99	105	146	190	114	3.35
7	RPOPYQ-2	92	97	148	177	98	2.70
8	RPOPYQ-4	91	96	147	185	95	3.40
9	RPOPYQ-6	93	98	148	187	91	3.25
10	RPOPYQ-8	89	96	147	171	93	2.55
11	RPOPYQ-10	96	102	149	209	108	3.55

SN	Genotype	Days to			Height, cm		Grain yield (t/ha)
		Tasseling	Silking	Maturity	Plant	Ear	
12	RPOPYQ-12	94	102	152	191	84	2.50
13	RPOPYQ-14	97	104	150	192	105	2.90
14	Posilo Makai-1	94	102	147	187	97	3.10
15	Farmers' variety	87	92	147	226	128	4.35
	Grand mean	93	99	148	194	101	3.15
	F-test	*	*	ns	ns	**	ns
	CV (%)	2.9	2.9	1.6	9.7	7.1	14.4
	LSD(0.05)	5.818	6.213	-	-	15.32	-

In total, 15 genotypes were evaluated at pakhribas during 2016/17. Tasseling days, silking days, ear height were found significant among genotypes but maturity days and plant height and grain yield were found non-significant among tested entries (Table 54).

Table 55: Performance of QPM genotypes in CVT at ARS Pakhribas, 2016

SN	Genotype	Tasseling	Silking	Maturity	Plant height, cm	Ear height, cm	Grain yield, t/ha
1	S00TLWQ-B	91	97	146	183	93	2.25
2	S01SIWQ-2	96	103	149	163	79	1.85
3	CORRALJO59951	88	95	145	180	87	1.75
4	S00TLWQ-B	89	95	149	182	94	3.05
5	S99TLWQ-B	90	96	149	193	96	3.45
6	S03TLYQ-AB-01	93	99	150	199	86	3.05
7	S01SIYQ	93	99	148	201	109	3.75
8	S03TLYQ-AB-2	93	100	146	147	75	2.30
9	Posilo Makai-1	98	104	149	181	87	2.70
10	Farmers' variety	92	98	150	231	123	3.85
	Grand mean	92	98	148	186	92.7	2.80
	F-test	ns	ns	ns	ns	*	*
	CV (%)	3.8	3.6	1.4	10.1	11.2	18.5
	LSD(0.05)	-	-	-	-	23.54	1.17

The CVT of QPM consisted of10 entries during 2016/17 at Pakhribas. Mean grain yield of all tested entries were significant. The results showed that entry differed significantly for ear height and grain yield however, non-significant for tasseling, silking, maturity and plant height. Farmers' variety produced the highest grain yield (3.85 t/ha) fallowed by S01SIYQ (3.75 t/ha) and S99TLWQ-B (3.45 t/ha) (Table 55).

Table 56: Performance of QPM genotypes on CFFT at ARS Pakhribas 2016

SN	Ge notype	Tasseling	Silking	Maturity	Plant height, cm	Ear height cm	GY t/ha
1	S03TLYQ-AB-01	78	85	128	168	69	3.45
2	S01SIYQ	78	84	127	194	97	5.30
3	S99TLYQ-B	78	84	127	175	81	4.40
4	S99TLYQ-HG-AB	78	83	129	182	91	4.95
5	Poshilo Makai-1	81	87	129	174	80	5.05
6	Farmers' vaiety	79	85	129	207	113	4.00
	Grand mean	79	85	128	184	89	4.53
	F-test	ns	ns	ns	*	**	**
	CV (%)	2.6	1.9	2.4	8.7	11.7	10.6
	LSD(0.05)	3.694	2.851	5.647	29.02	18.93	0.87

This experiment included six entries. Grain yield, ear height and plant height differed significantly where as, tasseling; silking and maturity were found non-significant among tested entries. Genotype S01SIYQ produced the highest grain yield (5.30 t/ha) followed by Poshilo Makai-1 (5.05 t/ha) and S99TLYQ-HG-AB (4.95 t/ha), respectively (Table 56).

Table 57: Performance of QPM genotypes in CVT at ARS Dailekh, 2016

SN	Genotype	Tasseling	Silking	Plant height, cm	Ear height, cm	Grain yield, t/ha
1	S00TLWQ-B	70	72	243	133	7.71
2	S01SIWQ-2	71	73	222	105	7.50
3	CORRALJO59951	65	67	230	128	7.93
4	S00TLWQ-B	69	71	246	136	7.17
5	S99TLWQ-B	69	71	246	127	7.91
6	S03TLYQ-AB-01	71	73	241	112	8.56
7	S01SIYQ	70	72	247	140	8.38
8	S03TLYQ-AB-2	69	71	233	120	8.64
9	Posilo Makai-1	72	74	245	117	8.28
10	Farmers' variety	62	64	253	132	8.15
	Grand mean	69	71	240	125	8.02
	F-test	**	**	ns	ns	ns
	CV (%)	2.1	2.1	4.4	9.4	5.1
	LSD(0.05)	3.30	3.30	23.8	26.59	0.93

Total 10 entries were tested in CVT during 2017 at Dailekh. The result of this experiment showed that genotype S03TLYQ-AB-2 produced the highest grain yield (8.64 t/ha), followed by S03TLYQ-AB-01 (8.56 t/ha) and S01SIYQ (8.38

t/ha). Tasseling and silking were found significant among the tested entries but plant height and grain yield were found non-significant (Table 57).

Table 58: Performance of QPM genotypes on CFFT at ARS Dailekh, 2016

SN	Genotype	Tasseling	Silking	Plant height, cm	Ear height, cm	Grain yield, (t/ha)
1	S03TLYQ-AB-01	58	60	264	154	6.59
2	S01SIYQ	66	68	258	151	6.95
3	S99TLYQ-B	65	67	254	154	7.56
4	S99TLYQ-HG-AB	67	69	273	153	8.29
5	Poshilo Makai-1	65	67	299	163	7.33
6	Farmers' vaiety	63	65	261	153	6.52
	Grand mean	64	66	268	155	7.21
	F-test	**	**	ns	ns	ns
	CV (%)	0.5	0.6	9.4	38.03	15.4
	LSD(0.05)	0.74	0.94	64.79	9.6	2.85

The analysis of variance showed that grain yield, plant height and ear height were recorded non-significant but tasseling and silking exhibited significant value. The S99TLYQ-HG-AB produced the highest grain yield (8.29 t/ha) fallowed by S99TLYQ-B (7.56 t/ha) and Poshilo Makai-1 (7.3 t/ha).From tasseling and silking point of view S03TLYQ-AB-01 recorded as earliest (Table 58).

Table 59: Performance of QPM genotypes on CFFT at HCRP Dolakha, 2016

SN	Genotype	Plant height, cm	Ear height, cm	Grain yield, t/ha
1	S03TLYQ-AB-01	198	89	3.00
2	S01SIYQ	224	117	5.47
3	S99TLYQ-B	200	95	5.05
4	S99TLYQ-HG-AB	229	126	5.01
5	Poshilo Makai-1	240	123	5.11
6	Farmers Vaiety	265	168	4.91
	Grand mean	226	120	4.75
	F-test	ns	ns	ns
	CV (%)	11.4	17	25.4

The experiment consisted of six entries and was evaluated at Dolakha. Non-significant differences were observed for mean grain yield and rest of the traits under observations (Table 59).

Table 60: Performance of QPM genotypes in CVT at ARS Surkhet, 2016

SN	Genotype	Tasseling	Silking	Plant height, cm	Ear height, cm	Grain yield, t/ha
1	S00TLWQ-B	62	65	169	74	3.46
2	S01SIWQ-2	58	62	173	64	2.44
3	CORRALJO59951	60	63	182	68	2.66
4	S00TLWQ-B	62	65	151	62	2.27
5	S99TLWQ-B	63	66	142	58	3.47
6	S03TLYQ-AB-01	63	66	166	67	3.48
7	S01SIYQ	63	67	185	86	4.12
8	S03TLYQ-AB-2	62	65	177	72	3.36
9	Poshilo Makai-1	61	64	179	80	3.88
10	Farmers' Variety	55	58	197	103	4.27
	Grand mean	61	64	172	73	3.34
	F-test	ns	ns	*	**	*
	CV (%)	5.6	4.9	7	10.3	18.7
	LSD(0.05)	-	-	27.1	16.97	1.41

Under this activity, 10 maize entries were tested during 2017 at surkhet. The ANOVA of tested entries showed that grain yield, plant height and ear height were significant, where as tasseling and silking showed non-significant results (Table 60). Farmers' Variety gave the highest grain yield (4.33 t/ha), followed by S01SIYQ (4.12 t/ha) and Poshilo Makai-1 (3.88 t/ha).

Table 61: Performance of QPM genotypes in CVT at ABD Khumaltar, 2016

SN	Genotype	Days to flowering		Height, cm		Disease score (1-5)			Grain yield, t/ha
		Male	Female	Plant	Ear	GLS	NLB	BLSB	
1	SOOTLWQ-B	63	66	182	83	1	3	2	3.67
2	S01SIWQ -2	65	67	163	68	1	3	2	0.78
3	CORRALJOS99SIWQ	63	65	144	61	1	3	2	1.01
4	SOOTLYQ-B	64	66	188	90	1	2	2	3.47
5	S99TLWQ-B	65	68	171	73	1	2	2	1.94
6	SO3TLYQ-AB-01	66	68	183	77	1	3	2	3.57
7	S01SIYQ	64	66	185	83	1	3	2	2.25
8	SO3TLYQ-AB-2	67	69	160	57	1	3	2	1.15
9	Poshilo Makai-1	66	68	154	67	1	3	2	1.08
10	Khumal Yellow	64	66	188	91	1	2	2	2.69
	Grand mean	65	67	172	75	1	3	2	2.16
	F-test	**	**	ns	ns	ns	ns	ns	ns
	CV (%)	0.9	0.78	10.7	15.41	0	22.5	7.33	64.77
	LSD(0.05)	1.32	1.18	-	-	-	-	-	-

Table 61 showed that S00TLWQ-B produced the highest grain yield (3.67 t/ha) followed by S03TLYQ-AB-01 (3.57 t/ha) and S00TLYQ-B (3.47 t/ha). All traits were recorded non significant except flowering.

Table 62: Performance of QPM genotypes in CFFT at ABD Khumaltar, 2016

SN	Genotype	Days to flowering		Height, cm		Number/ha		Score(1-5)			Diseases (1-5)			Grain yield, t/ha
		Male	Female	Plant	Ear	Plant	Ear	PA	EA	HC	GLS	NLB	BLSB	
1	SO3TLYQ-AB-01	66	68	191	78	16	17	5	4	1	1	4	3	1.09
2	SO1SIYQ	64	66	191	84	36	40	5	3	1	1	3	3	3.05
3	S99TLYQ-B	66	68	189	75	29	31	3	3	1	1	3	2	2.75
4	S99TLYQ-HG-AB	63	65	203	100	30	30	4	3	1	2	4	3	2.63
5	Poshilo Makai-1	64	66	189	88	23	25	4	3	2	1	2	2	4.56
6	Khumal Yellow	62	64	198	87	23	29	4	3	1	1	3	2	4.56
	Grand Mean	64	66	194	85	26	29	4	3	1	1	3	2	3.11

Table 62 showed that the highest grain yield (4.562 t/ha) was produced by Khumal Yellow followed by Poshilo Makai-1 (4.56 t/ha) and SO1SIYQ (3.05 t/ha).

2.1.6.1 Maintenance and seed increase of QPM genotypes

Maintenance

To maintain the highest level of genetic and physical purity, QPM genotypes were planted in small plots so that they can be managed easily. The size of plot was 8 rows of 10 m length and spacing was 75 cm x 25 cm. In total, 39 QPM genotypes were maintained during 2016 winter through controlled bulk pollination method.

Table 63: List of QPM genotypes maintained along with their seed quantity (kg) at NMRP Rampur during 2016 winter season

SN	Genotype	Quantity of seed produced, kg	SN	Genotype	Quantity of seed produced, kg
1	S03TLYQ-AB-01	3.36	21	S00TLYQ-B	5.56
2	S03TLYQ-AB-02	1.21	22	S99TLWQ-B	5.24
3	S99TLYQ-B	2.68	23	S99TLYQ-A	3.98
4	S99TLYQ-HG-AB	3.85	24	CORRALJOS002SIYQ	4.36
5	S01SIYQ	3.77	25	CORRALJO99SIWQ	2.5
6	Poshilo Makai-1	6.98	26	S00TLWQ-B	5.3
7	Rampur S13FQ-08	6.98	27	S00TLYQ-AB	5.51
8	Rampur S13FQ-06	7.30	28	S03SIWQ	5.3
9	Rampur S13FQ-02	5.54	29	S00TLYQ-A	4.78

SN	Genotype	Quantity of seed produced, kg	SN	Genotype	Quantity of seed produced, kg
10	Rampur S13FQ-10	6.84	30	OBTANPA(W)	4.0
11	Rampur S13FQ-04	5.26	31	OBATANPA	4.9
12	Rampur S13FQ-01	1.82	32	S03TLWQ-05	3.07
13	R-POPYQ-08	8.28	33	S03TLYQ-AB-05	1.01
14	R-POPYQ-06	6.57	34	S02G29TQ	2.08
15	R-POPYQ-12	6.71	35	RC/S03TLYQ-AB-05	1.72
16	R-POPYQ-10	5.01	36	Mana-3/S03TLWQ-05	1.43
17	R-POPYQ-02	6.33	37	S99TLYQ HG-B(CIMMYT)	2.55
18	R-POPYQ-04	5.76	38	S06TLWQ HGAB-02	6.18
19	R-POPYQ-14	6.42	39	S07TLWQ AB	6.50
20	S01SIWQ-02	3.43			

2.1.7 Development of Open Pollinated Full Season Maize Varieties for Nepal

Objective

To identify high yielding open pollinated full season white and yellow maize varieties for Nepal

Materials and methods

A series of trials such as IYT, CVT and CFFT were carried out at Pakhribas, Kabre, Khumaltar, Lumle, Salyan and Dailekh for hill set and Surkhet, Doti, and Rampur for the terai set during summer season of 2016 A.D. to find the performance of open pollinated maize varieties,. Randomized Complete Block Design with 3 replication was used for each trial. In IYT, there were two rows per plot. In CVT, there were four rows per plot. In CFFT, there were six rows per plot. Length of rows was three meter. The row to row and plant to plant distances were 75 cm and 25 cm respectively. Other agronomic practices were conducted according to the recommended packages.

Achievements

2.1.7.1 IYT Full Season Hill Set

IYT Full season hill set at ARS, Dailekh

The analysis of the 14 genotypes evaluated at ARS, Dailekh during summer, 2016 showed that the genotype Rampur S10F18 produced the highest yield (8.51 t/ha) followed by ZM627 (8.37 t/ha) and HGA/HG-AB (7.70 t/ha) respectively (Table 64).

Table 64: Initial Yield Trial (IYT) of full season maize genotypes at Agricultural Research Station, Dailekh in 2016.

Genotypes	DTT	DTS	PH	EH	PN	EN	YLD
BLBSRS07F10	61	63	219	115	42222	14400	6.48
BLSBRS07F12	63	65	219	117	48889	15269	6.87
Farmers' Local	61	63	241	140	53333	16889	7.60
HGA/HG-AB	65	67	221	120	51111	17118	7.70
KLYPOP	65	67	261	166	46667	15004	6.75
MANAKAMANA-3	73	75	238	133	46667	16620	7.48
RAMPUR S03F08	69	71	235	135	48889	14071	6.33
RAMPUR S10F18	64	66	225	126	42222	18931	8.52
RAMPUR S10F20	63	65	222	112	42222	15811	7.12
RAMPUR S13F01	65	67	234	127	44444	16253	7.31
RAMPUR S13F28	71	73	242	140	40000	15547	7.00
RAMPUR S13F30	62	64	226	126	51111	15671	7.05
R-POP-2	63	65	228	132	48889	12120	5.45
ZM627	68	70	222	119	53333	18591	8.37
Grand Mean	65	67	231	129	46667	15878	7.15
F-test	***	***	ns	*	ns	ns	*
LSD	2.5	2.6	-	23.8	-	-	1.4683
CV	2.3	2.4	6.2	11	13.4	19.2	12.2

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha

IYT Full season hill set at HCRP, Kabre

Among the 14 genotypes evaluated at HCRP, Kabre during summer, 2016, the genotype RAMPUR S13F28 produced the highest yield (9.63 t/ha) followed by Manakamana-3 (7.89 t/ha) and RAMPUR S13F01 (7.37 t/ha) respectively (Table 65).

Table 65: Initial Yield Trial (IYT) of full season maize genotypes at HCRP, Kabre in 2016.

Genotypes	DTT	DTS	PH	EH	EN	PN	YLD	HC	PA	EA
BLBSRS07F10	63	74	227	136	51111	53333	6.49	2	3	2
BLSBRS07F12	71	75	226	127	55556	53333	6.97	1	2	3
Farmers' Local	73	76	283	197	51111	51111	6.46	1	3	2
HGA/HG-AB	68	72	214	128	51111	48889	6.19	2	2	3
KLYPOP	70	75	270	154	53333	51111	6.68	2	3	3
MANAKAMANA-3	76	81	279	150	46667	51111	7.89	1	2	2
RAMPUR S03F08	74	79	250	142	53333	53333	6.81	1	2	3
RAMPUR S10F18	70	74	224	118	51111	53333	6.97	2	2	2
RAMPUR S10F20	72	74	223	116	51111	44444	5.76	3	3	3
RAMPUR S13F01	70	74	247	111	55556	53333	7.38	2	2	2

Genotypes	DTT	DTS	PH	EH	EN	PN	YLD	HC	PA	EA
RAMPUR S13F28	73	80	260	149	64444	60000	9.63	2	2	3
RAMPUR S13F30	70	74	243	126	51111	48889	4.05	1	3	4
R-POP-2	70	73	242	138	55556	51111	6.81	1	3	3
ZM627	71	75	236	125	51111	51111	6.34	2	2	3
Grand Mean	71	75	245	137	53333	53333	6.75	2	3	3
F-test	*	***	*	**	ns	ns	**	**	ns	ns
LSD	5.77	2.3	37.03	35.5	-	-	2.021	0.8	-	-
CV (%)	4.9	1.8	9	15.5	9.0	8.5	17.9	31.7	22.6	21.5

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, PA = Plant Aspect, EA = Ear Aspect and HC = Husk Cover.

IYT Full season hill set at ABD, Khumaltar

In total 14 genotypes were evaluated at Khumaltar during summer season of 2016, the genotypes RAMPUR S13F28 produced the highest grain yield (5.75 t/ha) followed by RAMPUR S03F08 (5.10 t/ha) and Manakamana-3 (4.80 t/ha) (Table 66).

Table 66: Initial Yield Trial (IYT) of full season maize genotypes at Agri-botany Division, Khumaltar in 2016.

Genotypes	YLD	DTT	DTS	PH	EH	PN	EN	PA	EA	HC	GLS	NLB	BLSB	RE
BLBSRS07F10	4.178	61	63	172	85	37778	37778	2	3	1	1	3	1	2
BLSBRS07F12	3.065	63	65	163	73	35556	40000	3	3	1	2	3	1	3
FARMERS' LOCAL	2.477	62	64	193	90	28889	33333	2	3	1	1	2	2	2
HGA/HG-AB	3.542	62	64	181	84	37778	40000	2	3	1	1	2	1	4
KLYPOP	3.67	64	66	215	101	33333	40000	3	3	2	1	3	2	2
MANAKAMANA-3	4.8	65	67	209	95	35556	40000	2	2	1	1	2	1	3
RAMPUR S03F08	5.107	64	66	192	84	44444	46667	2	2	1	1	3	1	1
RAMPUR S10F18	3.113	63	65	167	71	31111	33333	2	3	1	1	3	1	4
RAMPUR S10F20	4.124	62	64	171	71	40000	44444	2	3	2	1	3	1	3
RAMPUR S13F01	2.546	62	64	180	71	26667	28889	2	3	1	1	3	1	3
RAMPUR S13F28	5.752	67	69	185	86	40000	44444	2	3	1	1	3	1	2
RAMPUR S13F30	1.573	63	65	155	64	24444	31111	3	4	1	1	3	1	2
R-POP-2	3.467	60	62	175	86	37778	40000	2	3	1	1	3	1	4
ZM627	3.151	67	68	177	69	31111	33333	2	3	1	1	2	1	4
Grand Mean	3.612	63.1	65.1	181	80.5	34222	38000	2.2	2.9	1.1	1.1	2.4	1.3	2.71
F-test	***	***	***	***	***	***	**	ns	ns	***	ns	**	ns	*
LSD	0.5942	2.15	2.15	12	7.5	7111	8000	-	-	0.19	-	0.6	-	1.7
CV (%)	9.8	2	2	4	5.6	12.5	12.8	21.7	19.8	10.1	18.3	15.1	11.8	37.5

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, PA = Plant Aspect, EA = Ear Aspect, HC = Husk Cover, GLS = Grey Leaf Spot, NLB = Northern Leaf Blight, BLSB = Banded Leaf and Sheath Blight, RE = Rotten Ear.

IYT Full season hill set at RARS, Lumle

The analysis of the 14 genotypes evaluated at RARS, Lumle during summer, 2016 showed that the genotype RAMPUR S03F08 produced the highest yield (5.80 t/ha) followed by Farmer's Local (5.68 t/ha) and ZM627 (5.66 t/ha) respectively (Table 67).

Table 67: Initial Yield Trial (IYT) of full season maize genotypes at RARS, Lumle in 2016.

Genotypes	DTT	DTS	DTM	EH	PH	PN	EN	YLD
BLBSRS07F10	71	76	126	82	184	51111	46667	4.73
BLSBRS07F12	73	74	125	91	187	51111	46667	5.09
FARMERS' LOCAL	70	72	126	95	207	53333	51111	5.68
HGA/HG-AB	73	77	130	88	186	53333	51111	4.76
KLYPOP	73	76	127	102	187	53333	48889	4.62
MANAKAMANA-3	77	79	137	112	218	48889	44444	5.42
RAMPUR S03F08	74	76	138	97	206	53333	53333	5.81
RAMPUR S10F18	73	76	132	78	173	53333	53333	5.28
RAMPUR S10F20	72	74	128	79	176	51111	46667	4.49
RAMPUR S13F01	73	77	134	83	191	53333	48889	4.53
RAMPUR S13F28	75	79	132	101	207	51111	46667	4.08
RAMPUR S13F30	72	74	121	96	185	53333	42222	2.66
R-POP-2	72	75	121	93	185	51111	40000	3.37
ZM627	75	78	137	89	196	53333	51111	5.67
Grand Mean	73	76	130	92	192	53333	48889	4.73
F-test	**	*	***	*	ns	ns	*	***
LSD	2.8	3.6	6.3	17.48	-	-	6444.438	1.05
CV (%)	2.3	2.9	2.9	11.3	11	4.5	8.2	13.2

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, DTM = Days to maturity, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha

IYT Full season hill set at ARS, Pakhribas

Statistical analysis of 14 genotypes evaluated at ARS, Pakhribas during summer 2016 showed that the genotype RAMPUR S03F08 produced the highest yield (6.05 t/ha), followed by Manakamana-3 (5.55 t/ha) and RAMPUR S13F28 (5.14 t/ha) respectively (Table 68).

Table 68: Initial Yield Trial (IYT) of full season maize genotypes at ARS, Pakhribas in 2016.

Genotypes	DTT	DTS	TLB	GLS	HC	PA	EA	PH	EH	PN	EN	RE	DTM	YLD
BLBSRS07F10	63	67	3	2	1	2	3	196	100	46667	46667	6	115	3.54
BLSBRS07F12	65	70	3	3	1	3	3	193	97	46667	42222	3	118	3.78
Farmers' Local	67	70	2	2	1	3	3	261	145	48889	44444	2	118	5.00
HGA/HG-AB	63	67	3	3	1	2	2	204	109	46667	44444	4	115	4.04
KLYPOP	65	70	3	2	2	3	3	235	125	51111	46667	5	118	3.80
MANAKAMANA-3	69	72	2	2	1	3	2	242	121	48889	44444	1	119	5.55
RAMPUR S03F08	66	70	2	2	1	3	2	219	113	48889	51111	5	118	6.06
RAMPUR S10F18	63	67	3	2	1	3	3	197	107	42222	40000	4	115	3.74
RAMPUR S10F20	61	65	2	2	2	3	3	209	113	48889	48889	7	113	4.07
RAMPUR S13F01	63	67	3	2	1	2	3	211	105	51111	44444	2	115	3.95
RAMPUR S13F28	68	73	3	2	2	2	3	231	128	51111	51111	5	120	5.14
RAMPUR S13F30	63	66	4	3	1	3	3	204	111	46667	46667	4	115	3.12
R-POP-2	62	65	3	2	1	3	3	205	117	51111	48889	6	113	3.51
ZM627	67	70	2	2	2	2	3	194	90	51111	48889	3	118	4.08
Grand Mean	65	69	3	2	1	3	3	214	113	48889	46667	4	117	3.54
F-test	***	***	**	ns	***	ns	ns	***	***	ns	ns	**	***	***
LSD	2	2.1	0.79	-	0.58	-	-	22.2	16.6	-	-	2.5	2.3	1.21
CV (%)	1.9	1.9	18.2	15.2	25.8	23	20	6.2	8.8	7.6	8.6	37	1.2	17

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, PA = Plant Aspect, EA = Ear Aspect, HC = Husk Cover, GLS = Grey Leaf Spot, NLB = Northern Leaf Blight, and RE = Rotten Ear.

IYT Full season hill set combined analysis

The combined analysis of IYT full season hill set across Pakhribas, Khumaltar, Lumle, Kabre and Dailekh showed that RAMPUR S13F28 produced the highest yield (6.32 t/ha) followed by Manakamana-3 (6.22 t/ha) and RAMPUR S03F08 (6.02 t/ha) respectively (Table 69). Genotypes were very highly significant for grain yield, days to tasseling, days to silking, plant height, ear height, and significant for number of ear per plot, but non significant for plant number per plot. Locations were very highly significant for grain yield, days to tasseling, days to silking, plant height, ear height, plant number per plot and number of ears per plot. Interactions were very highly significant for grain yield, days to silking, plant number per plot and highly significant for days to tasseling, and significant for ear height, number of ears per plot but non-significant for plant height.

Table 69: Combined analysis of grain yield (t/ha) of Initial Yield Trial (IYT) of full season maize genotypes conducted at different NARC stations in 2016

Genotypes	Locations					Average
	Dailekh	Kabre	Khumaltar	Lumle	Pakhribas	
BLBSRS07F10	6.48	6.49	4.18	4.73	3.53	5.08
BLSBRS07F12	6.87	6.97	3.06	5.09	3.77	5.15
Farmers' Local	7.60	6.46	2.48	5.68	5.00	5.44
HGA/HG-AB	7.70	6.19	3.54	4.76	4.04	5.25
KLYPOP	6.75	6.68	3.67	4.61	3.80	5.10
MANAKAMANA-3	7.48	7.89	4.80	5.42	5.55	6.23
RAMPUR S03F08	6.33	6.81	5.11	5.80	6.06	6.02
RAMPUR S10F18	8.52	6.97	3.11	5.28	3.74	5.52
RAMPUR S10F20	7.11	5.76	4.12	4.49	4.07	5.11
RAMPUR S13F01	7.31	7.37	2.55	4.53	3.96	5.14
RAMPUR S13F28	7.00	9.63	5.75	4.08	5.14	6.32
RAMPUR S13F30	7.05	4.05	1.57	2.66	3.11	3.69
R-POP-2	5.45	6.81	3.47	3.37	3.51	4.52
ZM627	8.37	6.34	3.15	5.67	4.08	5.52
Genotype	(F-test = ***, LSD = 0.585)					
Location	(F-test = ***, LSD = 0.350)					
Genotype × Location	(F-test = ***, LSD = 1.309)					
CV (%)	15.3					

2.1.7.2 CVT Full Season Hill Set

CVT Full season hill set at ARS, Dailekh

Ten genotypes were evaluated at ARS, Dailekh under CVT. ZM401 produced the highest yield (7.19 t/ha) followed by KSYNF10 (6.06 t/ha) and farmer's local (6.01 t/ha) respectively (Table 70).

Table 70: Coordinated Varietal Trial (CVT) of full season maize genotypes at Agricultural Research Station, Dailekh in 2016.

Genotypes	DTT	DTS	PH	EH	PN	EN	YLD
05SADVI	69	71	248	161	50667	40000	5.67
FARMER'S LOCAL	60	62	251	172	46667	44000	6.01
KSYN10	65	67	245	164	36000	36000	5.47
KSYNF10	69	71	224	146	49333	40000	6.06
MANAKAMANA-3	69	71	255	178	48000	36000	5.66
P501SRCO/P502SRCO	71	73	233	142	42667	36000	4.63
RAMPUR S03F04	69	71	219	146	44000	38667	5.12

Genotypes	DTT	DTS	PH	EH	PN	EN	YLD
RAMPUR S03F06	68	70	245	151	49333	33333	5.70
RAMPUR S10F22	63	65	241	156	52000	45333	6.00
ZM401	66	68	229	139	48000	48000	7.20
Grand Mean	67	69	239	156	46667	40000	5.75
F-test	***	***	**	ns	ns	ns	*
LSD	2.35	2.35	17.38	-	-	-	1.07
CV %	2.1	2	4.2	9.8	11.6	15.3	10.9

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha

CVT Full season hill set at HCRP, Kabre

The analysis of 10 genotypes evaluated at HCRP, Kabre during summer 2016 showed that the 05SADVI produced the highest grain yield (6.45 t/ha) followed by Manakamana-3 (4.82 t/ha) and KSYNF10 (6.17 t/ha) (Table 71).

Table 71: Coordinated Varietal Trial (CVT) of full season maize genotypes at HCRP, Kabre in 2016.

Genotypes	DTT	DTS	PH	EH	EA	PA	EN	PN	YLD
05SADVI	75	80	229	128	2	2	52222	50000	6.45
FARMER'S LOCAL	54	79	290	179	2	3	52222	44444	5.31
KSYN10	74	78	218	117	2	3	53333	50000	5.13
KSYNF10	68	72	201	118	2	2	52222	51111	6.17
MANAKAMANA-3	77	82	271	152	3	2	52222	50000	6.28
P501SRCO/P502SRCO	68	73	211	106	3	3	48889	42222	4.61
RAMPUR S03F04	74	78	195	107	3	3	53333	51111	5.74
RAMPUR S03F06	70	73	211	118	3	3	51111	48889	5.00
RAMPUR S10F22	67	71	228	126	3	3	52222	48889	4.74
ZM401	69	72	213	115	4	3	52222	48889	5.01
Grand mean	70	76	227	127	3	3	52222	48889	5.44
F-test	ns	*	***	***	ns	ns	ns	**	*
LSD	-	6	32.4	17.4	-	-	-	4	1.05
CV (%)	15.3	4.7	8.3	8	24.6	16.4	4	5.4	11.30

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, PA = Plant Aspect and EA = Ear Aspect

CVT Full season hill set at ADB, Khumaltar

Evaluation of 10 genotypes at ADB, Khumaltar showed highest yield by ZM401 (3.82 t/ha) followed by Rampur 05SADVI (3.67 t/ha) and KSYN10 (3.46 t/ha) respectively (Table 72).

Table 72: Coordinated Varietal Trial (CVT) of full season maize genotypes at Agri-botany Division, Khumaltar in 2016.

Genotypes	YLD	DTT	DTS	PH	EH	PN	EN	PA	EA	HC	NLB	BLSB	INS
05SADVI	3.67	63	65	204	92	42222	46667	3	3	1	2	2	2
FARMER'S LOCAL	2.93	59	61	217	110	44444	46667	3	3	1	2	2	2
KSYN10	3.46	63	65	204	101	37778	42222	2	3	1	2	2	1
KSYNF10	3.25	61	63	180	84	46667	51111	3	3	1	2	1	1
MANAKAMANA-3	2.93	65	67	226	104	33333	37778	3	3	1	2	2	2
P501SRCO/P502SRCO	2.01	62	64	174	67	26667	28889	4	4	1	3	2	2
RAMPUR S03F04	2.44	63	65	189	84	33333	35556	3	3	1	3	2	2
RAMPUR S03F06	2.54	61	63	211	106	31111	33333	2	3	1	3	2	2
RAMPUR S10F22	1.78	60	62	196	89	28889	28889	3	3	1	3	2	2
ZM401	3.82	60	62	199	84	44444	46667	3	3	1	2	2	2
Grand Mean	2.88	62	64	200	92	35556	40000	3	3	1	2	2	2
F-test	ns	***	***	*	*	*	ns	*	ns	ns	**	ns	ns
LSD	-	1.9	1.8	27.1	23.8	12444	-	0.6	-	-	0.57	-	-
CV	30.5	1.9	1.7	7.9	15.1	20.1	23.1	13.6	15.8	17.1	14.1	19.7	21.6

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, PA = Plant Aspect, EA = Ear Aspect, HC = Husk Cover, GLS = Grey Leaf Spot, NLB = Northern Leaf Blight, BLSB = Banded Leaf and Sheath Blight, INS = Insect damage score.

CVT Full season hill set at RARS, Lumle

Among 10 genotypes under the CVT, at RARS, Lumle, 05SADVI produced the highest yield (3571 t/ha) followed by KSYNF10 (3571 t/ha) and RAMPUR S10F22 (3206 t/ha) respectively (Table 73).

Table 73: Coordinated Varietal Trial (CVT) of full season maize genotypes at RARS, Lumle in 2016.

Genotypes	DTT	DTS	DTM	HC	YLD	PH	EH	EN	PN
05SADVI	75	80	141	7	3.57	201	97	48889	53333
FARMER'S LOCAL	72	74	126	1	3.33	227	108	44444	51111
KSYN10	74	79	133	6	3.43	214	97	46667	51111
KSYNF10	73	76	136	5	3.57	191	89	51111	51111
MANAKAMANA-3	77	80	139	2	3.26	239	114	48889	53333

Genotypes	DTT	DTS	DTM	HC	YLD	PH	EH	EN	PN
P501SRCO/P502SRCO	75	78	135	4	2.48	200	86	40000	51111
RAMPUR S03F04	76	80	135	2	3.23	184	86	55556	53333
RAMPUR S03F06	73	76	132	3	2.80	200	77	40000	51111
RAMPUR S10F22	73	75	131	2	3.21	208	102	51111	53333
ZM401	73	78	135	3	3.07	200	78	48889	51111
Grand Mean	74	77	134	3	3.20	206	93	48889	51111
F-test	*	*	***	*	ns	*	ns	ns	ns
LSD	2.4	3.8	4.1	3.3	-	25.8	-	-	-
CV	1.9	2.9	1.8	57.2	20.5	7.3	15.3	12.8	3.9

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, DTM = Days to maturity, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, HC = Husk Cover

CVT Full season hill set at ARS, Parkhribas

Ten genotypes were evaluated under CVT at ARS, Parkhribas during summer 2016. Manakamana-3 produced the highest yield (5.96 t/ha) followed by 05SADVI (5.56 t/ha) and ZM401 (5.28 t/ha) (Table 74).

Table 74: Coordinated Varietal Trial (CVT) of full season maize genotypes at ARS, Pakhribas in 2016.

Genotypes	DTT	DTS	TLB	GLS	HC	PA	EA	PH	EH	PN	EN	RE	DTM	YLD
05SADVI	67	71	2	2	2	2	2	234	113	51111	46667	4	119	5.56
FARMER'S LOCAL	66	71	3	3	1	3	3	252	136	50000	47778	4	119	4.92
KSYN10	66	71	3	2	2	2	3	203	103	51111	48889	16	119	4.95
KSYNF10	65	69	3	3	1	2	3	193	92	48889	47778	9	117	4.49
MANAKAMANA-3	67	71	3	3	2	3	3	260	140	51111	48889	4	118	5.96
P501SRCO/P502SRCO	66	70	3	3	2	3	3	201	88	50000	46667	10	118	4.41
RAMPUR S03F04	65	69	3	3	1	2	2	201	101	51111	52222	6	117	5.27
RAMPUR S03F06	65	69	3	3	1	2	3	217	111	52222	41111	7	117	3.95
RAMPUR S10F22	62	68	3	3	1	2	3	217	107	48889	42222	8	116	3.64
ZM401	62	68	2	2	1	2	2	207	97	52222	51111	7	116	5.29
Grand Mean	65	70	3	3	1	2	3	219	109	51111	47778	8	118	4.84
F-test	**	*	ns	ns	*	ns	ns	***	***	ns	*	***	ns	*
LSD	2.4	2	-	-	0.8	-	-	18.3	12.8	-	5.3	3.5	-	1.287
CV (%)	2.2	1.7	14.3	18	36.2	23.8	24.3	4.9	6.9	3.1	7.3	27.8	1	15.5

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, PA = Plant Aspect, EA = Ear Aspect, HC = Husk Cover, GLS = Grey Leaf Spot, TLB = Turcicum Leaf Blight, and RE = Rotten Ear.

CVT Full season hill set at GRP, Salyan

Under CVT, 10 genotypes were evaluated at GRP, Salyan. 05SADVI produced the highest yield (6.44 t/ha) followed by RAMPUR S03 S04 (6.09 t/ha) and KSYN10 (5.24 t/ha) (Table 75).

Table 75: Coordinated Varietal Trial (CVT) of full season maize genotypes at GRP, Salyan in 2016

Genotypes	DTT	DTS	PH	EH	PN	EN	YLD
05SADVI	83	85	181	90	53333	55556	6.44
FARMER'S LOCAL	78	80	197	111	52222	53333	5.23
KSYN10	82	84	182	95	43333	44444	5.25
KSYNF10	79	81	165	83	46667	46667	5.01
MANAKAMANA 3	83	85	206	106	43333	47778	5.17
P501SRCO/P502SRCO	80	82	169	76	24444	24444	2.16
RAMPUR S03F04	81	83	171	88	50000	56667	5.40
RAMPUR S03F06	80	82	180	96	44444	44444	4.19
RAMPUR S10F22	80	82	183	99	42222	41111	4.42
ZM-401	79	81	182	89	42222	45556	4.87
Grand Mean	81	83	182	93	44444	45556	4.81
F-test	ns	*	*	**	*	**	***
LSD	-	2.9	16.9	14.8	13144	11889	1.36
CV (%)	2.3	2.1	5.4	9.2	17.3	15.1	16.5

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha

CVT Full season hill set combined analysis

Combined analysis of CVT full season hill set showed that 05SADVI produced the highest yield (5.22 t/ha) followed by Manakamana-3 (4.87 t/ha) and ZM401 (4.87 t/ha) respectively (Table 76). Genotype was very highly significant for grain yield, days to tasseling, days to silking, plant height, ear height and number of plants per plot. Location was very highly significant for grain yield, days to tasseling, days to silking, plant height, ear height, number of plants per plot and ear number per plot. Interaction was very highly significant for days to silking, number of plants per plot and ear number per plot. Interaction was non-significant for grain yield, days to tasseling, plant height, and ear height.

Table 76: Combined analysis of grain yield (t/ha) of Coordinated Varietal Trial (CVT) of full season maize genotypes conducted at different NARC stations in 2016

Genotypes	Locations						Average
	Dailekh	Kabre	Khumaltar	Lumle	Pakhribas	Salyan	
05SADVI	5.67	6.45	3.66	3.57	5.55	6.44	5.22
FARMER'S LOCAL	6.00	5.30	2.92	3.32	4.91	5.23	4.61
KSYN10	5.46	5.12	3.46	3.42	4.94	5.24	4.61
KSYNF10	6.06	6.17	3.25	3.57	4.48	5.00	4.76
MANAKAMANA-3	5.65	6.28	2.92	3.26	5.96	5.16	4.87
P501SRCO/P502SRCO	4.62	4.60	2.01	2.47	4.40	2.16	3.38
RAMPUR S03F04	5.11	5.73	2.43	3.23	5.27	5.40	4.53
RAMPUR S03F06	5.69	5.00	2.54	2.80	3.94	4.19	4.03
RAMPUR S10F22	5.99	4.73	1.77	3.20	3.63	4.42	3.96
ZM401	7.19	5.00	3.81	3.06	5.28	4.86	4.87
Genotype	(F-test = ***, LSD = 0.274)						
Location	(F-test = ***, LSD = 0.212)						
Genotype × Location	(F-test = ns)						
CV (%)	18.4						

2.1.7.3 CFFT Full Season Hill Set

CFFT Full season hill set at ARS, Parkhribas

Seven genotypes were evaluated under CFFT at ARS, Parkhribas during summer 2016. BGBYPOP produced the highest yield (5.45 t/ha) followed by Across 9942/Across9944 (5.15 t/ha) and TLBRS07F16 (4.75 t/ha) (Table 77).

Table 77: Coordinated Farmer Field Trial (CFFT) of full season maize genotypes at Regional ARS, Pakhribas in 2016.

Genotypes	DTT	DTS	HC	PH	EH	PN	EN	YLD	DTM	RE
07SADVI	78	84	1	197	96	33333	33333	3.20	131	1
Across 9942/Across 9944	78	83	2	208	110	42222	41111	4.03	128	4
BGBYPOP	81	87	3	212	116	50000	46667	4.93	133	1
Farmer's local	78	84	1	231	109	44444	42222	4.50	128	2
Manakamana-3	81	88	1	229	139	50000	42222	4.07	131	2
TLBRS07F16	79	83	1	182	106	41111	35556	3.63	129	2
ZM 627	81	87	1	185	93	44444	46667	3.70	133	3
Grand Mean	80	85	1	206	110	43333	41111	4.01	130	2
F-test	ns	ns	ns	ns	ns	ns	ns	ns	*	ns
LSD	-	-	-	-	-	-	-	-	3.4	-
CV (%)	3.6	3.8	50.9	10.7	14.9	14.3	20.3	25	1.5	70.7

Note: YLD = Grain Yield (kg/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, PA = Plant Aspect, EA = Ear Aspect, HC = Husk Cover and RE = Rotten Ear.

CFFT Full season hill set at RARS, Lumle

Among 7 genotypes under the CFFT, at RARS, Lumle, 07SADVI produced the highest yield (6.30 t/ha) followed by TLBRS07F16 (5.88 t/ha) and BGBYPOP (5.81 t/ha) respectively (Table 78).

Table 78: Coordinated Farmer Field Trial (CFFT) of full season maize genotypes at Regional Agricultural Research Station, Lumle in 2016.

Genotypes	DTT	DTS	DTM	PH	EH	YLD	PN	**EN**
07SADVI	58	65	109	266	130	6.30	53333	55111
Across 9942/Across 9944	60	65	112	280	140	4.80	49777	49777
BGBYPOP	62	67	107	273	132	5.81	49777	47111
Farmer's local	68	76	113	294	169	4.10	45333	43555
Manakamana-3	64	69	111	263	114	4.41	53333	51555
TLBRS07F16	60	65	108	279	142	5.88	53333	54222
ZM 627	65	71	109	247	138	5.03	53333	55999
Grand Mean	62	68	110	272	138	5.19	52444	50666
F-test	*	*	ns	ns	***	ns	ns	ns
LSD	3.6	5.2	-	-	6.3	-	-	-
CV (%)	2.4	3.1	2.5	6.4	1.9	14.2	13.4	13.5

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, DTM = Days to maturity, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha

CFFT Full season hill set combined analysis

Combined analysis of CFFT full season hill set showed that BGBYPOP produced the highest yield (5.63 t/ha) followed by 07SADVI (5.35 t/ha) and TLBRS07F16 (5.31 t/ha) respectively (Table 79). Genotype was non-significant for grain yield, days to tasseling, days to silking, plant height, ear height, plant number per plot and ear number per plot. Location was very highly significant for days to tasseling, days to silking, plant height, plant number per plot and ear number per plot. Location was non-significant for grain yield and ear height. Interaction was significant for ear height. Interaction was non-significant for grain yield, days to tasseling, days to silking, plant height, plant number per plot, and ear number per plot.

Table 79: Combined analysis of grain yield (t/ha) of Coordinated Farmer Trial (CFFT) of full season maize genotypes conducted at different NARC stations in 2016

Genotypes	Locations		Average
	Lumle	Pakhribas	
07SADVI	6.30	4.40	5.35
Across 9942/Across 9944	4.80	5.15	4.97
BGBYPOP	5.81	5.45	5.63
Farmer's local	4.10	4.65	4.37
Manakamana-3	4.41	4.00	4.20
TLBRS07F16	5.88	4.75	5.31
ZM 627	5.03	3.90	4.46
Genotype	(F-test = ns)		
Location	(F-test = ns)		
Genotype × Location	(F-test = ns)		
CV (%)	19.4		

2.1.7.4 IYT Full Season Terai Set

IYT Full season terai set at NMRP, Rampur

Statistical analysis of 14 genotypes evaluated at NMRP, Rampur during summer 2016 showed that the genotype S 0128 produced the highest yield (5.31 t/ha), followed by POZARICA 9531 (5.00 t/ha) and Rampur Composite (4.92 t/ha) respectively (Table 80).

Table 80: Initial Yield Trial (IYT) of terai set maize genotypes at NMRP, Rampur in 2016

Genotypes	DTT	DTS	PH	EH	PN	EN	YLD
Farmers Variety	58	61	187	90	41333	45333	4.09
PHRA PHUTTABAT- S0031	57	60	177	93	48000	53333	3.88
POZARICA 9531	59	63	210	105	48000	50667	5.01
POZARICA-S 9627 (RE)	61	64	203	85	48000	52000	4.70
R Composite	62	64	200	93	49333	44000	4.92
R POP-2	61	64	190	100	48000	46667	3.62
R POP-3	60	64	160	80	42667	44000	3.21
R POP-4	61	64	220	112	52000	53333	4.20
RAMPUR S03 F06	61	64	193	95	44000	41333	3.20
RAMPUR S03 F08	60	64	233	107	49333	49333	4.50
RAMPUR S03F02	60	63	207	110	44000	40000	3.23
S 0128	60	63	220	111	50667	49333	5.32

Genotypes	DTT	DTS	PH	EH	PN	EN	YLD
S97TLYGH"AYB"(3)	59	62	190	90	49333	49333	4.55
SIN-IBP-UTYF	60	64	210	100	44000	44000	3.59
Grand Mean	60	63	200	98	46667	46667	4.14
F-test	**	ns	**	ns	ns	ns	*
LSD	2.07	-	31.4	-	-	-	1.24
CV (%)	2.1	2.3	9.4	15.5	10.1	14.4	17.8

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha.

IYT Full season terai set at RARS, Bhagetada

Among the 14 genotypes evaluated at RARS, Bhagetada during summer, 2016, the genotype POZARICA 9531 produced the highest yield (3.22 t/ha) followed by RAMPUR S03 F08 (2.76 t/ha) and S 0128 (2.58 t/ha) respectively (Table 81).

Table 81: Initial Yield Trial (IYT) of terai set maize genotypes at RARS, Bhagetada, Doti in 2016

Genotypes	DTT	DTS	PH	EH	PN	EN	YLD	HC	PA	EA
Farmers Variety	35	37	215	118	20000	13333	0.77	1	1	1
PHRA PHUTTABAT- S0031	52	56	227	119	42222	37778	2.55	3	4	3
POZARICA 9531	51	55	232	118	35556	35556	3.22	3	3	3
POZARICA-S 9627 (RE)	53	57	220	114	33333	44444	2.25	3	3	3
R Composite	51	55	242	132	28889	28889	2.49	3	4	4
R POP-2	52	56	253	161	35556	24444	1.92	3	3	3
R POP-3	51	56	238	136	37778	33333	1.69	3	4	3
R POP-4	51	55	232	128	40000	35556	2.26	3	4	3
RAMPUR S03 F06	52	56	252	132	42222	31111	1.53	4	4	4
RAMPUR S03 F08	52	55	240	142	40000	37778	2.76	3	4	4
RAMPUR S03F02	52	56	227	154	31111	33333	2.05	3	4	4
S 0128	51	55	245	132	40000	33333	2.58	3	4	3
S97TLYGH"AYB"(3)	52	56	230	132	33333	28889	2.13	2	4	4
SIN-IBP-UTYF	52	57	236	127	28889	20000	1.02	2	3	3
Grand Mean	51	54	235	132	35556	31111	0.77	3	3	3
F-test	***	***	ns	ns	ns	*	*	*	***	**
LSD	1.13	1.31	-	-	-	14667	1.15	1.2	0.85	1.1
CV (%)	1.3	1.4	9.4	18.8	22.4	28.2	32.90	25	14.9	20.4

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, PA = Plant Aspect, EA = Ear Aspect and HC = Husk Cover

IYT Full season terai set at ARS, Dashrathpur

Ten genotypes were evaluated at ARS, Dasrathpur under CVT. PHRA PHUTTABAT-S0031 produced the highest yield (2.91 t/ha) followed by POZARICA 9531 (2.64 t/ha) and Farmer's Variety (2.63 t/ha) respectively (Table 82).

Table 82: Initial Yield Trial (IYT) of terai set maize genotypes at ARS, Dasharathpur in 2016

Genotypes	YLD	EN	PN	EH	PH	DTS	DTT
Farmers Variety	2.63	51111	53333	103	203	58	54
PHRA PHUTTABAT- S0031	2.91	46667	48889	107	189	56	53
POZARICA 9531	2.65	51111	53333	108	193	57	54
POZARICA-S 9627 (RE)	2.14	37778	44444	102	189	54	51
R Composite	2.18	40000	53333	118	198	56	53
R POP-2	1.30	24444	28889	98	201	59	55
R POP-3	2.03	40000	44444	99	212	56	52
R pop-4	2.12	37778	44444	105	188	58	55
Rampur S03 f06	2.60	44444	48889	85	183	57	54
Rampur S03F02	2.23	48889	53333	98	193	57	54
Rampur S03F08	2.53	42222	46667	78	169	56	53
S0128	1.83	37778	48889	86	190	56	53
S97TLYGH "AYB"(3)	2.32	40000	48889	105	208	56	53
SIN-IBP-UTYF	2.56	48889	53333	87	193	57	54
Grand Mean	2.29	42222	48889	99	194	57	53
F-test	ns	ns	ns	ns	ns	ns	ns
LSD	-	-	-	-	-	-	-
CV (%)	32.1	26.3	22.4	18	8.8	5.2	4.9

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha.

IYT Full season terai set combined analysis

The combined analysis of IYT full season terai set across Bhagetada, Dasrathpur and Rampur showed that POZARICA 9531 produced the highest yield (3.62 t/ha) followed by RAMPUR S03 F08 (3.26 t/ha) and S 0128 (3.24 t/ha) respectively (Table 83). Genotypes were very highly significant for grain yield, days to tasseling and days to silking. Genotypes were significant for ear number per plot. Genotypes were non significant for plant height, ear height and number of plants per plot. Locations were very highly significant for grain yield, days to tasseling, days to silking, ear height, number of plants per plot and ear number per plot. Interactions were very highly significant for days to tasseling and days to silking. Interactions were highly significant for plant height. Interactions

were significant for grain yield. Interactions were non significant for ear height, plant number per plot and ear number per plot.

Table 83: Yield (t/ha) of different genotypes at different locations in IYT of full season terai set in 2016.

Genotypes	Locations			Average
	Bhagetada	Dasrathpur	Rampur	
Farmers Variety	0.77	2.63	4.09	2.50
PHRA PHUTTABAT- S0031	2.55	2.91	3.88	3.12
POZARICA 9531	3.22	2.64	5.00	3.62
POZARICA-S 9627 (RE)	2.24	2.14	4.70	3.03
Rampur Composite	2.49	2.18	4.92	3.20
R POP-2	1.91	1.31	3.62	2.28
R POP-3	1.69	2.02	3.21	2.31
R POP-4	2.26	2.12	4.20	2.86
RAMPUR S03 F06	1.53	2.60	3.20	2.44
RAMPUR S03 F08	2.76	2.53	4.49	3.26
RAMPUR S03F02	2.05	2.23	3.23	2.50
S 0128	2.58	1.83	5.32	3.24
S97TLYGH"AYB"(3)	2.13	2.32	4.55	3.00
SIN-IBP-UTYF	1.02	2.56	3.59	2.39
Genotype	(F-test = ***, LSD = 0.662)			
Location	(F-test = ***, LSD = 0.306)			
Genotype × Location	(F-test = * , LSD = 1.147)			
CV (%)	24.9			

2.1.7.5 CVT Full Season Terai Set

CVT full season terai set at RARS, Bhagetada

Evaluation of 10 genotypes at RARS, Bhagetada showed highest yield by R-POP-1 (3.13 t/ha) followed by CEL-OHGYA×CEL-OHGYB (2.55 t/ha) and Rampur Composite (2.424 t/ha) respectively (Table 84).

Table 84: Coordinated Varietal Trial (CVT) of terai set maize genotypes at RARS, Bhagetada, Doti in 2016

Genotypes	DTT	DTS	PH	EH	PN	EN	EA	PA	HC	YLD
ACROSS 9331 RE	52	56	235	133	31111	24444	4	4	3	2.00
AGUA FRIA S0031	52	56	210	103	40000	37778	3	4	3	2.00
CEL-OHGYA×CEL-OHGYB	52	56	230	126	42222	40000	3	4	2	3.00
FS' LOC. CHECK	36	38	218	116	11111	8889	2	2	2	1.00
HG-A	51	55	201	128	31111	40000	3	3	3	2.00

Genotypes	DTT	DTS	PH	EH	PN	EN	EA	PA	HC	YLD
Narayani	51	55	249	133	40000	31111	3	3	3	2.00
R.COMP. (ST.CHK.)	52	56	258	139	40000	28889	4	4	4	2.00
R-POP-1	51	55	246	137	35556	35556	4	4	3	3.00
TAKFA-S- 9536	53	57	221	106	40000	40000	3	3	2	2.00
TERAI POOL YELLOW	52	56	233	126	37778	31111	4	4	4	2.00
Grand Mean	50	54	229	124	35556	31111	3	3	3	2.00
F-test	***	***	ns	ns	**	**	ns	ns	ns	*
LSD	1.8	1.7	-	-	12444	14444	-	-	-	1.00
CV (%)	2.1	1.9	10	12.6	21.4	26.6	20.9	20.3	26.3	29.9

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha, EN = Ear number per ha, PA = Plant Aspect, EA = Ear Aspect and HC = Husk Cover

CVT full season terai set at NMRP, Rampur

Among 10 genotypes under the CVT, at NMRP, Rampur, CEL-OHGYA×CEL-OHGYB produced the highest yield (5.02 t/ha) followed by R-POP-1 (4.86 t/ha) and HG-A (4.38 t/ha) respectively (Table 85).

Table 85: Coordinated Varietal Trial (CVT) of terai set maize genotypes at NMRP, Rampur in 2016

Genotypes	DTT	DTS	PH	EH	PN	EN	YLD
ACROSS 9331 RE	57	60	193	105	44000	46667	3.37
AGUA FRIA S0031	60	63	185	82	49333	44000	4.06
CEL OHGYA × CEL-OHGYB	63	66	183	73	42667	46667	4.72
FS"LOC.CHECK	56	59	210	105	41333	40000	3.87
HG-A	55	58	193	97	45333	44000	4.04
NARAYANI	55	59	180	85	32000	41333	2.79
R.COMP (ST.CHK.)	56	60	207	110	38667	40000	4.24
R-POP-1	59	62	217	112	49333	49333	4.44
TAKFA-S-9536	64	67	203	97	46667	45333	3.49
TERAI POOL YELLOW	56	59	247	113	52000	50667	4.09
Grand Mean	58	61	202	98	44000	45333	3.91
F-test	**	**	ns	*	*	ns	ns
LSD	4.36	4.45	-	25.2	7.5	-	-
CV (%)	4.4	4.2	12.6	15.1	13.3	15.6	17.7

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha.

CVT full season terai set at ARS, Dashrathpur

Ten genotypes were evaluated at ARS, Surkhet under CVT. Farmer's local produced the highest yield (4.24 t/ha) followed by AGUA FRIA S0031 (3.84 t/ha) and HG-A (3.78 t/ha) respectively (Table 86).

Table 86: Coordinated Varietal Trial (CVT) of terai set maize genotypes at ARS, Dasharathpur in 2016

Genotypes	DTT	DTS	PH	EH	PN	EN	YLD	YLD
ACROSS 9331 RE	58	61	135	90	53333	51555	2.96	2.96
AGUA FRIA S0031	59	63	118	44	49777	49777	3.84	3.84
CEL-OHGYA×CEL-OHGYB	59	62	123	24	45333	38222	3.28	3.28
FS' LOC. CHECK	59	63	114	87	53333	55999	4.24	4.24
HG-A	53	57	138	46	52444	58666	3.78	3.78
Narayani	55	58	120	68	53333	53333	2.87	2.87
R.COMP. (ST.CHK.)	55	58	136	78	53333	48888	3.08	3.08
R-POP-1	54	57	145	80	50666	50666	3.75	3.75
TAKFA-S- 9536	56	60	131	80	45333	45333	2.25	2.25
TERAI POOL YELLOW	56	59	129	86	50666	45333	3.13	3.13
Grand Mean	56	60	129	68	51555	49777	3.32	3.32
F-test	ns	ns	ns	ns	ns	ns	ns	ns
LSD	-	-	-	-	-	-	-	-
CV (%)	3.9	4	13.6	34.4	14.9	15.5	28.1	28.1

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha.

CVT full season terai set combined analysis

Combined analysis of CVT full season terai set showed that R-POP-1 produced the highest yield (3.91 t/ha) followed by CEL-OHGYA×CEL-OHGYB (3.61 t/ha) and HG-A (3.54 t/ha) respectively (Table 87). Genotypes were very highly significant for days to tasseling, days to silking. Genotypes were highly significant for ear height. Genotypes were significant for grain yield. Genotypes were non significant for plant height, plant number per plot and ear number per plot. Locations were very highly significant for grain yield, days to tasseling, days to silking, plant height, ear height, plant number per plot and ear number per plot. Interactions were very highly significant for days to tasseling and days to silking. Interactions were non significant for grain yield, plant height, ear height, plant number per plot and ear number per plot.

Table 87: Yield (t/ha) of different genotypes at different locations in CVT of full season terai set in 2016.

Genotypes	Locations			Average
	Bhagetada	Dashrathpur	Rampur	
ACROSS 9331 RE	1.64	2.96	2.87	2.49
AGUA FRIA S0031	1.95	3.84	4.27	3.35
CEL-OHGYA×CEL-OHGYB	2.55	3.27	5.02	3.61
FS' LOC. CHECK	0.67	4.24	3.90	2.94
HG-A	2.48	3.783	4.38	3.55
Narayani	1.43	2.87	2.84	2.38
R.COMP. (ST.CHK.)	2.42	3.08	4.13	3.21
R-POP-1	3.13	3.75	4.86	3.91
TAKFA-S- 9536	1.60	2.24	3.92	2.59
TERAI POOL YELLOW	2.14	3.13	4.13	3.13
Genotype	(F-test = * , LSD = 0.873)			
Location	(F-test = ***, LSD = 0.478)			
Genotype × Location	(F-test = ns)			
CV (%)	23.7			

2.1.7.6 CFFT Full Season Terai Set

CFFT full season terai set at ARS, Dashrathpur

Seven genotypes were evaluated at ARS, Surkhet under CVT. Across 9331 RE produced the highest yield (4.39 t/ha) followed by HG-AB (3.43 t/ha) and Upahar (3.35 t/ha) respectively (Table 88).

Table 88: Coordinated Farmer Field Trial (CFFT) of terai set maize genotypes at ARS, Dasrathpur in 2016

Genotypes	PH	EH	PN	EN	YLD
Across9931RE	270	150	46000	47333	4.40
Farmers local	310	180	37333	37333	2.82
HG.B	250	162	44666	36666	2.32
HG-AB	295	175	40000	34666	3.43
Rampur S13F24	298	149	48666	38000	2.77
Rampur S13F26	304	184	45333	37333	3.04
Upahar	249	117	37333	34000	3.35
Grand Mean	282	160	42666	38000	3.16

Note: YLD = Grain Yield (t/ha), PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha.

CFFT full season terai set at NMRP, Rampur

Under CFFT, 7 genotypes were evaluated at NMRP, Rapur. Rampur S13F26 produced the highest yield (4.91 t/ha) followed by Upahar (4.75 t/ha) and HG-AB (4.52 t/ha) (Table 89).

Table 89: Coordinated Farmer Field Trial (CFFT) of terai set maize genotypes at NMRP, Rampur in 2016

Genotypes	DTT	DTS	PH	EH	PN	EN	PA	EA	RE	YLD
Across 9331 RE	57	60	160	80	28666	42000	2	2	5	3.35
Farmers local	53	57	230	120	38000	37333	2	3	7	4.39
HG.AB	60	64	195	110	43333	48666	2	2	8	4.52
HG.B	57	61	190	100	42666	36000	2	3	5	3.44
Rampur S13F24	52	62	120	100	46666	42666	2	2	6	4.35
Rampur S13F26	61	65	220	112	53333	53999	2	2	8	4.91
Upahar	54	58	210	120	45333	47333	3	2	3	4.75
Grand Mean	56	61	189	106	42666	44000	2	2	6	4.24

Note: YLD = Grain Yield (t/ha), DTT = Days to tasseling, DTS = Days to silking, PH = Plant Height (cm), EH = Ear Height (cm), PN = Plant Number per ha and EN = Ear number per ha.

2.1.8 Development of maize varieties for Karnali region

The coordinated varietal trial (CVT) of maize for Karnali region was conducted at NMRP Rampur during winter in 2016. A total of 10 maize genotypes which had had the high yield potential among the tested genotypes in the last years' experiment were evaluated in randomized complete block design with 3 replications. The individual plot size was 11.2 m^2 with a planting geometry of RR 75 cm x PP 25 cm. The fertilizer application and intercultural operations were managed as per recommendations.

The data revealed that there were no differences in silking days among the tested genotypes but all the genotypes took comparatively less days for tasselling as compared with check variety Ganesh-1. Significantly higher plant height (250 cm) and ear height (140 cm) was observed in Jumka-POP. The yields of tested genotypes were statistically at par to each other (Table 90).

Table 90: Performance of maize genotypes developed for Karnali region in CVT at NMRP Rampur 2016/17

SN	Genotype	Days to flowering		Plant height, cm	Ear height, cm	Yield , t/ha
		Male	Female			
1	KK6-01	63 [b]	66	202 [ab]	107 [ab]	3.29
2	KKT-POP	65 [ab]	68	190 [b]	93 [b]	4.08
3	Karnali pool yellow	64 [b]	68	192 [b]	103 [b]	4.92
4	Karnali pool white	64 [b]	67	207 [ab]	113 [ab]	3.86
5	KWL-POP	63 [b]	67	223 [ab]	123 [ab]	3.59
6	Jumka-POP	64 [b]	67	250 [a]	140 [a]	3.79
7	KLY-POP	65 [ab]	69	200 [ab]	115 [ab]	3.93
8	KKT-03	64 [ab]	67	190 [b]	103 [b]	3.20
9	Ganesh-1	66 [a]	70	198 [ab]	120 [ab]	3.93
10	Farmers' local	64 [b]	67	193 [b]	127 [ab]	4.69
	Grand Mean	64	68	205	115	3.93
	F-test	0.16	NS	0.24	0.17	NS
	CV (%)	2.1	2.7	13.3	16.0	25.8
	LSD (0.05)	2.33	3.14	46.54	31.35	1.73

2.2 AGRONOMY

2.2.1 Enhancing maize productivity through improvement in agronomic management practices in Terai and inner Terai of Nepal

2.2.1.1 Hybrid maize with different fertilizer doses and plant population

The experiment was conducted at NMRP field during winter season in 2016/17. The trial was laid in strip split plot design with 3 replications. The plot size was 22.5 m^2. Two maize hybrids namely RML-95/RML-96 and RML-86/RML-96 were used as vertical factor and in horizontal factor there were five population densities (55,555/ha, 66,666/ha, 77,519 /ha, 87,719/ha and 98,039/ha) along with two doses of fertilizer (1. Recommended dose i.e. 120:60: 40 $NP_2O_5K_2O$ kg/ha and 2. Judicial dose i.e fertilizer applied as per the plant basis assuming that 53,333 plant population of maize required the fertilizer dose of 120:60:40 $NP_2O_5K_2O$ kg/ha).

Genotypic variation for grain yield, plant height and ear height was not observed between RML-95/RML-96 and RML-86/RML-96. However, irrespective of the genotypes, significantly higher grain yield (7.55 t/ha) was observed when the plant population was maintained at 77,519/ha with the fertilizer @ 174:87:58 $NP_2O_5K_2O$ kg/ha (Table 91). The data revealed that, increased population

densities and fertilizer rate had positive effect on plant height. The significantly higher plant height (222.17 cm) was recorded in the maize genotypes having the plant population of 98,039/ha with the fertilizer applied @ 221:110:74 $NP_2O_5K_2O$ kg/ha.

Table 91: Grain yield, plant and ear heights of Hybrid maize as influenced by plant densities and differential fertilizer doses during winter season at NMRP Rampur 2016/17

Treatment	Grain yield t/ha	Plant height, cm	Ear height, cm
Variety			
RML-95/ RML-96	5.72	209	118
RML- 86/RML- 96	6.04	209	119
F-test	ns	ns	ns
CV (%)	2.7	3.7	1.5
Population densities cum fertilizer			
D1JD (55555 PP 125:63:42 $NP_2O_5K_2O$ kg/ha)	5.75 ^{bc}	197 ^{c}	114
D1RD (55555 PP 120:60:40 $NP_2O_5K_2O$ kg/ha)	5.97 ^{bc}	203 ^{bc}	113
D2JD (66666 PP 150:75:50 $NP_2O_5K_2O$ kg/ha)	6.27 ^{b}	211 ^{ab}	118
D2RD (66666 PP 120:60:40 $NP_2O_5K_2O$ kg/ha)	5.84 ^{bc}	204 ^{bc}	115
D3JD (77519 PP 174:87:58 $NP_2O_5K_2O$ kg/ha)	7.55 ^{a}	212 ^{ab}	118
D3RD (77519 PP 120:60:40 $NP_2O_5K_2O$ kg/ha)	5.69 b^{c}	208 ^{bc}	120
D4JD (87719 PP 197:99:66 $NP_2O_5K_2O$ kg/ha)	6.25 ^{b}	214 ^{ab}	122
D4RD (87719 PP 120:60:40 $NP_2O_5K_2O$ kg/ha)	4.90 ^{bc}	210 ^{b}	120
D5JD (98039 PP 221:110:74 $NP_2O_5K_2O$ kg/ha)	5.89 ^{bc}	222 ^{a}	121
D5RD (98039 PP 120:60:40 $NP_2O_5K_2O$ kg/ha)	4.66 ^{c}	210 ^{b}	123
Grand mean	5.878	209.1	118.4
F-test	0.010	0.008	0.680
CV (%)	12.20	3.0	5.8
LSD (0.05)	*	**	ns

2.2.1.2 Weed management in maize

The weed management experiment was conducted in 2016/17 at NMRP field (228 masl). The experiment was carried out in randomized complete block design with 3 replications and 8 treatments. Maize variety Deuti was sowed on October 5, 2016 at a planting geometry of 60 cm x 25 cm. The plot size was 30 m^2. The chemical fertilizer was applied as per recommendation i.e. 120:60:40 $NP_2O_5K_2O$ kg/ha.

The maize grain yield and weed dry matter accumulations were significantly influenced by the weed management practices. Significantly higher grain yields were recorded in black plastic mulched (7.97 t/ha) and weed free (7.36 t/ha) treatments which were at par with rice straw mulched (6.06 t/ha) (Table 92). Any of the chemical herbicides either pre or post emergence could not impact on grain yield of maize since the maize yield of those treatments were at par

with the weedy check. In case of weed dry matter accumulation, the weed free treatment recorded no weed as weeds were uprooted every 7 days interval. Excluding the weed free treatment, significantly lower weed dry weight (0.017 t/ha, 0.013 t/ha and 0.008 t/ha were recorded in black plastic mulch in every computed time i.e. 30, 60 and 90 DAS respectively. The effect was clearly reflected on the maize yield. The estimated regression line indicated that the unit rise in the weed dry weight (t/ha), there existed possibilities of yield reduction by 0.796 t/ha. The predicted linear regression line displayed downward slope i.e. y = 7.302-0.796 x with regression coefficient R^2= 0.817, where y denoted predicted crop yield of maize and x stood for weed dry weight (Figure 1).

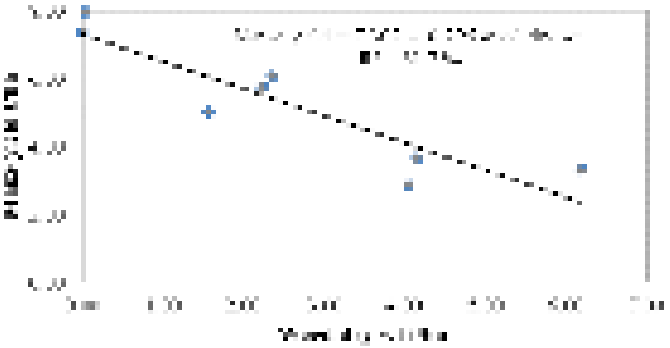


Figure 1: Relationship of weed dry weight and maize grain yield at NMRP Rampur 2016.

Table 92: Effect of different weed control practices for maize yield and weed dry matter accumulation at NMRP Rampur 2016/17

	Treatment	Grain yield, t/ha	Weed dry wt., t/ha		
			30 DAS	60 DAS	90 DAS
1	Weedy check	3.33^{d}	1.51^{a}	2.03^{a}	2.65^{a}
2	Weed free	7.36^{a}	0.00^{d}	0.00^{d}	0.00^{c}
3	Two hand weeding at 30 & 60 DAS	5.74^{abc}	1.56^{a}	0.11^{d}	0.57^{bc}
4	Crop residue mulch (rice straw)	6.06^{ab}	0.80^{c}	0.86^{c}	0.70^{bc}
5	Black plastic mulch	7.97^{a}	0.02^{d}	0.01^{d}	0.01^{c}
6	Tank mixture pre-emergence herbicide (Atrazine @ 0.75 kg a.i./ha + Pendimethaline	2.85^{d}	1.14^{abc}	1.47^{b}	1.45^{b}
7	Tank mixture pre-emergence herbicide (Atrazine @ 0.75 kg a.i./ha + Pendimethaline @ 0.5 kg a.i./ha) + One hand weeding at 30 DAS	5.03^{bcd}	0.89^{bc}	0.12^{d}	0.57^{bc}
8	Tank mixture pre-emergence herbicide (Atrazine @ 0.75 kg a.i./ha + Pendimethaline @ 0.5 kg a.i./ha) followed by 2,4-D Ethyl Ester at 35 DAS	3.65^{cd}	1.34^{ab}	1.59^{b}	1.22^{b}
	Grand Mean	5.25	0.91	0.77	0.89
	F-test	**	**	**	**
	LSD (0.05)	2.10	0.45	0.39	0.86

2.2.1.3 Weed survey

The survey was carried out in Gulmi and Arghakhachi districts representing the mid-hill. The weed survey was made by least count quadrate method using 1 m^2 quadrates. In each field, 5 quadrates were laid down and observation regarding the quantitative characteristics of weed was recorded.

Weed dominance was recorded in the altitude from 1040 masl to 1524 masl. According to the farmers' feedback, two weeds namely *Oxalis acetosella* (Amile Jhar) and *Ageratum* spp. (Gandhe jhar, Nepali jhar, Ganaune Jhar, Palpali Jhar) are very problematic weed in the maize field. The observed data also supported the farmers' feedback where the weed densities of those weeds were 307.4/m^2 and 220.3/m^2, respectively (Table 93).

Table 93: Weeds and weed densities observed in maize field in Gulmi and Arghakhachi districts 2016

Local name	Scientific name	Arghakhanchi	Gulmi	Grand total
Amile Jhar	*Oxalis acetosella*	468	146	307
Nepali jhar	*Ageratum* spp.	19	422	220
Kuro	*Triumfetta pilosa*	0	263	132
Kane	*Commelina* spp.	41	11	26
Banso	*Digiteria* spp.	27	7	17
Sama	*Echinochloa* spp.	0	30	15
Aankara	*Vacia sativa*	6	14	10
Rawanne	-	20	0	10
Mothe	*Cyperus* spp	10	2	6
Others (9 species)		6	6	9
Grand total		597	902	752

2.2.1.4 Performance of maize varieties in various planting dates

Two pipeline maize varieties namely RML-95/RML-96and S03TEY-FM were sown throughout the year at every 10 days interval with 3 replications in randomized complete block design at the field of NMRP. The soil was sandy loam. The planting geometry was 60 cm x 25 cm with the plot size of 6 m^2. The fertilizer was applied at the ratio of 120:60:40 $NP_2O_5K_2O$ kg/ha along with the FYM @ 10 t/ha.

Result revealed that the higher grain yield (15.70 t/ha) of hybrid maize RML-95/RML-96 was recorded when sown on 29th Chaitra followed by 19th Chaitra (14.10 t/ha) and 19th Bhadra (13.47 t/ha). In case of OPV maize S03TEY-FM the highest grain yield (10.13 t/ha) was recorded when the maize seed sown on 28th Baishakh followed by 29th Chaitra (8.38 t/ha), 19th Chaitra (8.30 t/ha) and 19th Bhadra (8.22 t/ha) (Table 94). In the context of flowering, the tasseling and silking was observed at 45 and 50 days for RML-95/RML-96 (Figure 2)when sown on 21st Shrawan afterward the required days gradually increased and reached up to 120 to 124 days for the flowering after that started to drop down from 8th Poush.

Similar scenario was observed in OPV variety S03TEY-FM (Figure 3) but the number of days required for flowering was lesser than RML-95/RML-96.

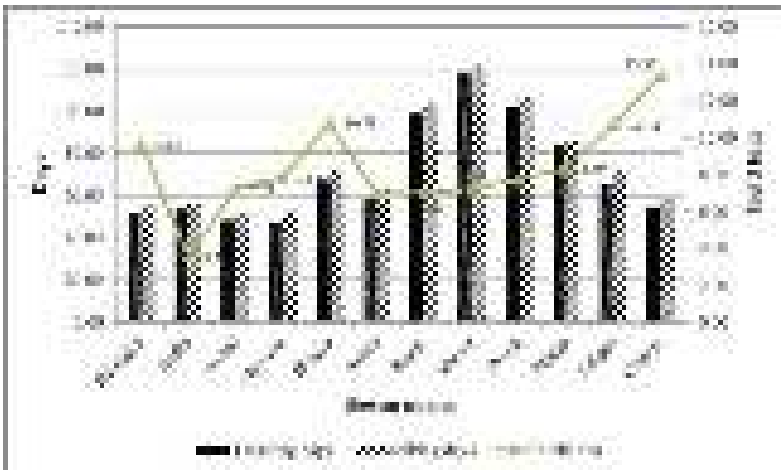


Figure 2: Grain yield and flowering time of hybrid maize (RML-95/RML-96) as influenced by sowing dates at NMRP Rampur 2016/17

Table 94: Studying the performance of full season and hybrid maize genotypes throughout the year at Rampur 2016/17

Sowing date	RML-95/RML-96			S03TEY-FM		
	Days to		Yield, t/ha	Days to		Yield, t/ha
	Tasseling	Silking		Tasseling	Silking	
3/22/2073	48	51	7.21	43	46	6.36
4/1/2073	49	53	6.58	44	47	5.63
4/11/2073	48	53	6.62	40	44	5.88
4/21/2073	45	50	9.67	41	46	6.92
4/30/2073	49	53	8.52	40	45	7.68
5/9/2073	55	65	8.24	50	55	5.01
5/19/2073	70	75	13.47	55	60	7.16
5/29/2073	75	78	10.63	58	64	8.22
6/8/2073	52	57	7.48	49	54	5.91
6/18/2073	59	63	6.86	52	56	5.29
6/28/2073	65	70	6.48	58	60	6.52
7/8/2073	85	90	6.22	78	83	2.58
7/18/2073	102	106	7.49	90	94	4.67
7/28/2073	110	114	7.39	100	105	4.25
8/8/2073	118	122	5.47	106	109	4.36
8/18/2073	118	119	7.98	108	111	4.52
8/28/2073	120	124	8.32	110	114	5.88
9/8/2073	108	112	8.66	99	103	5.64

Sowing date	RML-95/RML-96			S03TEY-FM		
	Days to		Yield, t/ha	Days to		Yield, t/ha
	Tasseling	Silking		Tasseling	Silking	
9/18/2073	100	104	6.42	95	100	6.10
9/28/2073	99	102	8.04	90	94	4.89
10/9/2073	91	94	6.78	84	88	4.16
10/19/2073	82	85	8.62	77	80	4.32
10/29/2073	77	80	9.80	71	74	6.25
11/9/2073	78	81	9.98	60	64	5.91
11/19/2073	65	78	10.59	52	55	5.67
11/29/2073	54	58	11.58	50	53	5.11
12/9/2073	55	59	11.05	50	53	6.83
12/19/2073	54	57	14.10	50	53	8.30
12/29/2073	55	60	15.70	51	54	8.38
1/8/2074	55	60	7.09	50	54	5.44
1/18/2074	50	54	9.02	49	53	4.29
1/28/2074	51	53	12.81	48	52	10.13
2/7/2074	53	56	3.48	45	48	1.90
2/17/2074	53	56	3.66	45	48	2.85
Grand Mean	72	76	8.63	64	68	5.68

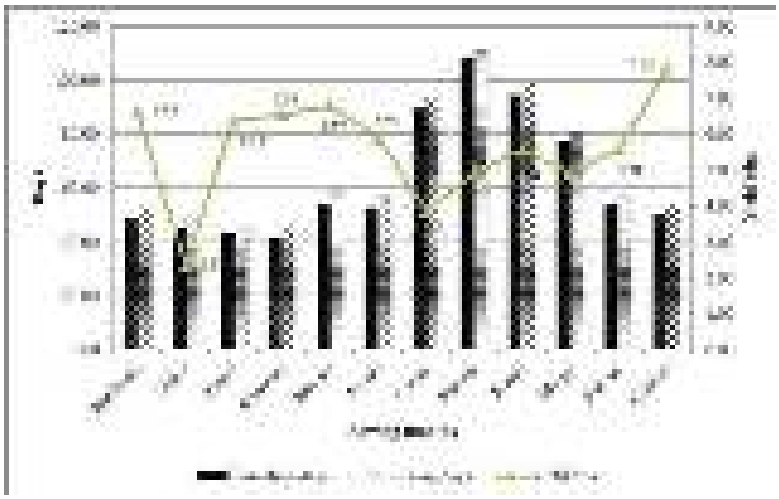


Figure 3: Grain yield and flowering time of OPVs maize (S03TEY-FM) as influenced by sowing dates at NMRP, Rampur, 2016/17

2.2.1.5 Conservation agriculture and maize genotypes

The field experiment was conducted at NMRP Rampur during winter in 2016/17 and was laid out in randomized complete block design with 3 replications. Four

different maize genotypes namely RML-95/RML-96, Rampur Hybrid-4, HGB ZM-401 and Rampur Composite were sown under tilled without mulch and no tilled with mulch. The mulching material was maize stover. The fertilizer application and intercultural operations were managed as per recommendations.

All the maize genotypes showed comparatively higher grain yield in mulching on no tilled practices as compared to the only tilled practices. The maize genotype RML-95/RML-96 gave significantly higher grain yield (10.3 t/ha) when grown under mulching on no tilling method of practices (Table 95). Similarly, significantly higher stover yield was recorded in all mulching treatments having no tilled practices.

Table 95: Performance of hybrids and OPVs under till and no tillage with residue in Terai 2016/17

Treatment	Grain yield, t/ha	Plant height, cm	Ear height, cm	Stover yield, t/ha
CTM0V1	8.40 ^{bc}	203 ^{abc}	97 ^{ab}	8.3 ^{b}
CTM0V2	8.80 ^{abc}	190 ^{c}	75 ^{b}	8.2 ^{b}
CTM0V3	6.10 ^{d}	203 ^{abc}	93 ^{ab}	7.8 ^{b}
CTM0V4	7.10 ^{cd}	198 ^{bc}	97 ^{ab}	7.3 ^{b}
NTM1V1	10.30 ^{a}	212 ^{abc}	113 ^{a}	11.9 ^{a}
NTM1V2	9.10 ^{abc}	205 ^{abc}	90 ^{ab}	12.1 ^{a}
NTM1V3	8.40 ^{bc}	230 ^{a}	107 ^{a}	11.5 ^{a}
NTM1V4	8.90 ^{abc}	218 ^{ab}	115 ^{a}	11.6 ^{a}
Grand Mean	8.4	208	98	9.8
CD (0.05)	1.64	24.78	26.14	1.19
CV%	11.2	6.8	15.2	6.9
F test	0.003	0.088	0.083	<.001

Note: NT=No tillage; CT=Conventional tillage; M1= Mulching; M2= No Mulching; V1= RML-95/RML-96; V2= Rampur Hybrid-4; V3= HGB ZM-401; V4= Rampur Composite

2.3 SOIL SCIENCE

2.3.1 Updating fertilizer dose for hybrid maize RML-86/RML-96

Pipeline hybrid RML-86/RML-96 developed by NMRP was selected for this purpose. Experiment was conducted at NMRP research field in winter season of 2016/17. Maize was planted in 6 rows of 4-meter long plot size with spacing of 60×25 cm^2. Outer two rows were used as border and remaining four central rows were used to take observations. 50% of recommended N fertilizer was applied at planting time and remaining 50% was applied at knee height and before tasseling stage. Full dose of P and K fertilizers were applied at planting time. Recommended dose of FYM was applied at the time of land preparation. Treatments were tested on RCB Design with three replications. Treatments details are described as follows.

1. 120 kg N_2O, 60 kg P_2O_5 and 40 kg K_2O
2. 150 kg N_2O, 60 kg P_2O_5 and 40 kg K_2O
3. 180 kg N_2O, 60 kg P_2O_5 and 40 kg K_2O
4. 210 kg N_2O, 60 kg P_2O_5 and 40 kg K_2O
5. 240 kg N_2O, 60 kg P_2O_5 and 40 kg K_2O.

Statistically highly significant differences were recorded only for ear circumferences. Rest of the traits under observations were at par statistically. The details of the research results have been presented in Table 96.

Table 96: Mean grain yield and yield attributing characters of hybrid maize RML-86/ RML-96 as affected by different dozes of chemical fertilizers during winter seasons of 2016/17 at Rampur.

SN	Treatment	Grain yield, t/ha	1000 grain wt., g.
1	120:60:40 N_2O:P_2O_5;K_2O kg/ha	6.87	393
2	150:60:40 N_2O:P_2O_5;K_2Okg/ha	6.06	389
3	180:60:40 N_2O:P_2O_5;K_2O kg/ha	7.05	404
4	210:60:40 N_2O:P_2O_5;K_2Okg/ha	7.01	415
5	240:60:40 N_2O:P_2O_5;K_2O kg/ha	5.83	420
Mean		6/.570	404
F-test		ns	ns
LSD (0.05)		-	-
CV (%)		6.6	16

2.3.2 Fertilizer dose response study on hybrid maize RML-95/RML-96

Promising native hybrid RML-95/RML-96 was selected for experimental purpose. Experiment was conducted at NMRP research farm. Hybrid maize was planted in 6 rows of 4 meter long at the spacing of 60×25cm^2. Outer two rows were used as border lines and remaining four rows were harvested for recording grain yield and yield attributing traits. Half dose of recommended N fertilizer was applied at planting and remaining dose was applied in two splits, first at knee height and second before tasseling stage. Two third of recommended P fertilizer was applied at planting time and remaining one third was applied at knee height stage. Full dose of K fertilizers was applied at planting time. Recommended dose of FYM was applied at the time of land preparation. Treatments were tested on RCB design with three replications. Treatments details are presented as follows:

1. 120 kg N, 60 kg P_2O_5 and 40 kg K_2O
2. 120 kg N, (40+20) kg P_2O_5 and 40 kg K_2O
3. 160 kg N, 60 kg P_2O_5 and 40 kg K_2O

4. 160 kg N, (40+20) kg P_2O_5 and 40 kg K_2O
5. 200 kg N, 60 kg P_2O_5 and 40 kg K_2O
6. 200 kg N, (40+20) kg P_2O_5 and 40 kg K_2O
7. 240 kg N, 60 kg P_2O_5 and 40 kg K_2O
8. 240 kg N, (40+20) kg P_2O_5 and 40 kg K_2O .

There was no any statistically significant difference in different parameters. The details of the research results have been summarized following Table 97.

Table 97: Average grain yield and yield attributing characters of hybrid RML-95/ RML-96 as affected by different doses of major chemical fertilizers during winter seasons of 2016/17 Rampur.

SN	Treatment	thousand grain wt., g	Grain yield (t/ha)
1	120:60:40 N_2O:P_2O_5;K_2O t/ha	379	6.14
2	120:(40+20):40 N_2O:P_2O_5;K_2O t/ha	367	6.63
3	160:60:40 N_2O:P_2O_5;K_2O t/ha	357	7.38
4	160:(40+20):40 N_2O:P_2O_5;K_2O t/ha	383	6.6
5	200:60:40 N_2O:P_2O_5;K_2O t/ha	384	6.87
6	200:(40+20):40 N_2O:P_2O_5;K_2O t/ha	383	7.39
7	240:60:40 N_2O:P_2O_5;K_2O t/ha	351	6.6
8	240:(40+20):40 N_2O:P_2O_5;K_2OK_2O t/ha	369	6.8
Mean		371	8.45
F-test		ns	ns
CV (%)		8.1	16

2.3.3 Variety cum fertilizer trial (VCFT) on maize

Fertilizer recommendation for maize depends upon variety. Naturally, longer duration (full season) varieties need more fertilizer as compared to shorter duration varieties. Similarly, hybrid varieties need more fertilizer as compared to open pollinated varieties. NMRP has recommended 120:60:40 kg N_2O;P_2O_5;K_2O /ha for all types of maize except hybrids. This experiment aims at appropriate and economic dose of fertilizer for early, medium and full season maize varieties. Experiment was conducted at NMRP Rampur. Four different improved maize genotypes namely S99TLYQ-HG-AB, Arun-4, TLBRSO7F16 and BGBYPOP were used. Maize was planted in 4 rows of 4-meter-long plot at the spacing of 60×25cm^2. Maize was planted during winter season of 2016/17. This experiment was conducted in split plot design with three replications. Six different levels of major chemical fertilizers were applied:

1. 120 kg N_2O, 60 kg P_2O_5 and 40 kg K_2O.
2. 120 kg N_2O, 75 kg P_2O_5 and 50 kg K_2O
3. 150 kg N_2O, 60 kg P_2O_5 and 40 kg K_2O
4. 150 kg N_2O, 75 kg P_2O_5 and 50 kg K_2O.
5. 180 kg N_2O, 60 kg P_2O_5 and 40 kg K_2O.
6. 180 kg N_2O, 75 kg P_2O_5 and 50 kg K_2O

Statistically highly significant differences were recorded for days to tasseling, days to silking, plant height, ear height, ear length, number of kernels per row, 1000 kernels' weight and grain yield among the tested genotypes. Likewise, highly significant differences for days to tasseling, days to silking, plant height and ear height were observed due to fertilizer. However, there interaction effect of variety by fertilizer applications could not be noticed. Results have been highlighted in Table 98.

Table 98: Average grain yield and yield attributing characters of different maize genotypes as affected by different dozes of major chemical fertilizers during winter season of 2016/17 at Rampur

SN	Treatment	Days to tasseling					Days to silking					Plant height, cm					Grain yield t/ha				
		S99TLYQ-HG-AB	Arun-4	TLBRSO7F16	BGBYPOP	Mean	S99TLYQ-HG-AB	Arun-4	TLBRSO7F16	BGBYPOP	Mean	S99TLYQ-HG-AB	Arun-4	TLBRSO7F16	BGBYPOP	Mean	S99TLYQ-HG-AB	Arun-4	TLBRSO7F16	BGBYPOP	Mean
1	120:60:40 N2O:P2O5;K2O kg/ha	66	57	68	68	65	70	62	70	71	68	161	163	150	150	156	3.05	2.2	2.62	2.98	2.71
2	120:75:50 N2O:P2O5;K2O kg/ha	67	57	67	67	65	70	60	70	70	68	168	163	163	165	165	3.54	2.75	3.09	3.69	3.27
3	150:60:40 N2O:P2O5;K2O kg/ha	67	57	68	68	65	70	61	71	71	68	171	181	158	160	168	3.62	2.57	3.85	3.3	3.33
4	150:75:50 N2O:P2O5;K2O kg/ha	66	57	67	67	64	70	60	70	70	67	174	163	172	164	169	3.34	2.58	3.23	3.54	3.26
5	180:60:40 N2O:P2O5;K2O kg/ha	68	57	69	68	65	70	61	71	70	68	167	157	156	155	159	3.23	2.46	2.79	3.18	2.91
6	180:75:50 N2O:P2O5;K2O kg/ha	67	58	67	67	65	69	61	70	69	67	169	160	160		162	3.72	2.21	3.49	4.19	3.4
	Mean	67	57	68	68	65	70	61	70	70	68	168	165	160	159	163	3.43	2.45	3.18	3.48	3.15
	F-test (variety)			**					**					**					**		
	F-test (fertilizer)			**					**					**					ns		
	F-test (variety*fertilizer)			ns					ns					ns					ns		
	LSD (0.05) (variety)			0.49					0.65					6.92					1.85		
	LSD (0.05) (fertilizer)			0.61					0.8					8.41					26.4		
	CV (%)			1.1					1.4					6.3					10.5		

2.3.4 Soil and plant based approach for the recommendation of nitrogen, phosphorus and potassium to rice and wheat in rice-wheat cropping system (SSD)

2.3.4.1 Nitrogen experiment in wheat

This experiment was laid out in randomized complete block design with nine treatments and replicated thrice. This trial was conducted to estimate the best response of wheat to different rates of nitrogen with fixed phosphorus and Potassium. The recommended dose of fertilizer for irrigated wheat is 100:40:30 kg $N_2OP_2O_5K_2O$ /ha. The plot size was $12m^2$ (4×3) and planting was done in December 22, 2016. Nine treatments consisted of 0%, 25%, 50%, 75%, 100%, 125%, 150%, 175%, and 200% of PRD for Nitrogen (previous recommended dose). Significant results were observed only for spike length and rest of the traits were at par statistically (Table 99)

Table 99: Results of different attributes of wheat in response to different nitrogen rates at NMRP Rampur 2016/17

SN	Treatment	Plant height, cm	Spike Length, cm	Tillers/ m^2	Grain yield, t/ha	Straw yield, t/ha	Remaining nutrient status in soil	
							P_2O_5 kg/ha	K_2O kg/ha
1	0:24:30:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	98	7	308	2.39	2.15	38	33
2	25:24:30:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	101	8	352	2.99	3.24	41	23
3	50:24:30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	103	8	341	3.132	3.1	39	27
4	75:24:30:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	101	9	391	3.07	3.7	38	31
5	100:24:30:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	101	8	327	3.16	3.2	39	35
6	125:24:30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	100	9	321	2.7	2.9	38	29
7	150:24;30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	98	9	276	2.27	2.49	39	37
8	175:24:30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	96	9	285	2.24	2.2	42	33
9	200:24:30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	99	9	278	2.61	3.3	41	33
	Grand mean	100	8	320	2.73	2.9	39	31
	F-test	ns		ns	ns	ns	ns	ns
	CV (%)	3	9.9	18.9	15.8	27.5	18.6	22.3
	LSD (0.05)	5.114	1.397	104.5	747.8	1395.8	12.66	12.10

2.3.4.2 Phosphorus experiment

In this experiment, the nitrogen and potassium level was same for all treatments. Only phosphorus level ranged from 0% to 200% of recommendation. Nine treatments consisted of 0%, 25%, 50%, 75%, 100%, 125%, 150%, 175%, 200% of PRD for phosphorus (previous recommended dose). All the traits under observation were statistically at par under various treatments (Table 100).

Table 100: Results of different attributes of wheat in response to different phosphorus rates at NMRP Rampur 2016/17

SN	Treatment	Plant height, cm	Spike length, cm	Tillers /m^2	Grain yield t/ha	Straw yield, t/ha	Remaining nutrient status in soil	
							P_2O_5 kg/ha	K_2O kg/ha
1	75:0:30:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	98	9	296	2.92	2.91	30	44
2	75:10:30:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	100	9	263	3.2	2.8	29	38
3	75:16:30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	96	8	265	3.2	2.55	32	52
4	75:24:30:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	101	8	289	3.2	2.7	28	48
5	75:40:30:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	101	9	289	3.1	2.95	37	46
6	75:50:30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	101	8	288	3.3	2.63	35	48
7	75:60:30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	100	9	262	3.06	2.67.	29	48
8	75:70:30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	101	8	345	3.02	2.49	33	44
9	75:80:30:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	99	9	318	2.89	2.8	29	38
	Grand mean	100	9	290	3.1	2.72	31	45
	F-test	ns	ns	ns	ns	ns	ns	ns
	CV (%)	3.6	9.9	15.8	7.5	11.7	16	22.1

2.3.4.3 Potassium experiment

In this experiment, the nitrogen and Phosphorus level was same for all treatments. Only Potassium level ranged from 0% to 200% of recommendation. Total nine treatments consisted of 0 %, 25%, 50%, 75%, 100%, 125%, %150%, 175%, 200% of PRD for Potassium (previous recommended dose). All the traits under observation were statistically at par under various treatments (Table 101).

Table 101: Results of different attributes of wheat in response to different Potassium rates at NMRP Rampur 2016/17

SN	Treatment	Plant height, cm	Spike length, cm	Til-lers/ m^2	Grain yield, t/ha	Straw yield, t/ha	Remaining nutrient status in soil	
							P_2O_5 kg/ha	K_2O kg/ha
1	75:24:0:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	95	8	258	2.27	1.80	26	34
2	75:24:7.5:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	97	9	297	2.75	2.1	27	32
3	75: 24:12:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	96	8	239	3	2.3	29	38
4	75: 24:18:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	98	9	228	3	2.2	31	38
5	75: 24:30:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	98	9	283	2.9	2.2	31	44
6	75: 24:37.5:2:5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	101	8	253	2.9	2.3	29	42
7	75: 24:45:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	97	9	274	2.6	2.3	23	50
8	75: 24:52.5:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	98	8	270	2.8	2.3	21	39

S N	Treatment	Plant height, cm	Spike length, cm	Til-lers/ m^2	Grain yield, t/ha	Straw yield, t/ha	Remaining nutrient status in soil	
							P_2O_5 kg/ha	K_2O kg/ha
9	75: 24:60:2.5:8 $N_2OP_2O_5K_2O$ BZn kg/ha	101	9	259	2.7	2.3	24	44
	Grand mean	98	9	262	2.8	2.2	27	40
	F test	ns	ns	ns	ns	ns	ns	*
	CV (%)	3.3	138.6	15	10.6	12.3	21.4	17.4
	LSD (0.05)	5.533	27.74	68.04	509	474.4	9.93	12.10

2.3.5 Updating fertilizer dose for maize hybrid RML-86/RML-96 and RML-95/ RML96 in spring season

Experiment was conducted at NMRP. planted at the spacing of 60×25cm^2. Among six rows/plot, middle four rows were harvested to record boservation on grain yield and yield attributing characters. Treatments were tested on RCB Design and replicated thrice. Treatments consisted of five levels of nitrogen and two hybrids namely RML-86/ RML-96 and RML-95/96.

Both RML-86/ RML-96 and RML-95/ RML-96 gave the highest grain yield (3.15 t/ha and 3.16t/ha respectively) with 150:60:40 kg NPK/ha followed by 120:60:40 kg NPK/ha in both variety. The details of the results have been given in Table 102.

Table 102: Responses of hybrid maize RML86/96 and RML95/96 to different level of Nitrogen

S.N	Treatments	1000 grain weight (g)	Grain yield, t/ha
1	120:60:40 kg $N_2OP_2O_5K_2O$ /ha×RML86/ RML-96	339	10
2	150:60:40 kg $N_2OP_2O_5K_2O$ /ha ×RML86/ RML-96	315	10.5
3	180:60:40 kg $N_2OP_2O_5K_2O$ /ha ×RML86/ RML-96	349	9.5
4	210:60:40 kg $N_2OP_2O_5K_2O$ /ha ×RML-86/ RML-96	330	10
5	240:60:40 kg $N_2OP_2O_5K_2O$ /ha ×RML86/ RML-96	336	9
6	120:60:40 kg $N_2OP_2O_5K_2O$ /ha×RML95/ RML-96	376	10
7	150:60:40 kg $N_2OP_2O_5K_2O$ /ha ×RML95/ RML-96	366	10.5
8	180:60:40 kg $N_2OP_2O_5K_2O$ /ha ×RML95/ RML-96	332	10
9	210:60:40 kg $N_2OP_2O_5K_2O$ /ha ×RML95/ RML-96	346	9.5
10	240:60:40 kg $N_2OP_2O_5K_2O$ /ha ×RML95/ RML-96	341	9.2
	Mean	343	9.8
	CV (%)	4.4	6.1
	F-test	**	*
	LSD (0.05)	2.57	1.019

2.3.6 Impacts of land degradation on maize yield in the middle hills

The research was carried out in Ginger Research Program Salyan in 2016 April. It consisted of five treatments replicated four times. Manakamana- 4 was used and planted at a spacing of 75×25cm^2. The plot size was 3.75m × 3 m with 5 rows.

None of the traits under various treatments were found significant (Table 103).

Table 103: Response of maize to different tillage practices

Treatment	Grain yield, t/ ha	thousand grain weight, g
No tillage + No mulch	5.51	481
No tillage + Mulch	7.2	504
Tillage + no mulch	5.18	466
Tillage + mulch	5.98	494
Bare field	0	
Mean	5.97	486
CV (%)	20.3	11.8
F-test	ns	ns

2.3.7 Use of less acidifying nitrogen fertilizers in maize tori cropping system

The research comprised of 6 treatments with 4 replications which consisted of different combination of cattle urine, FYM and mineral fertilizer. The recommended dose of fertilizer for maize is 120:60:40 kg/ha N_2O:P_2O_5:K_2O and FYM is provided at the rate of 20 t/ ha. The soil, FYM and cattle urine were analysed before and after the cultivation practices . The maize variety Rampur Composite was planted at 2073, Jestha. The subsequent crop after maize harvest was Tori for each treatment. The research plot was 3x5 m$^{2.}$ .Grain yield differences among the various treatments were found non-significant (Table 104)

Table 104: Effect of cattle urine on maize yield

Treatment	Grain yield, t/ha
All nitrogen provided by cattle urine + SSP + MOP	3.03
Recommended FYM + all nitrogen provided by cattle urine +SSP+MOP	3.27
Recommended FYM + urea + nitrogen provided by cattle urine + SSP + MOP	3.55
Recommended FYM+ urea + SSP + MOP	3.37
Double recommended FYM + urea + SSP + MOP	3.4
Recommended FYM + urea + DAP + MOP	3.2
Mean	3.3
CV (%)	8.1
F-test	ns

2.3.8 Use of wood ash and biochar as soil amendments in maize tori cropping system

The research comprised of 6 treatments with 4. The recommended dose of fertilizer 120:60:40 kg/ha $N_2OP_2O_5K_2O$ and FYM 20 t/ha was applied. The soil, FYM and cattle urine analysis were done before and after the cultivation practices (soil)**.** The plots treated by the combination of biochar @ 5 t/ha and @ 10 t/ha and FYM along with other recommended fertilizer revealed the highest grain yield (3.03) t/ha. It means biochar @ 5t/ha have same effect as biochar @10 t/ha which was followed by 2.98 t/ha as a result of the application of woodash (Table 105).

Table 105: Use of woodash and biochar as soil amendments on maize.

Treatment	Grain yield t/ha
No fertilizers	2.42
Recommended FYM + Recommended NPK	2.88
Recommended FYM + Recommended NPK + Recommended lime based on soil pH	2.9
Recommended FYM + Recommended NPK + woodash based on soil pH	2.98
Recommended FYM + Recommended NPK + biochar@ 5 t/ha	3.02
Recommended FYM + Recommended NPK + biochar@ 10 t/ha	3.02
Mean	2.88
F-Prob	**
LSD (0.05)	0.274
CV (%)	6.3

2.4 ENTOMOLOGY

2.4.1 Maize stem borer management in field condition

2.4.1.1 Testing efficacy of insecticides against maize stem borer in field condition

A field experiment with 8 treatments including control was evaluated at NMRP Rampur during 2016/17 to manage maize stem borer. The experiment was laid out in RCB design with three replications. A released variety Rampur Hybrid-4 was seeded on 2073/11/8 in a unit plot size of 6 rows of 5 m long with the spacing of 60 × 20 cm between row to row and plant to plant. After a completion of sowing, the experiment was kept under constant supervision to an entire crop cycle. Agronomic practices were followed as recommended. Each experimental unit was fertilized with a recommended dose of 180:60:40 (N_2:P_20_5:K_20) kg/ha. Data on damage percentage and yield (t/ha) were recorded.

All used insecticides had significant effect (P≤0.05) on percent damage and crop yield over control. The lower percent damage (5.29%) was observed at the plot sprayed with spinosad 45% EC at 0.5 ml/l of water with higher crop yield (1.99 t/ha) followed by the plot treated with Imidacloprid 17.8% @ 0.5 ml/l of water with percent damage of 5.73%, crop yield (1.94 t/ha). The highest percent damage (16.69%) was observed in the control plot with lower yield of 0.76 t/ha (Table 106)

Table 106: Effect of different insecticides to control maize stem borer at Rampur during 2016/17

Treatment	Total plant	% DBS	% DAS	Grain Yield (t/ha)
Fipronil 0.5 Gr @ 3-4/whorl	†147.00	7.26	7.87^{c}	1.42^{f}
Spinosad 45% EC @ 0.5ml/l of water	130.00	9.70	5.29^{h}	1.99^{a}
Chloropyrifos 10%EC @ 1.5ml/l of water	133.30	7.72	7.55^{d}	1.56^{e}
Margosom @ 3ml /l of water	131.00	9.57	7.21^{e}	1.81^{d}
Chloropyrifos 20% EC @ 1.5ml/l of water	141.00	8.69	9.06^{b}	1.28^{g}
Chloropyrifos 50%EC + Cypermethrin 5% EC (Super D) @1.5ml/l of water	123.30	11.55	6.50^{f}	1.88^{c}
Imidachloprid 17.8% (Confider 200SL) @0.5 ml/l of water	136.70	10.48	5.73^{g}	1.94^{b}
Control (water spray)	125.30	12.48	16.69^{a}	0.76^{h}
Grand mean	133.46	9.68	8.24	1.58
F test	ns	ns	**	**
$LSD_{0.05}$	50.32	4.90	0.14	0.02
CV (%)	21.53	28.92	0.91	0.80

*†Means of 3 replications. %DBS- Percent damage before spray, %DAS- Percent damage after spray, G YLD- Grain yield, t/ha- Ton per hectare, l- Liter, EC- Emulsifiable concentration, ml- Mililitre, g- Gram, Gr- Granule, NS- Not significant, **- highly significant*

2.4.1.2 Relative susceptibility of maize genotypes to maize stem borer (*Chilo partellus* Swinhoe) in the field condition

The screening activities were organized following randomized complete block design during spring season of 2016/17 under field condition at Rampur. Forty elite maize genotypes were sown on 2016/02/21 in a unit plot size of 2 rows of 5 m long with the spacing of 60 × 20 cm between row to row and plant to plant. Agronomic practices were followed as recommended. Each experimental unit was fertilized with a recommended dose of 180:60:40 (N_2:P_20_5:K_20) kg/ha. Data on damage plant, pin hole, tunnel length and yield (t/ha) were recorded.

Out of 40 screened maize genotypes, the minimum damaged plants due to stem borer were recorded on KKT-03 (7217) followed by S99TLYQ-B (9450), KEW-POP (11117) and Rampur Composite (11117) at tasseling stage (Table-94). The high yielding maize genotypes were RML-86/ RML-96 (2.60 t/ha), Rampur hybrid-4 (2.40 t/ha), R POP 14 (2.33 t/ha), S00TLYQ-B (2.18 t/ha) and S03T-

LYQ-AB-02 (2.05 t/ha), respectively (Table 107).

Table 107: Susceptibility of maize genotypes to maize stem borer *(Chilo partellus* Swinhoe) in field condition at Rampur Chitwan during 2016/17

Genotype	Total plant in ha.	Damaged plant in ha	Plant height, cm	No. of exit hole in ha	Tunnel length, cm	Grain yield (t/ha)
S03TLYQ-AB-01	96117	18333	139	10883	17	0.99
S00TLYQ-A	82783	15000	183	2217	6	1.36
HG B	81117	21117	161	7883	22	1.47
R-POPYQ-4	71117	16117	164	2333	6	1.35
LMG-23	71117	15550	150	6783	22	0.59
S99TLYQ-B	77783	22783	160	5450	15	1.50
S99TLYQ-A	78883	15000	170	3333	11	1.63
KKT-03	60550	7217	150	4883	14	0.97
RLW-POP	97217	14450	143	7217	17	0.89
R-POPYQ-2	83883	11667	158	3783	12	1.71
S03TLYQ-AB-02	78883	14450	164	7883	21	2.05
RampurS03F02	85550	16667	169	7333	19	1.27
Upahar	83333	11667	156	3883	17	1.24
BJG-14	51117	15000	154	3117	14	1.11
S00TLYQ-AB	85550	16667	157	4117	11	2.18
RampurS10F18	82217	13333	170	6550	24	1.64
MHEW-7	76667	13883	158	4783	12	1.15
R-POP-14	78333	12217	160	6217	16	2.33
KKJ-01	92783	12217	159	6883	19	0.86
S01SIWQ-12	60550	20550	151	5117	19	1.42
S99TLYQ-HG-B	79450	16117	161	6783	22	1.20
RML-95/ RML-96	77217	12783	162	5117	21	1.31
Rampur hybrid-6	90550	16667	166	3783	12	1.42
Rampur hybrid-4	94450	12783	164	6667	19	2.40
RampurS03F08	64450	16117	162	7217	20	1.75
KEW-POP	80000	11117	148	8450	22	0.75
MHEW-4	72217	17783	166	7550	25	0.87
S99TLYQ-B	90000	9450	163	7333	19	0.94
Khumal Yellow x pool-17E	96667	15550	153	4550	12	0.86
R-POP-10	90550	11667	145	4783	16	1.53
KLW-POP	84450	13883	174	6667	23	1.47
R-POP-2	82217	12783	150	7717	26	1.52
RampurS10F20	58333	22783	144	2667	11	1.38
R-POP-1	77783	13883	162	4883	14	1.40
RML-86/RML-96	73883	12783	162	4883	13	2.60

Genotype	Total plant in ha.	Damaged plant in ha	Plant height, cm	No. of exit hole in ha	Tunnel length, cm	Grain yield (t/ ha)
Jumka-pop	75000	15000	160	5450	19	1.25
MHPW-4	91667	21117	166	9550	33	0.89
Rampur Composite	80000	11117	152	6450	23	1.10
Arun-2	80000	15550	157	4667	19	1.37
Poshilo Makai-1	89450	16117	160	4783	17	1.38
Grand mean	80100	14967	159	5767	18	1.38
CV (%)	23.05	33.83	10	54.13	57.72	42.7

2.4.2 Biological parameters of maize insect pests

2.4.2.1 Collection, identification and preservation of natural enemies associated with maize based cropping system

Parasitized eggs and different stages of host insects along with damaged material like pieces of leaves, stems, twigs or other plant parts were collected. At the same time, few un-parasitised host specimens were also collected individually from the same plant and allowed to emerge to facilitate their proper identification. However, sweep net collections were also made to acquire large amount and variety of micro-hymenoptera within a possible shortest period of time in most types of vegetation. A complete record was maintained indicating the locality, date of collection, name of the host plant and host insect. The collected materials were brought into the entomology laboratory of NMRP for rearing. The selected pieces of leaves, stems, ears, tassels and other plant parts were cut into small pieces and put in rearing jars. The mouth being tightly closed with very fine muslin cloth held with a rubber band. As per necessity, the leaves and other plant parts were wrapped with cotton soaked in water to maintain proper turgid conditions. Specimens were put in constant temperature cabinet running at 70 °F and with 70 percent RH to expedite the emergence of parasitoids, otherwise the parasitoids reared under room temperature. The rearing jars examined daily for the emerged parasitoids. The emerged parasitoids collected from jars and preserved in 75 % alcohol in glass vials.

2.4.2.2 Preparation of insectaries, permanent slides, measurements and illustrations

Preparation of insectaries

Insectarium (a place for keeping, breeding, or observing living insects) prepared from multiple size bottles equipped with minute nylon mesh in order to observe their behaviors. Eggs, larva and pupa of *Corcyra cephalonica* that were reared in the laboratory were used as host in insectaries for rearing of live parasitoids

depending upon their nature that were egg parasitoids, larval parasitoids, pupal parasitoids or composite.

Preparation of permanent slides, measurements and illustrations

Natural enemies like hymenopteran wasp, Dragon fly, Ladybird beetle, Rove beetle, Ground beetle etc were collected from field using insect catching net. Collected natural enemies were reared on mixture of honey and water syrup whereas larva and pupa of *Corcyra cephalonica* were reared in the laboratory. They were used as host in insectaries for rearing of live parasitoids depending upon their nature i.e. egg parasitoids, larval parasitoids, pupal parasitoids or composite. Insect pests were reared on selected pieces of leaves, stems, ears, tassels and other plant parts that were cut into small pieces and put in rearing jars strictly following necessary arrangements for the purpose. A total of one hundred and fifty permanent slides were made and some adults of natural enemies were dried, preserved and maintained on insect collection box. Few dead insect larvae were also kept and preserved at 75% ethyl alcohol.

2.4.3 Screening of some elite maize germplasm against maize stem borer (*Chilo partellus* Swinhoe) on glass house condition at NMRP Rampur

2.4.3.1 Monitoring of maize stem borer through light trap

In order to find out the trend and diversity of insect species, light trap was operated from dusk to down from Shrawan 2073 to Ashadh 2074 at NMRP Rampur. However, trapping activities were disturbed frequently due to electricity cut and rainfall. Trapped insects were collected weekly, counted and preserved on insect collection box. A total number of borer trapped and their frequency have been summarized in Table 108.

Table 108: Frequency of maize stem borer trapped through light trap at NMRP Rampur during 2016/17

SN	Month	Average no. of borer trapped	Frequency	Remarks
1	Sharwan	4	3	Few borer, more moth, beetle and honeybee were collected from light trap.
2	Bhadra	6	3	Few borer, more moth, beetle, honeybee, tiger beetle and dragon fly were found on light trap.
3	Asoj	17	4	Dragonfly and tiger beetle were collected.
4	Kartik	21	3	More moth, some borer and field cricket were found.
5	Mangsir	11	6	Borer, moth, green stink bug, and sentomid fly were collected.
6	Poush	12	2	Some borer, green stink bug and red ant were found.
7	Magh	13	5	Some borer, green stink bug and red ant were found.

SN	Month	Average no. of borer trapped	Frequency	Remarks
8	Falgun	37	4	More borer, whitegrub adult, sentomid fly were trapped.
9	Chaitra	45	5	More borer, whitegrub adult, sentomid fly were collected.
10	Baishak	25	4	Some borer, moth and adult of red ant were trapped.
11	Jestha	11	4	Some beetles, borer and and dragon fly were found on trap.
12	Ashadh	21	3	More beetles, sentomid fly and white grub adult were trapped.

The highest (45) frequency of borer were recorded during the month of Chaitra whereas lowest during Poush. Besides borer, some moths, bug and some natural enemy namely hymenotperan pest, dragonfly, rove beetle were collected and preserved on an insect collection box.

2.4.3.2 Life history study

Adult insects, larvae, pupae or eggs were collected both from fields and light traps. Larvae collected from fields were put with host materials to become pupae and finally turned to adults from where eggs were harvested. Eggs kept on blotting paper inside petri-plate and reared for adults. Their life span in each stage/instar, and fecundity of adults recorded. Daily room temperature and relative humidity in laboratory conditions were also monitored. Life cycle of *C. partellus* larvae were studied under laboratory conditions at NMRP Rampur at room temperature of 26-27° C and RH of 70-80%. The experiments were conducted on nylon cage where larva were arranged according to size and age transferred in to plastic container. The diet was replenished in the container as and when required. The bottom of the container was lined with what-man filter paper. The average life cycle of *C partellus* was completed in 28 days during summer whereas 39 days during winter. With the availability of host plant, *C. partellus* normally developed all year round.

Egg: Flat oval and creamy white in color. Egg mass may contain 20-35 eggs. Egg appeared white in first laid and darken later. Egg hatched in 5-6 days generally in the early morning (6-8 AM).

Larva: 25-30 mm in length, purplish pink on dorsal side and white on ventral side. Larval period was 25-35 days. The average duration of first, second, third, fourth and fifth instars were; 4.7, 6.5, 7.2, 7.9 and 8 days, respectively.

Pupa: The pupae were pale brown with cylindrical shape. The average duration of pupa was 7-10 days.

Male pupa length: 13 mm while female was 16 mm long.

Moth: The fecundity of *C. partellus* was recorded 150-160 eggs per female. Oviposition period: 4 days, adult male lived for 3-7 days while female lived for 3-8 days.

2.4.3.3 Mass rearing and release of *C. partellus* and screening of some elite maize germplasm

The screening nursery was conducted following augmented design during 2016/17 under glasshouse condition at Rampur. Fourteen elite maize genotypes were sown on November 6, 2016 in a unit plot size of 1 row of 6 m long with the spacing of 50 × 20 cm between row to row and plant to plant. Agronomic practices were followed as recommended. Production of larva and artificial infestation of maize plants were carried out. The larva was produced in the laboratory of NMRP Rampur. Late instar larva were collected from field and were introduced in to artificial diet (Fraction A: 105 g of chickpea flour, 2 g of methyl para-hydroxy benzoate, 1 g sorbic acid, 0.25 g streptomycin sulphate, 2 ml of 10% formaldehyde, Fraction B: 12.75 g of agar-agar, Fraction C: 3 g yeast tablet, 3.25 g ascorbic acid, 2 capsule multivataplex) . Pupae were collected from the vials and placed in small petriplates and then put in ovipositor cage. As male moth generally emerge earlier than female, male pupae of smaller in size were collected and stored for a couple of days in low temperature of 15° C in order to obtain simultaneous emergence of both sexes. Freshly emerged moths of both sexes were kept in cage with leaf. Piece of cotton soaked with honey and water were provided for the moth as food. After 2-3 days adult female laid their eggs. Egg masses were collected and put in vials closed with cotton. After 6-7 days, newly hatched larvas were released. Observation on insect scoring (0-9 scale), total healthy and infested plants per plot, tunnel length and exit hole were recorded as described by CIMMYT.

Range of visual score at vegetative stage was (2-4.6) whereas (2-4) was recorded at tasseling stage. Thus, majority of genotypes were scored resistant to moderately resistant reaction (2-3 score) except RML-95, RML-96, RML-86 and RML-17. Percent of damage was noticed almost same at knee height stage (9-30 %) and tasseling stage (8-30%). Average tunnel length was found (2-4 cm) whereas average number of exit hole was found 0.3-0.9 (Table 109).

Table 109: Susceptibility of maize genotypes to maize stem borer (*Chilo partellus* Swinhoe) under glasshouse condition at Rampur 2016/17

SN	Maize Genotype	% DVS	% DRS	Av H No.	Av. TL, cm	Score VS	Score RS	Yield (10 ears), g
1	S99TLYQ-AB	11.08	8.21	0.40	2.00	3.00	2.08	820.00
2	BGBY-P0P	12.00	14.00	0.60	3.00	3.00	3.40	940.40
3	Deuti	9.08	10.00	0.40	2.00	3.00	3.30	842.20
4	Posilo Makai-1	18.31	10.00	0.40	3.00	3.00	4.00	702.00

SN	Maize Genotype	% DVS	% DRS	Av H No.	Av. TL, cm	Score VS	Score RS	Yield (10 ears), g
5	Rampur Hybrid-6	10.30	15.80	0.50	4.00	3.00	3.10	1000.70
6	RML-95/RML-96	18.25	20.43	0.50	3.00	3.00	2.60	1200.50
7	RML-86/RML-96	20.40	20.80	0.40	3.00	3.00	4.00	1065.50
8	Rampur Hybrid-2	16.90	21.22	0.50	3.00	2.00	3.00	1074.40
9	Rampur Hybrid-4	9.42	17.33	0.30	3.00	3.00	3.00	1054.40
10	Across 9942/Across 9944	15.00	15.90	0.30	3.00	3.00	2.00	1006.00
11	RML-95	22.00	25.00	0.70	2.00	4.00	4.00	123.00
12	RML-96	30.00	34.00	0.90	4.00	4.50	4.00	150.20
13	RML-86	24.00	28.00	0.60	3.00	4.60	4.00	140.60
14	RML-17	27.00	30.00	0.60	3.00	4.40	4.00	148.50

%DVS- Percent damage at vegetative stage, %DRS- Percent damage at reproductive stage, Av. H. No.- Average hole number, Av. TL no- Average tunnel length, Score VS- Insect score at vegetative stage, RS- Reproductive stage, g- gram, cm- centimeter

2.4.4 Evaluation of *Trichogramma* wasp in maize stem borer management

2.4.4.1 Mass rearing of *Trichogramma* in lab, its maintenance and application against maize stem borer at NMRP seed production block

Mass rearing of rice moth (*Corcyra cephalonica*) as host insect *Trichogramma*

Artificial diet for rice moth *(Corcyra cephalonica)* composed of 2.5 kg of maize grit, 250 gm of groundnut powder, 0.5 g yeast and 0.5 g streptomycin and each rearing box received 0.5 ml of fresh Corcyra eggs and diet were kept on wooden boxes of dimension 18×30×58 cm^3.

At laboratory condition, the higher number of *C. cephalonica* moth emergence from reared per box per day was recorded during April 12 to May 18 followed by August 26 to November 10. C. *cephalonica* took longer time (more than two month) to complete their life cycle during November however the shortest life cycle was recorded during the month of June (Table 110).

Table 110: Summary of *C.cephalonica* emergence record under lab condition at Rampur 2016/17

Month	No of boxes for rearing	Avg. moth per box	Total no. of moth	Temperature (° C)		Relative humidity (%)	
				Max	Min	Max	Min
July 4, 2016- Sep 14, 2016	4	798	3190	30.4	27.6	89	77
Aug 10, 2016- Oct 15, 2016	4	730	2919	30.9	27.1	88	78
Aug 26, 2016- Nov 10, 2016	4	1171	4684	30.9	21.4	88	66
April 12, 2016- May 18, 2017	4	1690	6759	28.7	21.8	76	54
July 7, 2017- Aug 31, 2017	3	712	2135	38.1	14.6	97	75

Application of Trichogramma in seed production block at NMRP

A total of four maize seed production blocks (each of 10 m^2) at NMRP were selected and laboratory-reared *Trichogramma* @ 100000/ha were released on three plots out of 4 during the month of Mangshir 2073. Total healthy plants, total damaged plants and number of dead heart plants were recorded.

The percent damage before release of *Trichogramma* ranged from 18.2-30%, whereas it ranged from 6-12.4% after release. In case of control plot the percent damage was recorded 24 to 37% which was more than triple as compared to released plot (Table 111). Based on our field study it is concluded that infestation of maize borer was major problem in seed production block and, therefore release of *Trichogramma* is utmost necessary.

Table 111: Application of *Trichogramma* in maize seed production block at NMRP during 2074

Plot no.	% Damage before release	% damage after release	Dead heart per plot before release	Dead heart per plot after release
101	18.2	6	2	1
102	20	8	2	1
103	30	12.4	3	1
104 (Control)	24	37	2	5

2.4.5 Storage pest management

2.4.5.1 Management of maize storage pests through the use of indigenous botanical pesticides

A lab experiment was conducted in the entomology lab of NMRP from April to October, 2017 to evaluate the performance of seven various botanicals including control against weevil. Bojho (*Acorus calamus*) rhizome powder @ 10 g/kg, Neem (*Azadirachta indica*) seed powder @ 10 g/kg, Timur (*Zanthoxylum alatum*) seed powder @ 4 g/kg, Titepati (*Artemisia vulgaris*) leaf dust @10 g/kg, Asuro (*Justicia adhatoda*) leaf dust @ 10 g/kg, Bakaino (*Melia azadirach*) seed powder @10 g/kg were used in the experiment. Three kg maize seeds (Variety- Manakamana-3) were taken for each treatment for the experiment which was laid out in completely randomized design (CRD) with three replications for the management of weevil in natural conditions. For data observation, sampling was done with 100 g of maize seeds and analyzed for total grain damage, weight loss, total weevil emergence and the final number of exit holes made by the weevil.

Among the treatments, Bojho (*Acorus calamus*) @ 10 g/kg of maize seed showed the better result along the whole six months period of the experiment in storage condition at Rampur (Table 112).

Table 112: Response of botanicals on maize weevil management

SN	Treatment	% grain damage	% weight loss	Total weevil number	No. of exit holes
1	Bojho (*Acorus calamus*) rhizome powder@ 10 g/kg	0.77	1.124	0.71	1.17
2	Neem *(Azadirachta indica)* seed powder@ 10 g/kg	3.64	2.366	0.71	2.29
3	Titepati *(Artemisia vulgaris)* leaf dust@10 g/kg	1.75	1.921	1.56	1.95
4	Timur*(Zanthoxylum alatum)* seed powder@3 g/kg	2.11	1.607	1.18	2.32
5	Bakaino*(Melia azadirach)* seed powder@10 g/kg	2.60	2.150	1	1.71
6	Asuro *(Justicia adhatoda)* leaf dust @10 g/kg	2.27	2.218	1.56	2.23
7	Control	5.88	3.971	3.28	3.85
	Grand mean	2.717	2.194	1.429	2.217
	F-value	<0.001	<0.001	0.002	0.001
	CV (%)	22.3	19.1	41.4	22.3
	LSD (0.05)	1.104	0.624	1	0.881

2.4.5.2 Evaluation of effect of packing materials and seed moisture content on storability of maize (*Zea mays* L.) seeds

Maize variety (Manakamana-3) was taken for the experiment to evaluate the efficacy of different storage structures at different moisture level against the maize weevil for six months from April to October, 2017. A laboratory experiment was setup to select the best storage structure for maize at two different moisture levels (12% and 15%). Five kg of maize seeds was taken for each storage structure at both 12% and 15% moisture level. Treatments were arranged in a factorial design at two different moisture levels with seven storage structures. For data observation, sampling was done with 100 g of maize seeds and analyzed for total grain damage, weight loss, total weevil emergence and the final number of exit holes made by the weevil.

In both the moisture levels, the least damage was found in Super grain bag and PICS (Purdue Improved Crop Storage) bag. Both the structures were found safe for the whole six months experimental period against the maize weevil (Table 113 and Table 114).

Table 113: Response of different storage structures at 12% moisture level against maize weevil

SN	Treatment	% grain damage	% weight loss	Total weevil number	No. of exit holes
1	Super grain bag	1.49	0.75	1.22	1.77
2	PICS bag	1.84	1.91	1.74	3.32
3	400 gauge plastic	2.42	6.15	1.66	2.48
4	200 guage plastic	2.49	5.19	1.58	3.02
5	Metal bin	2.86	7.25	2.54	3.47

SN	Treatment	% grain damage	% weight loss	Total weevil number	No. of exit holes
6	Jute bag	6.31	7.39	3.66	9.28
7	Normal bag (control)	6.97	9.05	5.69	11.12
	Grand mean	3.48	5.38	2.58	4.92
	F-value	**	**	**	**
	CV (%)	23.0	10.6	18.2	25.5
	LSD (0.05)	1.427	1.014	0.838	2.237

Table 114: Response of different storage structures at 15% moisture level against maize weevil

SN	Treatment	% grain damage	% weight loss	Total weevil number	No. of exit holes
1	Super grain bag	2.36	0.848	1.332	2.51
2	PICS bag	2.54	1.732	1.549	3.07
3	400 gauge plastic	6.02	2.294	2.402	7.23
4	200 guage plastic	3.60	2.030	2.020	4.55
5	Metal bin	7.61	3.422	2.886	11.35
6	Jute bag	7.65	3.831	2.960	11.48
7	Normal bag (control)	8.11	4.249	3.080	11.80
	Grand mean	5.41	2.63	2.32	7.43
	F-value	<0.001	<0.001	<0.001	<0.001
	CV (%)	10.2	11.6	14.8	17.3
	LSD (0.05)	0.979	0.544	0.6114	2.283

2.4.5.3 Armyworm management

Study of bionomics of armyworm (*Mythimna spp.*) and their ecofriendly management using bio-rational alternatives

An experiment was conducted in research field of NMRP from October to April, 2017 to evaluate the efficiency of different rationale pesticides for the management of armyworm (*Mythimna separata*). Maize variety Rampur Hybrid-4 was used for the purpose with eight treatments in RCB design which was replicated thrice. The pesticides used were *Metarrhizium anisopliae* @ 0.2 ml/l water, *Nuclear Polyhedrosis* virus @ 2.5 g/l water, Spinosad @ 0.5 ml/l water, Multineem @ 2 ml/l water, Furadon @ 3-4 grannules/whorl, Lara (Chloropyriphos 50% + cypermethrin5%) @1 ml/l water, Magik (Imidachloropid 17.8%) @ 0.5 ml/l water and control. Three different sprays were made i.e. one month after sowing, fifteen days after first spray and another fifteen days after second spray. The number of infested plants was counted before the spray of pesticides and after each spray of pesticides. The final yield was weighted from each plot.

A field survey was also carried out at different places of Chitwan and Nawalparasi districts in farmers' field to observe the damage frequency at both knee height and before tasseling stages. The number of plants infested was counted from five selected farmers' fields from each place at both the stages.

From the experiment, Spinosad was found superior in terms of both the yield as well as damage of the plants (Table 115). Also, the loss assessment made in farmers' fields of different VDCs in Chitwan and Nawalparasi districts showed an average of 9.33% damage at knee height stage and 16.27% at before tasseling stage.

Table 115: Efficacy of different pesticides against armyworm (*Mythimna separata*)

SN	Treatment	Yield, t/ha	Damage before spray	Damage after spray
1	*Metarrhizium anisopliae*	8.15	5.03	4.26
2	Nuclear Polyhedrosis virus	8.25	2.4	3.39
3	Spinosad	9.12	3.45	1.07
4	Multineem	8.40	2.88	2.70
5	Furadon	8.22	3.31	2.71
6	Lara	8.70	2.63	1.60
7	Magik	8.21	2.11	3.54
8	Control	7.18	2.94	7.79
	Grand mean	8.28	3.094	3.383
	F-value	<0.001	0.558	0.001
	CV (%)	3.1	54.1	37.3
	LSD (0.05)	0.445	2.933	2.206

2.5 PLANT PATHOLOGY

Both abiotic and biotic stresses contribute to lower maize yields in Nepal. The most devastating diseases of maize in the context of Nepal are leaf blights (northern and southern), ear rot, stalk rot, rust, downy mildews etc. Considering the importance of major diseases, maize genotypes were evaluated for gray leaf spot (GLS), turcicum leaf blight (TLB), southern leaf blight (SLB), banded leaf and sheath blight (BLSB) and ear rot diseases during 2016/17 summer and winter seasons at different locations.

All experiments were conducted in RCB design with three replications having two rows of five meter long plot size. For banded leaf and sheath blight, turcicum leaf blight and ear rot diseases, all the plants were artificially inoculated using fresh culture multiplied in laboratory. For scoring foliar diseases (TLB, SLB, GLS) (Table 116), BLSB (Table 117), ear rot (Table 118) the following scoring methods were employed.

Table 116: Disease symptoms, severity scale and susceptibility reaction for foliar diseases (TLB, SLB, GLS)

Disease symptoms	Severity scale	Disease Reaction/ susceptibility class
Plants with one or two to few scattered lesions on lower leaves	1	Resistant
Moderate number of lesions on leaves, affecting less than 25 percent of the area	2	Moderately resistant
Abundant lesions on lower leaves, few on other leaves affecting 26-50% leaf area	3	Moderately susceptible
Lesions abundant on lower and mid leaves, extending to upper leaves affecting 51-75% leaf area	4	Susceptible
Lesions abundant on almost all leaves, plant prematurely dried or killed with 76-100% of the leaf area affected	5	Highly susceptible

Source:CIMMYT

Table 117: Disease symptoms, severity scale and susceptibility reaction of BLSB disease using following disease scoring scale (CIMMYT system)

Disease symptoms	Severity scale	Disease reaction/ susceptibility class
No infection	1	Resistant
Partial infection up to four leaf sheath and leaves	2	Moderately resistant
Heavy infection up to lower four leaf sheath and leaves partial on upper leaf sheath below the ear placement, no ear infection	3	Moderately susceptible
Heavy infection on all leaf sheath and leaves below the ear placement, partial infection on ears	4	Susceptible
Complete rotting of ears, very little or no grain formation, grain become chaffy or may be rotten	5	Highly susceptible

Table 118: Disease symptoms, severity scale and susceptibility reaction for ear rot disease, scoring scale (Reid & Hamilton, 1996)

Disease symptoms	Severity scale	Disease reaction/ susceptibility class
Ears without ear rot symptoms	1	Immune
Ears with 1-3% kernels diseased	2	Highly resistant
Ears with 4-10 % kernels diseased	3	Resistant
Ears with 11-25 % kernels diseased	4	Moderately resistant
Ears with 26-50% kernels diseased	5	Moderately susceptible
Ears with 51-75% ears diseased	6	Susceptible
Ears with >76% to 100% kernels diseased	7	Highly susceptible

2.5.1 Gray leaf spot (GLS)

This disease is caused by the fungus *Cercospora zeae maydis* and is the main destructive disease of maize crop in the mid hills and high hills of Nepal. To identify the source of resistant, maize genotypes were evaluated in different hill stations in the summer season of 2016. The experiment included 20 maize genotypes planted in two replications with two rows per plot. At Baluwapati, Kavre, out of 20 genotypes, ZM-627 reacted resistant (R) reaction and other 10 genotypes showed moderately resistant (MR) reaction (1.5-2.5) and rest of the genotypes were moderately susceptible (MS) (Table 119). The same set was also evaluated at HCRP, Kabre where most of the genotypes reacted resistant to moderately resistant (Table 120). Out of 20 genotypes 12 were resistant and 8 were moderately resistant. Genotypes promising for grain yield and resistant to GLS were Rampur-32 (7.7 t/ha), Manakamana-3 (7.1 t/ha) with resistant reaction and ZM-401 (7.2 t/ha) with moderately resistant against GLS. At Pakhribas, only farmers' local reacted moderately susceptible (MS) reaction and five genotypes namely 05SADVI, Across 9942/Across 9944, BGBYPOP, Rampur-28 and RML-32/RML-17 responded resistant reaction (1.0-1.5) and these genotypes also produced comparatively higher grain yield (Table 121). The result from GRP Salyan revealed that non of the genotypes exhibited resistant reaction but six genotypes reacted moderately resistant (MR) reaction and one genotype RML-32/RML-17 was found susceptible at this location (Table 122). The genotype ZM-627 produced the highest grain yield (7.2 t/ha) with moderately resistant reaction against GLS.

Table 119: Response of maize genotypes against GLS 2016 summer at Baluwapati Kavre

SN	Genotype	GLS (1-5)	Disease reaction	BLSB (1-5)	TLB (1-5)
1	ZM-401	2.0	MR	1.8	2.0
2	ZM-627	1.0	R	2.0	1.3
3	05SADVI	2.0	MR	1.8	1.5
4	07SADVI	1.8	MR	1.5	1.3
5	TLBRSO7F16	2.8	MS	1.5	2.0
6	P501SRCO/P502SRCO	2.9	MS	1.5	2.0
7	AC9942/AC9944	3.5	MS	1.8	1.3
8	BGBYPOP	2.8	MS	2.3	2.0
9	Rampur-33	2.0	MR	2.3	2.0
10	Rampur -24	2.5	MR	2.3	2.5
11	Rampur -36	3.2	MS	1.8	2.3
12	Rampur -27	3.0	MS	2.5	2.5
13	Rampur 03F08	2.4	MR	2.0	1.5

SN	Genotype	GLS (1-5)	Disease reaction	BLSB (1-5)	TLB (1-5)
14	Rampur -28	2.4	MR	2.0	2.0
15	Rampur -34	2.5	MR	1.8	2.3
16	Rampur -32	2.0	MR	2.3	2.3
17	Rampur -21	1.8	MR	2.3	1.5
18	Rampur Hybrid-4	3.1	MS	2.8	2.5
19	Manakamana-3	2.3	MS	2.3	2.0
20	Farmers' local	3.0	MS	2.0	2.3
	Mean	2.4		2.0	1.9
	F-test	ns		ns	*
	CV (%)	25.7		18.5	19.5
	LSD(0.05)	-		-	0.8

Table 120: Response of maize genotypes against GLS 2016 summer at HCRP Kabre

SN	Genotype	GLS (1-5)	Disease Reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
1	ZM401	2.0	MR	7.2	232	111
2	ZM-627	1.5	R	5.5	225	112
3	05SADVI	1.0	R	6.4	246	127
4	07SADVI	1.0	R	7.3	268	113
5	TLBRSO7F16	1.5	R	5.3	240	121
6	P501SRCO/P502SRCO	2.0	MR	3.4	231	120
7	Across 9942/Across 9944	1.0	R	5.2	273	127
8	BGBYPOP	1.0	R	6.7	232	121
9	Rampur-33	1.5	R	3.1	198	99
10	Rampur -24	2.0	MR	5.4	185	99
11	Rampur -36	2.0	MR	4.2	254	111
12	Rampur -27	1.0	R	6.2	246	119
13	Rampur S03F08	2.5	MR	6.0	186	116
14	Rampur -28	1.5	R	5.1	213	109
15	Rampur -34	2.0	MR	5.4	211	107
16	Rampur -32	1.0	R	7.7	258	134
17	Rampur -21	2.0	MR	3.0	189	90
18	Rampur Hybrid-4	2.5	MR	6.6	217	113
19	Manakamana-3	1.0	R	7.1	244	128
20	Farmers' local	1.5	R	6.7	293	185
	Mean	1.6		5.7	232	118
	F-test	*		ns	ns	*
	CV (%)	32		43.1	13.2	14.2
	LSD (0.05)	1		5.1	64	35.01

Table 121: Response of maize genotypes against GLS 2016 summer at ARS Pakhribas

SN	Genotype	GLS (1-5)	Disease reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
1	ZM-401	1.8	MR	3.8	164	88
2	ZM-627	2.0	MR	5.7	183	104
3	05SADVI	1.5	R	5.3	169	90
4	07SADVI	2.3	MR	3.8	182	86
5	TLBRS07F16	1.8	MR	3.7	187	96
6	P501SRCO/P502SRCO	1.8	MR	4.0	185	90
7	Across 9942/Across 9944	1.5	R	4.1	198	115
8	BGBYPOP	1.5	R	3.9	194	105
9	Rampur-33	1.8	MR	3.0	179	95
10	Rampur -24	2.3	MR	4.2	183	87
11	Rampur -36	1.8	MR	2.8	204	103
12	Rampur R-27	1.8	MR	3.9	180	99
13	Rampur SO3FO8	1.8	MR	3.8	188	100
14	Rampur -28	1.5	R	1.3	154	76
15	Rampur -34	2.3	MR	3.2	156	71
16	Rampur -32	1.8	MR	3.3	160	78
17	Rampur -21	2.3	MR	2.3	188	98
18	Rampur Hybrid-4	1.5	R	4.5	207	111
19	Manakamana-3	1.8	MR	3.9	163	85
20	F. local	2.8	MS	4.0	208	121
	Mean	1.9		3.7	181	95
	F-test	ns		ns	ns	ns
	CV (%)	26.7		31	11.4	16
	LSD(0.05)	1		2.4	43	31.8

Table 122: Response of maize genotypes against GLS 2016 summer at GRP Salyan

SN	Genotype	GLS (1-5)	Disease reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
1	ZM-401	2.0	MR	5.8	182	97
2	ZM-627	2.5	MR	7.2	177	96
3	05SADVI	3.0	MS	5.7	185	105
4	07SADVI	2.0	MR	6.3	197	105
5	TLBRSO7F16	2.8	MS	4.4	178	98
6	P501SRCO|P502SRCO	2.8	MS	4.0	204	98
7	AC9942|AC9944	3.5	MS	3.0	180	100

SN	Genotype	GLS (1-5)	Disease reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
8	BGBYPOP	2.8	MS	4.6	190	108
9	Rampur -33	2.3	MR	6.1	177	98
10	Rampur -24	3.0	MS	2.7	149	69
11	Rampur -36	2.8	MS	2.0	171	92
12	Rampur -27	3.0	MS	2.5	174	94
13	Rampur S03F08	3.0	MS	5.2	195	108
14	Rampur -28	2.8	MS	3.0	170	84
15	Rampur -34	2.8	MS	3.3	177	90
16	Rampur -32	2.8	MS	5.2	168	99
17	Rampur -21	2.0	MR	3.0	166	85
18	Rampur Hybrid-4	3.8	S	1.7	163	82
19	Manakamana-3	2.0	MR	5.8	173	103
20	F. local	3.0	MS	5.6	195	120
	Mean	2.7		4.4	178	96
	F-test	**		ns	ns	*
	CV (%)	10.3		47.6	7.3	10.6
	LSD(0.05)	0.6		4.3	27.4	21.3

2.5.2 Banded leaf and sheath blight (BLSB)

Banded leaf and sheath blight (BLSB) (*Rhizoctonia solani* f. sp. *sasakiI*) is considered to be the most important one creating a threat to successful maize cultivation in Terai during summer and mid hills of Nepal. The disease has become an increasing severe and economically important disease of maize during last two decades or so, in several countries of Asia including Nepal (Sharma *et al.,* 2002). This disease is favored by hot and humid environment and may appear in more severe form in the foot plains of Himalayan region including Terai region of Nepal. With the consideration of importance of disease, maize genotypes were screened against this disease under inoculated conditions including 20 genotypes at Rampur and RARS Lumle. The result from Rampur indicated that out of 20 genotypes 14 reacted moderately resistant (MR) against BLSB (Table 123). All the tested genotypes produced relatively lower grain yield at Rampur and highest grain yield was recorded from Rampur Hybrid-4 (3.5 t/ha) with moderately resistant reaction against this disease. At Lumle, out of 20 genotypes only six genotypes were recorded moderately susceptible (MS) and rest of the genotypes reacted susceptible (S) reactions. The tested genotypes yielded more than 2 t/ha grain yield (Table 124).

Table 123: Response of maize genotypes against BLSB 2016 summer at NMRP Rampur

SN	Genotype	BLSB (1-5)	Disease reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
1	BGBYPOP	2.0	MR	2.9	158	73
2	Rampur -33	2.0	MR	2.2	180	95
3	Rampur -24	2.8	MS	1.1	105	38
4	Rampur -36	2.5	MR	0.8	168	70
5	Rampur R-27	2.3	MR	1.9	148	70
6	Rampur S03F08	2.5	MR	2.2	170	78
7	Rampur -28	2.5	MR	1.9	158	85
8	Rampur R-34	2.5	MR	1.7	143	58
9	Rampur -32	2.5	MR	3.4	185	98
10	Rampur -21	3.0	MS	0.7	128	53
11	RML-95/RML-96	2.3	MR	0.8	168	95
12	ZM-401	3.0	MS	3.4	150	83
13	ZM-627	2.5	MR	2.5	160	78
14	05SADVI	2.0	MR	1.2	160	75
15	07SADVI	2.8	MS	2.8	180	93
16	TLBRSO7F16	2.3	MR	2.6	173	98
17	P501SRCO/P502SRCO	2.3	MR	2.9	175	88
18	Rampur Hybrid-4	2.0	MR	3.5	165	90
19	Rampur Composite	3.3	MS	3.2	185	113
20	F. local	3.3	MS	1	150	78
	Mean	2.5		2.1	160	80.1
	F-test	ns		**	ns	ns
	CV (%)	19		31.1	13.3	27.3
	LSD(0.05)	1		1.4	44.6	45.7

Table 124: Response of maize genotypes against BLSB 2016 summer at RARS Lumle

SN	Genotype	BLSB (1-5)	Disease reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
1	BGYPOP	3.5	MS	4.3	113	103
2	Rampur-33	4.0	S	5.0	83	54
3	Rampur-24	4.0	S	5.5	122	80
4	Rampur-36	4.0	S	4.3	131	98
5	Rampur-27	3.5	MS	4.7	104	97
6	Rams03F08	3.5	MS	3.1	109	92

SN	Genotype	BLSB (1-5)	Disease reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
7	Rampur-28	4.0	S	3.1	77	98
8	Rampur-34	2.9	MS	2.7	104	84
9	Rampur-32	3.8	S	4.8	81	54
10	Rampur-21	4.0	S	5.2	74	90
11	RML-95/RML-96	4.0	S	4.9	71	77
12	ZM401	3.8	S	4.4	73	56
13	ZM627	4.0	S	5.1	74	65
14	05SADVI	3.8	S	2.6	95	77
15	07SADVI	4.0	S	3.8	113	82
16	TLBRS07F16	3.6	S	3.3	99	68
17	P50SRCO/P502SRCO	3.1	MS	5.1	92	85
18	Rampur Hybrid-4	4.0	S	4.6	100	69
19	Rampur Composite	3.8	S	5.0	98	80
20	Farmers' local	3.5	MS	4.2	91	77
	Mean	3.7		4.28	95	79.3
	F-test	**		ns	ns	ns
	CV (%)	4		26.3	25.6	29
	LSD(0.05)	0.3		-	-	-

2.5.3 Turcicum leaf blight

Turcicum leaf blight (TLB) of maize caused by *Exserohilum turcicum* (Pass.) K.J. Leonard and E.G. Suggs (teleomorph *Setosphaeria turcica* Luttrell) was first observed by Passerini on maize (*Zea mays* L.) in Italy in 1876, and has been reported from all maize growing areas of the world. The pathogen was formerly known as *Helminthosporium turcicum.* Khadka and Shah (1967) reported this disease for the first time in Nepal. TLB, also known as Northern corn leaf blight (NCLB), is more prevalent in the hills during summer and winter to early spring in Terai and Inner Terai. The disease occurs in maize from the seedling to maturity stages. The epidemic of the disease is increasing every year in all maize growing areas because of intensive maize cultivation where two to three maize crops are harvested each year from the same land. With observing the importance of this disease, 15 maize genotypes were screened at Rampur under inoculated conditions. The severity of disease among the tested genotypes differed significantly (Table 125). None of the genotypes exhibited resistant reaction but four genotypes were found moderately resistant (MR) against this disease. Highest grain yield was recorded from RML-55/RL-105 (4.6 t/ha) with MR reactions.

Table 125: Response of maize genotypes against TLB 2016/17 winter at NMRP Rampur

SN	Genotype	TLB (1-5)	Disease reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
1	RML-76/RL-105	2.3	MR	3.6	220	115
2	RML-87/RL-105	2.7	MS	3.1	183	135
3	RL-180/RML-5	3.2	MS	2.0	192	102
4	RML-95/RL-105	3.7	S	2.4	202	115
5	RL-153/RL-105	2.7	MS	2.5	208	123
6	RML-55/RL-105	2.5	MR	4.6	212	143
7	RML-5/RL-105	2.3	MR	2.7	205	122
8	RML-85/RL-105	3.3	MS	2.4	222	122
9	RML-57/RL-174	3.7	S	1.8	227	127
10	RL-36/RL-197	3.0	MS	3.2	202	102
11	JM-4	3.2	MS	2.0	212	112
12	JM-7	3.7	S	1.9	235	137
13	JM-8	3.3	MS	4.2	210	103
14	P-3533	2.3	MR	4.0	228	112
15	Farmers' local	3.0	MS	3.1	200	127
	Mean	3		2.9	210	120
	F-test	*		ns	ns	ns
	CV (%)	19.3		52.2	9.8	15.5
	LSD(0.05)	1		-	-	-

2.5.4 Ear rot

Over 100 fungi are reported to cause ear rots in the field while the number of important ear rots is confined to less than 20 fungi. Several *Fusarium* spp. and *Aspergillus flavus* are important ear rot fungi and besides directly reducing the quality of the grain by their infection, they also produce potent mycotoxins which affect the health of humans and animals if consumed the infected grains. Not only production of toxins, these rotting fungi cause economic level of maize grain yield loss both in field as well as in storage conditions. Maize screening against ear rot caused by *Fusarium moniliformi* was carried out at Rampur in 15 maize genotypes under inoculated conditions. From the result, three genotypes; RML-6/RL-105, RML-55/RL-105 and RL-36/RL-197 were recorded resistant for ear rot disease (4-10%) and rest of the genotypes were moderately resistant for ths disease (Table 126).

Table 126: Response of maize genotypes against ear rot (ER) 2016 summer at NMRP Rampur

SN	Genotype	Ear rot (%)	Disease reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
1	RML-76/RL-105	10.7	MR	3.6	220	115
2	RML-87/RL-105	10.3	R	3.1	183	135
3	RL-180/RML-5	25.8	MS	2.0	192	102
4	RML-95/RL-105	15.4	MR	2.4	202	115
5	RL-153/RL-105	16.9	MR	2.5	208	123
6	RML-55/RL-105	8.4	R	4.6	212	143
7	RML-5/RL-105	12.5	MR	2.7	205	122
8	RML-85/RL-105	22.8	MR	2.4	222	122
9	RML-57/RL-174	13.9	MR	1.8	227	127
10	RL-36/RL-197	8.0	R	3.2	202	102
11	JM-4	23.7	MR	2.0	212	112
12	JM-7	15.3	MR	1.9	235	137
13	JM-8	15.6	MR	4.2	210	103
14	P-3533	23.7	MR	4.0	228	112
15	Rampur Hybrid-2	23.9	MR	3.1	200	127
	Mean	16		2.9	210	120
	F-test	ns		ns	ns	ns
	CV (%)	75.1		52.2	9.8	15.5
	LSD(0.05)					

2.5.5 Southern leaf blight (SLB)

Southern leaf blight (SLB) caused by *Dreschlera maydis* Synonym: *Helminthosporium maydis* is one of the major foliar diseases of maize in Nepal. Field experiments were conducted to identify the sources of resistance in different open pollinated varieties and synthetics in 2016 summer in 2 replications in RCBD at NMRP Rampur. Twenty maize genotypes including susceptible check (yellow popcorn) were included in the experiment. Nine genotypes namely; BGBYPOP, Rampur-27, RampurS03F08, Rampur-34, RML-95/RML-96, 05SADVI, TLBRS07F016, P501SRCO/P502SRCO and RML-32/RML-17 reacted moderately resistant (MR) and Rampur-24, Rampur-21 and Yellow popcorn were susceptible against this disease (Table 127).

Table 127: Response of maize genotypes against SLB 2016 summer at NMRP Rampur

SN	Genotype	SLB (1-5)	Disease reaction	Grain yield, t/ha	Height, cm	
					Plant	Ear
1	BGBYPOP	2.3	MR	2.9	158	73
2	Rampur-33	2.8	MS	2.2	180	95
3	Rampur -24	4.5	S	1.1	105	38
4	Rampur -36	3.0	MS	0.8	168	70
5	Rampur -27	2.5	MR	1.9	148	70
6	Rampur S03F08	2.3	MR	2.2	170	78
7	Rampur -28	2.8	MS	1.9	158	85
8	Rampur R-34	2.5	MR	1.7	143	58
9	Rampur -32	2.8	MS	3.4	185	98
10	Rampur -21	4.0	S	0.7	128	53
11	RML-95/RML-96	2.3	MR	0.8	168	95
12	ZM-401	2.8	MS	3.4	150	83
13	ZM-627	3.3	MS	2.5	160	78
14	05SADVI	2.0	MR	1.2	160	75
15	07SADVI	3.3	MS	2.8	180	93
16	TLBRSO7F16	2.3	MR	2.6	173	98
17	P501SRCO/P502SRCO	2.5	MR	2.9	175	88
18	Rampur Hybrid-4	2.0	MR	3.5	165	90
19	Rampur Composite	3.3	MS	3.2	185	113
20	Yellow pop corn	3.8	S	1.0	150	78
	Mean	2.8		2.1	160	80.1
	F-test	**		**	ns	ns
	CV (%)	17		31.1	13.3	27.3
	LSD(0.05)	1		1.4	44.6	45.7

From the result of the tested genotypes for different diseases, some genotypes showed multiple disease resistant and such types of genotypes could be directly released as a disease resistant variety or it can be utilized in national maize breeding program. Some selected genotypes moderately resistant to GLS were ZM-401, ZM-627, 05SADVI, 07SADVI, TLBRSO7F16, BGBYPOP and RAMPUR-21. Similarly promising genotypes against BLSB were BGBYPOP, RAMPUR-33, RAMS03F08, ZM-627 and P501SRCO/P502SRCO. For TLB resistant three genotypes were selected namely RML-76/RL-105, RML-55/RL-105 and RML-5/RL-105. For ear rot resistant, three genotypes namely RML-87/RL-105, RML-55/RL-105 and RL-36/RL-197 exhibited resistant reactions. Likewise for SLB, the selected genotypes from the

experiments were BGBYPOP, RAMPUR-27, RAMS03F08, RML-95/RML-96, 05SADVI, TLBRSO7F16, P501SRCO/P502SRCO and Rampur Hybrid-4.

2.5.6 Integrated management of maize stalk rot complex disease

Stalk rot complex of maize is now recognized as a remarkable problem in tropical and subtropical maize growing areas of Nepal. Usually post-flowering maize stalk rot is prominent than pre-flowering to reduce maize yield. The pre-flowering types of stalk rot includes pythium stalk rot (*Pythium aphanidermatum*) and bacterial stalk rot (*Erwinia chrysanthemi* pv. *Zeae*), whereas others, such as *Fusarium* wilt, late wilt (*Cephalosporium maydis*), black bundle disease and charcoal rot (*Macrophomina phaseolina*) appear in the post-flowering phase. Stalk rot is distributed throughout the country, but it is most prevalent in the hot and humid areas like Dang, Chitwan, Nawalparasi and Surkhet, however *Pythium* stalk rot is found to be common in the mountains and the valleys in Nepal. From global point of view, an estimated yield loss of 9-10% have been reported due to stalk rot complex and varied from 4% in northern Europe to 14% in South Asia and West Africa. In Nepal bacterial stalk rot of maize (*Erwinia chrysanthemi* pv Zeae) can cause up to 80% yield loss along with other fungal diseases in Terai area. Stalk rot complex slowly becomes a serious threat in most of the Terai and foot hill valleys in Nepal. The complete package including development of disease resistant/tolerant variety with management practices would be effective to maize growers to tackle with the biotic constraints they faced and ultimately help to increase the maize productivity too.

2.5.6.1 Disease monitoring

A field monitoring for stalk rot complex of maize was done during crop season (August 2016) covering about 10 farmers' field each of 5 potential maize growing districts – Chitwan, Nawalparsi, Dang, Banke and Surkhet. For the surveillance, concerned officers from the respective DADOs and scientists from NMRP, NARC research stations and CIMMYT were involved. The disease data were recorded from 10 randomly tagged plants/plot on the basis of 1-9 scoring scale (ICAR, 2012).

1 - Healthy or slight discoloration at the site of inoculation.

2 - Up to 50% of the inoculated inter-node is discolored.

3 - 51-75% of the inoculated inter-node is discolored.

4 - 76-100% of the inoculated inter-node is discolored.

5 - Less than 50% discoloration of the adjacent inter-node.

6 - More than 50% discoloration of the adjacent inter-node.

7 - Discoloration of three internodes.

8 - Discoloration of four internodes.

9 - Discoloration of five or more internodes and premature death of plant.

Based on the counts, disease incidence and index (severity) were recorded and suspected diseased specimens were collected for isolation and identification of pathogens under laboratory condition. Disease incidence and percent disease index (PDI) were calculated using the formula Developed by Wheeler, 1969.

A disease monitoring form was developed to record the surveyor name, location detail, date of the survey, latitude, longitude and elevation of the survey site, crop growth stage, field area size, if disease sample collected (sample ID number) and finally any comments or observations to understand the socio economic impact of the disease. Disease maps were developed by using disease data of surveyed area.

The stalk rot complex symptoms were found very common and damaging in maize fields in western belts of Dang (80.86% PDI and 65.00% incidence), Chitwan (61.82% PDI and 61.00% incidence) and Nawalparasi (55.55% PDI and 52.00 % incidence), respectively (Table 128).

The lower disease index of 23.52 % with 14.00% incidence was recorded in Khaskusum area of Banke district followed by Surkhet having 43.57% PDI and 29.00% incidence where crop showed resistant to moderately susceptible reaction to the disease (Table 128). Disease maps for disease index or severity (Figure 4) and disease incidence (Figure 5) were developed by using the disease data of PDI and incidence of 5 monitored districts during August 2016 where 1 dot represents 1% PDI for Figure 4 and 1% incidence for Figure 5. Districts with higher dot densities were considered as severely infected districts for maize stalk rot complex while districts with lower dot densities were showed mild response to the disease severity and incidence.

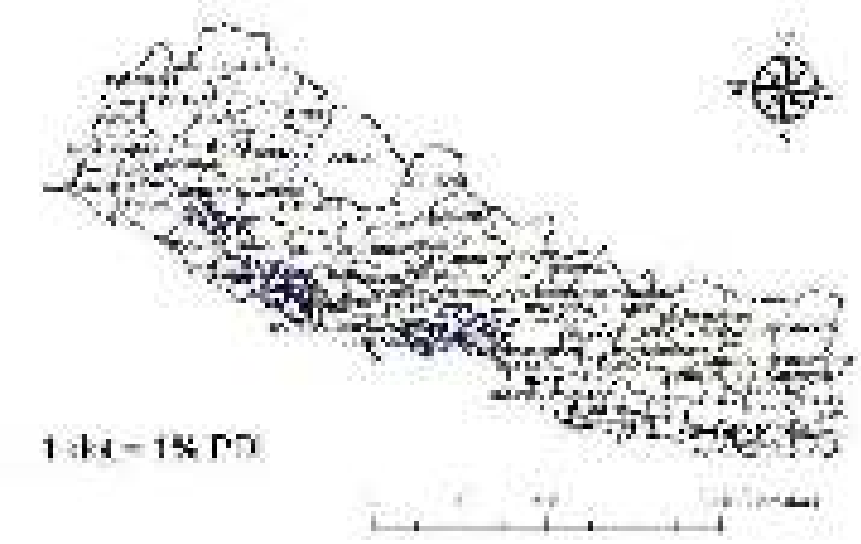


Figure 4: A disease map for disease index (severity) of maize stalk rot complex in 5 maize growing districts of Nepal monitored during summer season 2016

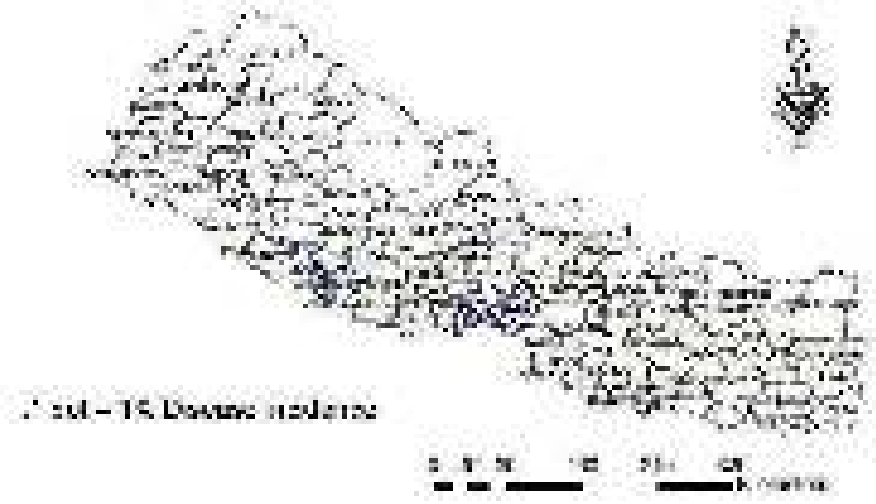


Figure 5: A disease map for disease incidence of maize stalk rot complex at 5 maize growing districts of Nepal monitored during summer season of 2016

Table 128: Disease index and incidence of maize stalk rot complex in 5 maize growing districts of Nepal during summer season of 2016

District /VDC	Year (2016)						Disease reaction
	Disease index (PDI) (n=10)			Disease incidence (n=10)			
	Mean	SD	SE±	Mean	SD	SE±	
Banke (Khaskusum)	23.52	5.51	1.74	14.00	5.16	1.63	R
Surkhet (Dasarathpur and Mayalkuna)	43.57	5.29	1.67	29.00	7.38	2.33	MS
Dang (Aswara and Panchakule)	80.86	11.00	3.48	65.00	12.69	4.01	HS
Chitwan (Mangalpur)	61.82	8.33	2.63	61.00	8.76	2.77	S
Nawalparasi (Gaindakot and Rajahar)	55.55	10.55	3.34	52.00	12.29	3.89	S

Note : PDI- Percent disease index, n10 = sample size 10, SD- Standard deviation, SE- Standard error, HS- Highly susceptible, S- Susceptible, R-Resistant, MS- Moderately susceptible

2.5.6.2 Screening of host resistance

Thirty genotypes were tested for maize stalk rot resistance during summer season of 2016 at NMRP Rampur. The experiment was carried out at natural epiphytotic condition following randomized complete block design with 2 replications. The plot size was 5 m long with 75 cm row to row spacing and each genotype was sown in two rows. Agronomic practices were followed as recommended. The recommended fertilizers @ 120:60:40 kg/ha ($N:P_2O_5:K_2O$) were applied. Early plant stand, tasseling days, silking days, plant height, ear height and final plant stand were recorded. The disease severity data were recorded thrice at an interval of 10 days. The area under disease progress curve (AUDPC) was computed using midpoint rule method (Campbell and Madden, 1990). The yield data (t/ha) and thousand seed weight (g) were recorded.

The summer maize season of 2016 was affable for stalk rot complex development. The early plant stand, disease severity, final plant stand, grain yield and thousand seed weight varied significantly ($P \leq 0.05$) among the tested maize genotypes at Rampur Chitwan.

Out of 30 genotypes, Rampur Composite, Arun-2, RamS03F08, Rampur 34, TLBRS07F16 and Rampur 24 were resistant having area under disease progress curve (AUDPC) value of 53.25, 56.38, 60.38, 62.75, 66.38 and 67.6, respectively (Table 129). The other remaining genotypes showed moderately susceptible and susceptible reaction to the disease. The high yielding genotypes were Rampur Composite (2.13 t/ha), Arun-2 (1.99 t/ha), RAMS03F08 (1.95 t/ha), Rampur 34 (1.94 t/ha), TLBRS07F16 (1.76 t/ha) and Rampur 24 (1.73 t/ha) (Table 129). The genotypes having higher thousand grain weight were TLBRS07F16 (415 g), ZM 627 (388 g), Rampur 34 (368 g), Across 9331 RE (365 g), Rampur 21 (363 g) and Rampur 27 (358 g) (Table 129).

Table 129: Screening of maize genotypes for stalk rot complex resistance at Rampur Chitwan 2016

Genotype	EPS	Disease severity (1-9)			AUDPC	FPS	Grain yield, t/ha	TSWt (g)
		60 DAS	70 DAS	80 DAS				
Rampur Composite	34.50 †	1.53	2.30	4.53	53.25	29.50	2.13	315.00
Arun-2	36.50	1.78	2.40	4.70	56.38	29.00	1.99	347.50
Poshilo Makai-1	30.00	3.15	3.60	6.05	82.00	13.50	1.34	282.50
Poshilo Makai-2	37.00	3.15	3.58	6.05	81.75	22.00	1.33	285.00
S99TLYQ-HG-AB	39.50	3.98	4.48	6.88	99.00	18.00	0.83	315.00
BGBYPOP	35.00	2.80	3.30	5.70	75.50	20.50	1.54	205.00
R pop-3	33.50	3.28	3.78	6.30	85.63	16.50	1.23	335.00
R pop-4	37.00	2.60	2.98	5.40	69.75	26.50	1.64	267.50
Rampur Hybrid-4	35.00	2.63	2.99	5.44	70.20	20.50	1.63	350.00
Rampur Hybrid-6	34.00	2.88	3.40	5.80	77.38	18.50	1.51	220.00
RML 95/RML 96	39.50	4.20	4.70	7.08	103.38	18.00	0.86	275.00
RAMS03F08	33.50	2.20	2.70	4.95	62.75	26.50	1.95	272.50
ZM 401	32.50	2.69	3.08	5.60	72.20	19.50	1.67	342.50
ZM 627	42.00	5.08	5.30	7.40	115.38	16.50	0.51	387.50
05 SADVI	34.00	3.80	4.28	6.63	94.88	14.50	1.03	260.00
07 SADVI	35.00	3.50	4.00	6.43	89.63	16.00	1.12	335.00
Rampur 21	38.00	5.33	5.80	8.08	125.00	11.00	0.33	362.50
Rampur 24	34.00	3.70	4.20	6.63	93.63	15.00	1.03	305.00
Rampur 27	36.00	2.43	2.95	5.20	67.63	25.00	1.73	357.50
Rampur 32	27.50	2.80	3.20	5.65	74.25	12.50	1.66	352.50
Rampur 33	33.00	3.60	4.08	6.55	91.50	14.00	1.05	267.50
Rampur 34	32.50	1.98	2.60	4.90	60.38	24.50	1.94	367.50
Rampur 36	37.00	3.08	3.58	6.05	81.38	20.50	1.36	275.00
TLBRS07F16	37.50	2.40	2.90	5.08	66.38	25.50	1.76	415.00
Rampur-4	35.50	3.40	3.90	6.33	87.63	19.50	1.18	365.00
Across-9942/Across- 9944	29.50	3.73	4.30	6.68	95.00	8.00	1.03	352.50
BLBSRS07F10	37.00	2.93	3.43	5.88	78.25	23.00	1.54	317.50
TLBRS07F14	36.00	3.63	4.13	6.65	92.63	17.50	1.08	357.50
Arun-4	40.00	2.84	3.28	5.73	75.58	26.00	1.55	315.00
Farmers' Local	41.00	5.20	5.55	7.58	119.38	14.00	0.42	315.00
Grand mean	35.43	3.21	3.69	6.06	83.25	19.38	1.33	317.33
F-test	**	**	**	**	**	**	**	**
LSD (0.05)	2.89	0.08	0.10	0.14	1.82	1.79	0.065	16.04
CV (%)	3.98	1.27	1.34	1.11	1.07	4.50	2.39	2.47

† *Means of 2 replications. EPS- Early plant stand, AUDPC- Area under disease progress curve, FPS- Final plant stand, TSWt- Thousand grain weight, g-gram, t/ha- ton per hectare, DAS- Days after sowing, SC- Susceptible check, **- highly significant*

The result showed that tasseling days varied from 46 days (Arun-2) to 58 days (TLBRS07F16). Similarly, the silking day varied from 50 days (Arun-2) to 61 days (TLBRS07F16). The tested genotypes were highly significant for tasseling and silking days (Table 130). The plant height varied from 136 cm (Rampur 24) to 185 cm (RAMS03F08). Similarly, the ear height also varied from 60 cm (Rampur 24) to 100 cm (R pop-4). The plant height and ear height varied significantly among the tested genotypes (Table 130).

Table 130: Evaluation of agronomic traits in maize genotypes in stalk rot complex screening nursery at Rampur 2016

Genotype	Tasseling	Silking	Plant height, cm	Ear height, cm
Rampur Composite	48[†]	52	180	96
Arun-2	46	50	180	88
Poshilo Makai-1	48	52	178	91
Poshilo Makai-2	49	52	156	83
S99TLYQ-HG-AB	52	55	171	87
BGBYPOP	48	52	165	87
R pop-3	50	53	147	88
R pop-4	49	52	176	100
Rampur Hybrid-4	55	58	149	74
Rampur Hybrid-6	55	58	160	81
RML 95/RML-96	57	60	174	95
RAMS03F08	51	54	185	100
ZM 401	49	53	160	83
ZM 627	53	56	150	75
05 SADVI	54	57	150	70
07 SADVI	54	58	166	82
Rampur 21	52	55	184	75
Rampur 24	55	58	136	60
Rampur 27	57	60	161	79
Rampur 32	55	58	173	85
Rampur 33	54	59	140	73
Rampur 34	55	59	154	66
Rampur 36	55	59	164	73
TLBRS07F16	58	61	173	88
Rampur-4	50	53	150	62
Across 9942/Across 9944	54	58	171	73
BLBSRS07F10	51	54	174	87
TLBRS07F14	57	60	157	75
Arun-4	47	50	143	70
Farmers' Local (SC)	58	61	172	84
Grand mean	52	56	163	81
F-test	**	**	**	**
LSD (0.05)	4.98	4.91	7.50	5.42
CV (%)	4.66	4.32	2.25	3.28

[†] *Means of 2 replications. cm- Centimeter, SC- Susceptible check, **- Highly significant*

Relationship between grain yield (t/ha) and AUDPC

During summer maize season (2016), among 6 (3 high yielding genotypes - Rampur Composite, Arun-2, RAMS03F08, and 3 low yielding genotypes ZM 627, Farmers' local and Rampur 21), grain yield was found to had highly significant negative correlation (r=-0.99) with the AUDPC of maize stalk rot complex disease. The predicted linear regression line also displayed downward slope i.e. y=- 0.039x+136.5, with regression coefficient R^2=0.99, where 'y' denoted predicted crop yield of maize genotypes and 'x' stood for AUDPC of stalk rot complex of maize (Figure 6). The estimated regression line indicated that the unit rise in the AUDPC of stalk rot complex disease (within 1-9 scale), there existed possibilities of yield reduction by 0.039 t/ha.

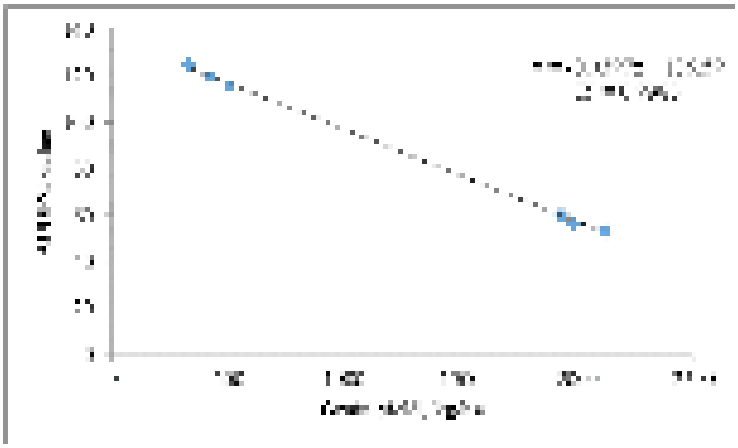


Figure 6: Relationship between crop yield and AUDPC of maize stalk rot complex in screening experiment at Rampur 2016

2.5.6.3 Integrated management experiment

The experiment was conducted under natural epiphytotic condition following randomized complete block design in 3 farmers' field of Pabannagar, Dang valley and considered as a hot spot for maize stalk rot severity. The unit plot size was six rows of 5 m meter long with 75 cm row to row spacing i.e. 22.5 m^2 gross plot area. A maize variety Rampur Composite was sown on May 28th of 2016 in all 3 fields. There were eight treatments of the experiment including cultural, agronomical, biological and chemical practices and compared with farmers' practice. The treatment combinations for the experiment were designed as follows:

1. Bavistin seed treatment @ 2 g/kg of seed + Saafulizer (2.5 g SAAF + 300 g Urea) during knee height and tasseling stage
2. Basal Application of high dose of phosphorous (80 kg/ha) and potassium (60 kg/ha)

3. Spray streptocyclin @ 2 g/l + insecticide (cypermethrin + chloropyrifos) @ 2.5 ml/l of water during knee height and subsequent spray at15 days interval
4. Seed treatment with *Trichoderma viridae* @ (One vial of 5 ml (1×10^8 conidia/ml)/kg of seed) + soil application @ (One vial of 5 ml (1×10^8 conidia/ml)/10 kg of FYM) per plot mixed during field preparation
5. Seed treatment with *Pseudomonas fluorescence* @ (One vial of 5 ml (1×10^8 spore/ml)/kg of seed) + soil application @ (One vial of 5 ml (1×10^8 spore/ml)/10 kg of FYM) per plot mixed during field preparation and vegetative stage both
6. Earthing up with appropriate plant population (75 × 25 cm spacing) for well drainage
7. Intercropping of maize with soybean (1:2 ratio) in raised bed system + copper oxychloride @ 2 g/l of water during knee height and subsequent spray after 15 days interval
8. Farmers' practice (Control)

All treatments were replicated thrice. One farmer was considered as one replication. In case of chemical, first spray was given during knee height stage and another after 15 days interval of first spray. Disease severity data were recorded before application of every treatment using 1-9 scoring scale from 25 randomly tagged plants/plot. The AUDPC and PDI were calculated. Percent disease control (PDC) was calculated on the basis of the formula developed by Shivankar and Wangikar (1993). Early plant stand (EPS) and final plant stand (FPS) were recorded. Data was recorded on grain yield (t/ha) and yield attributes after necessary sun drying. Yield increase over the farmers' practice was calculated. All data were analyzed using Microsoft Excel and MSTAT-C computer package program. Treatment means were compared using Duncan's Multiple Range Test (DMRT) at 5% levels of significance. All percent data were subjected to arcsine transformation before statistical analysis. Disease maps were developed by using ArcGIS 10.3 software.

All the treatments had significant ($P\leq0.05$) effect on percent disease index (PDI) and crop yield over farmers' practice. The higher percent disease control (52.36%) and yield increase (40.29%) were recorded from the plot sprayed with streptocyclin @ 2 g/l and insecticide (cypermethrin + chloropyrifos) @ 2.5 ml/l of water during knee height and subsequent spray after 15 days interval as compared to farmers' practice (Table 132). Similarly, the lower percent disease index (52.65% PDI) with higher yield (3.59 t/ha) was also found in the plot where maize seed were treated with Bavistin as a seed treatment @ 2 g/kg of seed and soil application of Saafulizer (2.5 g SAAF + 300 g Urea) during knee height and tasseling stage as compared to farmers' practice (PDI- 85.75% and grain yield

-2.76 t/ha) (Table 131). The plot applied with basal application of high dose of phosphorous (80 t/ha) and potassium (60 kg/ha) recorded significantly lower PDI (65.75%) (Table 131) with higher yield increase (19.71%) as compared to farmers' practice (Table 132).

Table 131: Effect of cultural, biological and chemical practices on stalk rot complex severity and yield performance of maize at Pabannagar Dang 2016

Treatment	EPS	AUDPC	PDI%	FPS	Grain yield (t/ha)	TSWt (g)
1. Bavistin seed treatment @ 2 gm/kg of seed + Saafulizer (2.5 g SAAF + 300 g Urea) during knee height and tasseling stage	126.67†	49.70^{g}	52.65^{g}	102.30^{ab}	3.59^{b}	370.70^{a}
2. Basal Application of high dose of phosphorous (80 kg/ha) and potassium (60 kg/ha).	122.33	69.08^{f}	65.75^{f}	98.67^{bc}	3.30^{c}	355.00^{b}
3. Spray streptocyclin @ 2 g/l + insecticide (cypermethrin + chloropyrifos @ 2.5 ml/l of water during knee height and subsequent spray after 15 days interval	117.67	47.08^{h}	40.85^{h}	106.00^{a}	3.87^{a}	375.70^{a}
4. Seed treatment with *Trichoderma viridae* @ (One vial of 5 ml (1×10^{8} conidia/ml)/kg of seed) + soil application @ (One vial of 5 ml (1×10^{8} conidia/ml) /10 kg of FYM) per plot mixed during field preparation	127.33	71.83^{e}	68.45^{e}	95.67^{bcd}	3.22^{d}	342.30^{c}
5. Seed treatment with *Pseudomonas fluorescence* @ (One vial of 5 ml (1×10^{8} spore/ml)/kg of seed) + soil application @ (One vial of 5 ml (1×10^{8} spore/ml)/10 kg of FYM) per plot mixed during field preparation and vegetative stage both	116.00	73.83^{d}	69.85^{d}	95.00^{cd}	3.22^{d}	330.00^{d}
6. Earthing up with appropriate plant population (75×25 cm spacing) for well drainage of excess water	109.67	78.42^{c}	75.85^{c}	93.67^{cd}	2.95^{e}	316.00^{e}
7. Intercropping of maize with soybean (1:2 ratio) in raised bed system + copper oxychloride @ 2 g/l of water during knee height and subsequent spray after 15 days interval	113.67	82.25^{b}	82.35^{b}	93.00^{cd}	2.79^{f}	310.00^{e}
8. Farmers' practice (Control)	107.33	95.25^{a}	85.75^{a}	88.67^{d}	2.76^{f}	307.70^{e}
Grand mean	117.58	70.93	67.69	96.63	3.21	338.42
F-test	ns	**	**	*	**	**
LSD (0.05)	-	1.15	1.13	6.68	0.08	9.12
CV (%)	11.17	0.93	0.95	3.95	1.41	1.54

† *Means of 3 replications. Means in column with same superscript is not significantly different by DMRT (P<0.05). EPS-Early plant stand, AUDPC- Area under disease progress curve, PDI-Percent disease index, FPS-Final plant stand, TSWt-Thousand grain weight, t/ha- Ton per hectare, g- Gram, %- percent, ml-milliliter, l-liter, cm-Centimeter, NS-Not significant, *-Significant, **- Highly significant*

Table 132: Effect of different treatments on stalk rot disease control and yield increase percent of maize at Pabannagar Dang 2016

Treatments	PDC%	YI%
1. Bavistin seed treatment @ 2gm/kg of seed + Saafulizer (2.5 g SAAF + 300 g Urea) during knee height and tasseling stage	38.60	30.04
2. Basal Application of high dose of phosphorous (80 t/ha) and potassium (60 t/ha).	23.32	19.71
3. Spray streptocyclin @ 2 g/l + insecticide (cypermethrin + chloropyrifos @ 2.5 ml/l of water during knee height and subsequent spray after 15 days interval	52.36	40.29
4. Seed treatment with *Trichoderma viridae* @ (One vial of 5 ml (1×10^8 conidia/ml) /kg of seed) + soil application @ (One vial of 5 ml (1×10^8 conidia/ml) /10 kg of FYM) per plot mixed during field preparation	20.17	16.78
5. Seed treatment with *Pseudomonas fluorescence* @ (One vial of 5 ml (1×10^8 spore/ml) /kg of seed) + soil application @ (One vial of 5 ml (1×10^8 spore/ml) /10 kg of FYM) per plot mixed during field preparation and vegetative stage both	18.54	16.56
6. Earthing up with appropriate plant population (75×25 cm spacing) for well drainage of excess water	11.55	6.88
7. Intercropping of maize with soybean (1:2 ratio) in raised bed system + copper oxychloride @ 2 g/l of water during knee height and subsequent spray after 15 days interval	3.97	1.20
8. Farmers practice (Control)		

PDC-Percent disease control, YI- Yield increase, %- Percent, g- Gram, ml-Milliliter, l-Liter, cm-Centimeter

Relationship between disease control and yield increase

During the experimentation period, the yield increase showed highly significant positive correlation (r=0.99) with the controlled maize stalk rot complex disease by the application of cultural, biological and chemical means. The predicted linear regression line was displayed upward slope i.e. $y = 0.799x - 0.463$, with regression coefficient $R^2=0.98$, where 'y' denoted predicted yield increase of maize and 'x' stood for disease control due to applied treatments (Figure 7). The estimated regression line indicated that the unit rise in the percent disease control of maize stalk rot complex (within 1-9 scale) due to applied treatments, there existed possibilities of yield increase by 0.80 percent.

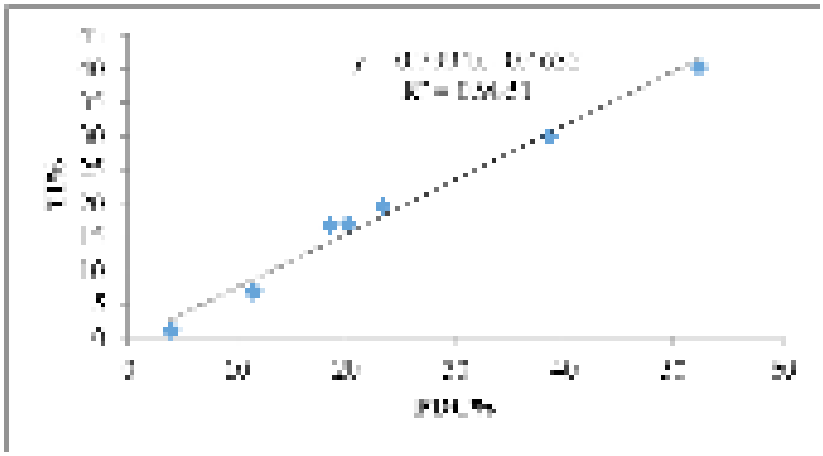


Figure 7: Relationship between disease control and yield increase in disease management experiment through cultural, biological, and chemical means at Pabannagar and Dang 2016.

2.6 OUTREACH RESEARCH

The outreach research program was designed to verify and validate the location specific suitable technologies of maize, rice, wheat and other crops, and to get feedback from farmers. The experiments were designed and managed by researchers. All experiments were laid out in RCB design at different sites of command districts. Each trial included farmers' cultivars to compare the performance of newly tested genotypes. The chemical fertilizers were applied @ 180:60:40, 120:60:40 and 80:60:40 $NP_2O_5K_2O$ kg/ha for hybrid, full season and early maturing maize, respectively. Half dose of nitrogen and full dose of phosphorus and potash was applied as basal at the time of final land preparation and remaining half dose of nitrogen was splitted into two; first at 20-25 and second at 40-45 days after sowing. All other intercultural operations were done by farmers per recommendation. In case of rice and wheat the chemical fertilizers applied in the trial were 100:30:30 and 100:50:25 $NP_2O_5K_2O$ kg/ha, respectively.

2.6.1 Hybrid maize CFFT

The trial was conducted in Madi with 2 replications. In total, eight genotypes were tested which were planted on October 26, 2016 and harvested on March 28, 2017. Statistically non significant results were found for plant height and ear height but significant for grain yield. The result showed that Rampur Hybrid-8 produced significantly higher grain yield (12.3 t/ha) followed by CP-808 (11.6 t/ha) and CAH 1515 (11.1 t/ha). These genotypes were at par with the pipeline genotype RML-95/RML-96 (10.7 t/ha) (Table 133).

Table 133: Performance of hybrid maize genotypes in CFFT in Madi, 2016/17

SN	Genotype	Plant height, cm	Ear height, cm	Grain yield, t/ha
1	RML-95/RML-96	172	89	10.7[ab]
2	CAH-1521	170	78	5.3 [c]
3	CAH-151	194	51	12.3 [a]
4	CAH-153	134	79	10.1 [ab]
5	CAH-1515	194	84	11.1 [ab]
6	Rampur Hybrid-6	164	83	9.4 [ab]
7	CP-808	189	88	11.6 [a]
8	Farmers' variety	187	96	7.5 [bc]
	Grand mean	175	81	9.8
	F-test	ns	ns	*
	CV (%)	18.1	30.6	16.3
	LSD (0.05)	-	-	3.76

2.6.2 Maize CFFT early set

Seven early maize genotypes including farmers' variety were evaluated at Madi, Chitwan. The trial was laid out in RCB Design with 4 replications. The crop was sown on March 3, 2017 and harvested on July 29, 2017. Statistically significant results were observed among the tested genotypes for plant height and grain yield. The higher plant height (176 cm), ear height (88 cm) and grain yield (7.2 t/ha) was recorded in S03TEY-IN (Table 134).

Table 134: Performance of early maize genotypes in CFFT at Madi and Jayamangala in 2016/17

SN	Genotype	Plant height, cm	Ear height, cm	Grain yield, t/ha
1	Across-99402	165[ab]	72	5.6[b]
2	S03TEY-lN	176[a]	88	7.2[a]
3	POOL-16	176[a]	82	5.3 [b]
4	S03TEY-SEQ	170[a]	80	5.6 [b]
5	Arun-6	154[b]	67	4.6 [b]
6	Arun-4	170[a]	81	4.3 [b]
7	Farmers' variety	176[a]	73	4.7 [b]
	Grand mean	170	78	5.30
	F-test	**	ns	**
	LSD (0.05)	11.28	-	1.37
	CV (%)	4.5	19.7	17.4

2.6.3 Maize CFFT full season set

The experiment was conducted at 2 farmers' field of Madi Chitwan in randomized complete block design. In total seven genotypes were evaluated. The seeds were sown on May 20, 2016 and harvested on October 1, 2016. Among the tested maize genotypes HG-AB performed well (5.5 t/ha) in terms of grain yield (Table 135).

Table 135: Performance of full season maize genotypes in CFFT at Madi in 2016/17

SN	Genotype	Plant height, cm	Ear height, cm	Grain yield, t/ha
1	UPAHAR	217	94	3.8
2	HG-AB	230	109	5.5
3	Across-9332RE	207	81	3.6
4	Rampur S13S26	209	91	3.3
5	Rampur S13S24	223	104	3.2
6	HG-B	190	84	2.7
7	Farmers' variety	198	93	4.4
	Grand mean	211	94	3.8

2.6.4 CFFT on QPM

Six genotypes including farmers' variety were tested at outreach site in Madi, Chitwan. The seeds were sown on May 20, 2016 and harvested on October 1, 2016. S03TLYQ-AB-02 gave higher grain yield (5.5 t/ha) followed by Poshilo Makai-1 (5.4 t/ha) (Table 136).

Table 136: Performance of quality protein maize genotypes in CFFT at Madi in 2016/17

SN	Genotype	Plant height, cm	Ear height, cm	Grain yield, t/ha
1	S03TLYQ-AB-01	189	105	3.8
2	S03TLYQ-AB-02	214	107	5.5
3	Poshilo Makai-2	212	110	3.9
4	S99TLYQ-HG-AB	247	116	5.3
5	Poshilo Makai-1	217	102	5.4
6	Farmers' variety	198	93	5.4
	Grand mean	213	106	4.9

2.6.5 Rice CFFT normal

CFFT of normal rice was carried out at 4 different locations i.e. Madi and Rampur (Chitwan), Manahari (Makawanpur) and Rajahar (Nawalparasi) in randomized complete block design. Altogether seven different rice genotypes including farmers' local were evaluated. The seedlings were transplanted on June

27, 2016 at Madi, June 29 at Rajahar, July 7 at Manahari and July 16 at Rampur. All the tested genotypes differed significantly for flowering days, maturity days, plant height, number of hills/m^2 and grain yield. HUA 565 and NR 2157-122-1-2-1-1-1 flowered in 82 days and matured in 124 days, and thus, were earlier whereas NR 2167-48-5-1-2-1-1 required more days (105 days) for flowering and maturity (132 days). All the improved rice genotypes were found insignificant to each other but IR 87615-9-3-1-3 gave significantly higher grain yield (5.24 t/ha) as compare to the farmers' local (4.32 t/ha) (Table 137).

Table 137: Performance of normal rice genotypes in CFFT) at Manahari, Rajahar, Madi and Rampur 2016/17

SN	Genotype	Flowering days	Maturity days	plant height, cm	No. of hill/ m^2	Grain yield, (t/ha)
1	IR87615-9-3-1-3	90 ^{b}	126 ^{ab}	104^{bc}	35^{a}	5.24^{a}
2	HUA-565	82 ^{c}	124 ^{b}	95 ^{c}	34 ^{ab}	4.79^{ab}
3	NR2167-48-5-1-2-1-1	105 ^{a}	132 ^{a}	122 ^{a}	33 ^{b}	4.89 ^{ab}
4	NR2167-41-1-1-3-1	94 ^{b}	126 ^{ab}	109 ^{b}	34 ^{ab}	4.77 ^{ab}
5	NR2157-122-1-2-1-1-1	82 ^{c}	123 ^{b}	104 ^{bc}	34 ^{ab}	4.72 ^{ab}
6	Sabitri	100 ^{a}	132 ^{a}	98 ^{bc}	35 ^{ab}	4.74 ^{ab}
7	Farmers' variety	101 ^{a}	132 ^{a}	95 ^{c}	34 ^{ab}	4.32^{b}
	Grand mean	93	128	104	34	4.78
	F-test	**	*	**	ns	ns
	LSD (0.05)	5.68	6.53	10.86	-	-
	CV (%)	3.5	3.4	7.1	3.9	9.5

2.6.6 CFFT on fine and aromatic rice

The CFFT of fine and aromatic rice was carried out at three different locations (Manahari, Rajahar and Madi). The tested genotypes differed significantly for maturity days, plant height and grain yield. Samba Masuli Sub-1 required significantly more days (136 days) for maturity whereas black rice matured significantly earlier (112 days) among the tested rice genotypes. In case of plant height, genotype TOX322-6-5-2-2-2-2 observed taller (110 cm) whereas black rice showed shorter plant height (77 cm). Grain yield of farmers' popular variety was comparatively higher (4.0 t/ha) but found insignificant to the other improved fine and aromatic rice genotypes except for grain yield (1.5 t/ha) of black rice. Among the improved rice genotypes, comparatively higher grain yield (3.9 t/ha) was obtained in Samba Masuli Sub-1 and IR83377-B-B-105-4 followed by TOX322-6-5-2-2-2-2 (3.8 t/ha) (Table 138).

Table 138: Performance of fine and aromatic rice genotypes in CFFT at Manahari, Rajahar and Madi 2016/17

SN	Genotype	Flowering days	Maturity days	Plant height, cm	Grain yield, t/ ha
1	TOX322-6-5-2-2-2-2	89	129	110	3.8
2	IR77537-24-1-3	85	126	101	3.7
3	IR83377-B-B-105-4	85	127	93	3.9
4	IR83373-B-B-24	83	124	97	3.5
5	IR83373-B-B-25-3	84	125	99	3.7
6	Samba Masuli Sub -1	103	136	86	3.9
7	Black rice	73	112	77	1.5
8	Farmers' variety	108	136	100	4.0
	Grand mean	89	127	95	3.5
	F-test	-	**	ns	**
	LSD (0.05)	-	6.52	-	0.76
	CV (%)	-	2.9	13.9	12.4

Rice CFFT early set

Seven early rice genotypes including farmers' local were evaluated in the farmers' field at different locations (Manahari, Rajahar and Madi). The combined analysis revealed that the plant height and grain yield differed significantly among the tested genotypes across the locations. The higher grain yield (4.3 t/ha) was recorded in IR83754-B-B-40-2 and IR 70210-39-CPA-7-1 followed by Radha-4 (4.1 t/ha). Similarly, higher plant height (115 cm) was also recorded in IR83754-B-B-40-2 which was at par with the rice genotype IR70210-39-CPA-7-1 (109 cm) (Table 139).

Table 139: Performance of early rice genotypes tested in CFFT at Manahari, Rajahar and Madi 2016/17

SN	Genotype	Flowering days	Maturity days	Plant height, cm	Grain yield, t/ha
1	IR83754-B-B-40-2	86	119	115	4.3 [a]
2	IR87754-42-2-2	88	120	108	3.9 [ab]
3	IR82635-B-B-25-4	86	119	102	3.7 [bc]
4	IR70210-39-CPA-7-1	82	117	109	4.3 [a]
5	Radha-4	92	121	96	4.1 [a]
6	Hardinath-1	75	98	89	3.3 [c]
7	Farmers' variety	85	118	96	3.8 [ab]
	Grand mean	85	116	102	3.9
	F-test	-	-	**	**
	LSD (0.05)	-	-	11.1	0.43
	CV (%)	-	-	6.1	6.2

2.6.7 CFFT wheat

The trial was conducted at Manahari, Rajahar and Madi sites. Seven wheat genotypes including farmers' variety were tested in 10 farmers' field assuming 1 farmer as one replication. The crop was sown in 3 different dates i.e 2017/04/01, 2017/04/03 and 2017/04/13. All parameters showed statistically significant results among the tested genotypes across the locations. The higher plant height (88 cm) was observed in BL-4407. The longer spike (9.3 cm) was recorded in BL-4463. In case of grain yield, all the improved wheat genotypes were at par but statistically superior than the farmers' variety. The higher grain yield (3.6 t/ha) was found in NL-1164 (Table 140).

Table 140: Performance of wheat genotypes tested in CFFT at Manahari, Rajahar and Madi 2016/17.

SN	Genotype	Plant height, cm	Spikes length, cm	No. of spikes/m^2	Grain yield, t/ha
1	BL-4406	88	8.7	335	3.5
2	BL-4407	85	8.2	337	3.5
3	BL-4463	84	9.3	327	3.5
4	NL-1164	86	9.0	321	3.6
5	NL-1193	83	8.3	314	3.5
6	Vijaya	87	8.3	320	3.4
7	Farmers' variety	86	7.5	307	3.2
	Grand mean	86	8.5	323	3.5
	F-test	ns	**	ns	*
	LSD (0.05)	-	0.85	-	0.24
	CV (%)	5.4	11.1	8.9	8.0

2.6.8 Maize vegetable intercropping

The experiment was conducted at 3 locations namely, Madi, Ratnanagar and Rampur of Chitwan district. At each location the trial was laid out in randomized complete block design with 2 replications. The maize variety was Rampur hybrid-4. The chemical fertilizer applied in the trial was 180:60:40 kg NPK/ha. The plant geometry of maize was 100 cm x 25 cm. Similarly, the vegetables were arranged in a line in between the maize rows. The plant to plant distance of cucumber, sponge gourd, bitter gourd was 50 cm and okra was planted in 25 cm.

Selling price of vegetables differed according to local market. Based on the price in the local market, the harvested vegetables from the trial were converted into the monetary units. The per unit value of maize was Rs 25/kg, sponge gourd ranged from Rs 25-40/kg, bitter gourd ranged from Rs 35-60/kg, and okra and cucumber ranged from Rs. 30-40/kg.

In combined analysis of 3 locations, significantly higher grain yield of maize (6.11 t/ha) was obtained when it was sown solely. In maize and vegetable intercropping trial conducted at different locations of outreach sites of NMRP, Rampur, the maize genotype Rampur hybrid-4 yielded non-significant result but the vegetable cucumber and sponge gourd produced significantly higher yield i.e. 8.88 t/ha and 8.07 t/ha, respectively whereas the higher gross income was obtained from maize and cucumber intercropping (Rs. 4,53,900/ha) followed by maize and bitter gourd (Rs. 4, 07,100/ha) (Table 141).

Table 141: Gross income and grain yield of maize and vegetable in different maize + vegetable intercropping system in Terai region 2073/074

SN	Treatment	Madi			Ratnanagar			Rampur			Total		
		Grain yield, t/ha		Gross income (Rs.'000)	Grain yield, t/ha		Gross income (Rs.'000)	Grain yield, t/ha		Gross income (Rs.'000)	Grain yield, t/ha		Gross income (Rs.'000)
		Maize	Vegetable		Maize	Vegetable		Maize	Vegetable		Maize	Vegetable	
1	Maize + Okra	6.5	4.3	291.5	3.6	4.5	268.0	4.6	4.5	297.0	4.76 ^{b}	4.17 ^{c}	273.4 ^{b}
2	Maize + Sponge gourd	5.5	6.4	298.1	3.5	6.4	247.9	4.5	11.3	562.9	4.47 ^{b}	8.07 ^{a}	373.0 ^{ab}
3	Maize + Cucumber	5.8	6.9	354.0	3.6	6.7	357.8	4.7	12.8	627.3	4.65 ^{b}	8.88 ^{a}	453.9 ^{a}
4	Maize + Bitter gourd	4.8	3.7	268.1	3.5	5.3	271.8	4.6	8.8	639.3	4.38 ^{b}	6.04 ^{b}	407.1 a
5	Maize sole	6.3	0.0	158.3	5.2	0.0	129.3	6.5	0.0	162.4	6.11 ^{a}	-	137.3 ^{c}
	Grand mean	5.8	4.3	274.0	3.9	4.6	255.0	5.0	7.5	457.8	4.87	5.7	329.0
	LSD (0.05)	-	-	-	-	-	-	-	-	-	0.42	1.65	102.9
	CV (%)	-	-	-	-	-	-	-	-	-	7.1	19.6	25.8
	F-test	-	-	-	-	-	-	-	-	-	**	**	**

2.7 MULTI-LOCATION EXPERIMENTS

2.7.1 Wheat

The set of experiment includes IYT, CVT and CFFT, wheat varietal display (WVD), and national rainfed nursery (NRN). The experimental set was received from NWRP, Bhairahawa. The genotypes namely NL1324 and NL1312 produced comparatively higher grain yield (> 4 t/ha) at Rampur as par as best check Bhirkuti in IYT (Table 142). Similarly, the highest grain yield was observed from NL1253 and NL1254 (>4.6 t/ha) which was more than 15% higher than best check Bhrikuti in CVT at Rampur (Table 143). Likewise, all the tested entries produced higher grain yield as compared to farmers' check in CFFT at outreach sites of NMRP, Rampur (Table 144). In WVD, mean grain yield was obtained 4.46 with minimum 1.78 and maximum 6.53 t/ha where fifty percent flowering ranged from 63 to 82 with mean value of 72 days (Table 145). Out of 100 genotypes evaluated in NRN, grain yield ranged from 0.4 to 6.89 t/ha with mean value of 3.79 t/ha (Table 146).

Table 142: Agronomic performance of wheat genotypes evaluated in IYT at NMRP Rampur 2016/17

Genotype	Days to 50% heading	Plant height, cm	No. of grains /spike	Spike length, cm	Test weight, g	Grain yield, t/ha
NL1297	75	101	52	9	49	3.51
NL1298	73	91	40	10	49	3.70
NL1299	76	98	41	10	55	3.23
NL1300	77	96	49	10	48	3.13
NL1301	75	93	43	9	51	3.46
NL1302	81	106	47	11	51	3.68
NL1303	79	91	54	10	40	2.93
NL1304	77	95	49	10	46	3.49
NL1305	79	98	36	10	47	2.82
NL1306	75	95	38	10	56	2.90
NL1307	76	91	33	10	60	2.71
NL1308	75	91	35	10	57	2.02
NL1309	75	93	48	11	37	3.14
NL1310	77	102	35	11	61	3.06
NL1311	79	107	50	10	52	3.90
NL1312	79	92	54	11	48	4.10
NL1313	79	95	41	11	51	2.69
NL1314	80	99	44	11	52	3.30
NL1315	72	92	46	10	48	3.44
NL1316	74	95	44	10	54	3.14
NL1317	76	92	50	10	43	3.59
NL1318	76	93	46	10	47	3.34
NL1319	77	97	43	10	47	3.38
NL1320	76	95	48	10	45	3.67
NL1321	73	93	44	10	50	3.32
NL1322	73	90	48	10	46	3.79
NL1323	74	90	43	11	48	2.40
NL1324	78	92	47	10	47	4.17
Bhirkuti	71	88	45	10	47	4.15
Gautam	72	93	44	12	52	3.14
Mean	75.7	94.6	44.4	10.1	49.4	3.31
F-test	**	**	*	*	**	*
LSD (0).05	2.6	7.1	11.4	1.8	12.0	1.14
CV (%)	1.7	3.7	12.6	8.7	11.8	16.8

Table 143: Performance of wheat genotypes tested in CVT at NMRP Rampur 2016/17 winter

Genotype	Days to 50% heading	Plant height, cm	No. of grains /spike	Spike Length, cm	Spikes /m^2	Test weight, g	Grain yield, t/ha
BL4335	73	102	40	11	333	55	3.54
BL4699	72	118	49	10	373	57	4.08
BL4707	73	105	47	12	349	47	3.56
BL4708	72	93	42	10	331	60	4.17
Gautam	71	99	48	12	321	52	3.62
NL1202	74	101	48	11	305	53	3.84
NL1207	77	93	48	10	333	47	4.51
NL1211	75	100	37	10	328	56	3.96
NL1244	76	106	56	10	417	47	4.08
NL1247	74	98	45	11	380	49	3.68
NL1253	71	92	47	11	301	52	4.73
NL1254	72	91	47	11	393	48	4.62
NL1260	73	95	51	10	361	42	4.43
NL1307	73	91	41	11	309	55	3.21
NL1325	71	92	44	10	330	54	3.54
NL1326	69	97	48	11	436	43	4.23
NL1327	73	99	56	11	329	50	4.18
NL1328	73	96	46	11	347	49	3.53
RR21	69	99	39	11	335	41	3.08
Bhrikuti	71	87	50	10	345	46	4.00
Mean	72.33	97.55	46.1	10.45	347.6	50.23	3.93
F-test	**	**	*	ns	ns	**	**
LSD (0.05)	1.72	7.69	9.63	-	-	8.34	0.64
CV (%)	1.1	3.8	10	6.2	12.1	7.9	7.8

Table 144: Grain yield and other agronomic traits of wheat genotypes tested in CFFT at NMRP Rampur 2016/17 winter

Genotype	Plant height, cm	Spikes length, cm	Spikes /m^2	Grain yield, t/ha
BL4406	88	8.6	335	3.49
BL4407	85	8.1	337	3.51
BL4463	84	9.3	327	3.53
Farmers' variety	86	7.5	307	3.18
NL1164	86	9	321	3.62
NL1193	83	8.3	314	3.47
Vijaya	87	8.3	320	3.44
Mean	86	8.4	323	3.46
F-test	ns	**	ns	**
LSD (0.05)		0.856	-	0.25
CV (%)	5.4	11.1	8.9	8.0

Table 145: Performance of genotypes in wheat varietal display (WVD) at NMRP Rampur 2016/17

Genotype	Grain yield, t/ha	Flowering	Plant height, cm	Spikes length, cm
Lerma-52	4.05	79	121	9
Lerma Rojo-64	4.79	75	99	9
Kalyansona	4.43	71	87	10
Pitic 62	3.51	81	93	10
RR-21	3.56	69	99	11
NL-30	3.46	80	98	10
HD-1982	4.47	68	100	10
UP-262	4.67	70	90	10
Lumbini	3.37	70	99	9
Triveni	5.23	73	99	10
Vinayak	4.75	66	90	9
Siddhartha	3.10	64	82	9
Vaskar	3.79	70	84	9
Nepal-297	5.24	65	92	10
Nepal-251	5.06	69	94	9
Annapurna-1	5.03	76	93	10
Annapurna-2	4.17	71	99	10
Annapurna-3	4.86	76	99	8
BL- 1022	5.06	65	100	9
Bhrikuti	5.22	70	96	11
BL-1135	5.93	65	94	10
Annapurna-4	6.34	65	100	12
Achyut	3.75	77	101	12
Rohini	6.53	66	99	9
Kanti	5.52	75	120	9
Pasang Lhamu	1.78	73	120	10
BL-1473	3.69	63	97	140
Gautam	4.59	71	99	11
WK-1204	2.61	75	92	10
Aditya	4.17	68	89	9
Vijaya	2.70	69	98	9
NL-971	3.38	75	94	9
Gaura	5.65	73	107	9
Dhaulagiri	3.45	70	94	10
Tilottama (NL-1073)	5.17	73	86	10
NL-1064 (Danphe)	4.38	82	102	8
Banganga (BL-3623)	5.12	69	85	10
Sworgadwari (BL-3629)	4.55	69	83	10
Munal (NL-1055)	6.22	79	101	9
Chyakhura (NL-1064)	3.99	78	98	12
BL-4341	5.75	78	99	10

Genotype	Grain yield, t/ha	Flowering	Plant height, cm	Spikes length, cm
Durum	2.30	*	86	7
Triticale	6.28	70	108	10
Mean	4.46	72	97	13
SE mean	0.17	1	1	3
CV (%)	25.27	7	9	156
Minimum	1.78	63	82	7
Maximum	6.53	82	121	140

Table 146: Performance of wheat genotypes in national rainfed nursery (NRN) at NMRP Rampur 2016/17

Genotype	Grain yield (t/ha)	Days to 50% heading	Plant height, cm	Leaf blight, (DDS)	Spikes length, cm
BL4823	4.59	70	103	97	10
BL4824	4.95	78	124	98	10
BL4825	4.59	80	110	98	10
BL4826	5.07	71	119	98	10
BL4827	3.81	74	119	98	11
BL4828	4.45	77	116	98	11
BL4829	4.55	73	119	98	10
BL4830	3.85	77	98	98	10
BL4831	5.14	76	125	98	10
BL4832	4.54	70	91	97	10
BL4833	4.30	71	118	99	12
KINDE*2/4/……	3.84	78	92	98	10
VILLAJUAREZ F2009/.	3.51	77	98	97	11
T.DT COCCON CI 9309/	4.42	75	100	97	11
68.111/RGB_U//…..	4.47	71	94	98	11
SOKOLL/3/……..	5.51	77	102	97	11
SOKOLL/WBLL1	6.89	74	99	97	11
SOKOL/WESTONIA	3.37	78	102	97	10
REEDLING#1	5.43	78	96	97	11
BHRIKUTI	4.51	71	86	99	9
BAIRDS/KNIPA	3.90	83	90	94	10
AJAIA_13/YAZI	3.36	80	88	96	9
MOHAWK/4/….	4.09	79	84	98	9
GAYACANINIA/……	2.58	79	83	99	8
TVNSYA_2/……	2.21	80	76	96	7
MARSYR_3/…..	3.00	75	74	98	7
WBLL1/6/…….	2.46	82	94	94	10
C80.1/……	2.23	79	93	95	10
SUP152//……	3.76	78	102	97	9
MEX94.27.1.20/3/.	4.16	79	95	97	11
CHECK1	4.39	79	91	97	9
PRL/2*PASTOR	2.53	79	91	98	9

Genotype	Grain yield (t/ha)	Days to 50% heading	Plant height, cm	Leaf blight, (DDS)	Spikes length, cm
KENYA SUNBIRD/KA-CHU	2.23	74	91	97	10
PARAQ/4/….	4.20	82	85	97	9
KACHU*2/BECARD	2.96	79	87	98	11
MELON//….	3.02	75	87	98	10
KACHU/SAUAL/3/…..	1.19	73	89	99	10
SUP152/….	3.65	74	88	98	9
KIRTATI/2*WBLL//…	2.55	75	87	97	8
GAUTAM (CHECK)	3.34	70	86	99	10
ND643/…….	0.39	74	87	97	9
PAURAQ/4/…..	2.73	75	83	99	10
ND643/……	0.64	70	88	98	8
KIRTATI//…….	2.37	66	87	98	9
SHA7/……	3.04	75	80	98	10
SERI.1B*2/3/……	3.88	75	86	97	9
MELON//…….	2.99	84	86	95	13
BABAX/…….	4.53	75	97	97	10
92.001E7.32.5/…….	4.26	76	89	98	10
CHECK2	3.27	75	88	98	11
BAVIS/4/……	3.97	84	88	97	9
KA/NAC//…..	4.87	72	91	97	10
MILAN/KAUZ//…	3.40	76	91	97	10
BAJ#1/8/……	4.49	66	86	98	10
FRANCOLIN#1/…..	4.70	73	94	98	9
MELON///……	4.12	77	91	96	10
WAXWING*2/……	3.36	75	91	97	10
SHA7//….	1.99	67	91	98	0.9
MUTUS*2/KIRTATI	1.82	71	95	99	10
VIJAY (CHECK)	3.25	69	88	98	9
MUTUS*2/…..	2.05	75	88	97	8
FRANCOLIN*2/…..	3.69	78	90	97	9
PAURAQ/…	3.06	72	86	98	9
NAJ07/…..	1.52	77	85	99	9
PASTOR//….	3.02	78	92	97	8
ALTIGD/….	6.10	78	85	96	9
AERSO/5/…	6.53	83	96	95	9
BAJ#1/3/	5.81	80	87	96	11
WAXWING/7/…..	4.40	76	98	93	10
KACHU/…..	4.54	77	91	95	10
FRET2*2/….	4.07	80	95	97	10
FRET2/…..	2.85	86	98	96	11
HUHWA1/3/…..	5.21	81	94	96	11
PBW65/2*PASTOR	1.38	78	91	96	9

Genotype	Grain yield (t/ha)	Days to 50% heading	Plant height, cm	Leaf blight, (DDS)	Spikes length, cm
92.001E7.32.5/…….	2.71	77	88	98	9
W15.92/4/….	3.17	80	94	98	8
BECARD/6/….	4.53	78	97	97	10
WBILL1*2/4/….	3.76	77	98	96	10
W15.92/4/….	3.08	78	98	96	10
TILOTTAMA (CHECK)	5.86	71	96	97	11
SOKOL/WBLL1	5.39	86	95	95	10
PASTOR//….	6.82	79	101	97	9
SOKOL//…	5.20	81	101	97	10
PUB94.15.1.12/WBLL1	0.90	86	96	95	10
SOKOL/WBLL1	6.01	85	98	97	10
WBLL 4//….	4.83	86	98	96	10
SOKOL*2/TROST	4.17	79	82	97	8
SOKOLL/ROLF07	4.66	78	89	98	9
SW 94.2690/SUNCO	5.25	85	102	96	10
WHEAR//….	5.15	79	98	98	9
PASTOR//….	3.65	82	98	99	9
SOKOL/3/….	2.39	81	93	97	9
PASTOR//..	3.74	82	84	97	9
CROC_1/…..	3.53	71	83	98	9
VEE/…..	2.87	82	86	96	10
FRANCOLIN#1/8/….	0.89	79	98	98	11
WHEAR/SOKOLL/3/…	3.73	78	93	98	11
SAUL/…..	4.88	81	96	97	10
CROC_1/…..	5.33	82	95	97	11
WK 1204	5.10	82	86	99	9
Mean	3.79	77	94	97	10
SE Mean	0.134	0	1	0	0
CV (%)	35.33	6	10	1	14
Min	0.398	66	74	93	1
Max	6.89	86	125	99	13

2.7.2 Rice

A total of 16 to 24 rice genotypes were evaluated in three sets of CVT at agronomy farm of NMRP Rampur during summer season of 2016. IR55423-01 followed by HHZ10-DT7-Y1, IR10L 151, IR11N400 and IR88965-39-16-4 produced the highest grain yield (>4.5 t/ha) in CVT--early (Table 147). Similarly, HHZ10-DT5-L11-L1i followed by NR2188-3-2-4-1, HHZ24-DT11-L1-L1 and NR2124-43-3-1-1-1 produced the higher grain yield (>4.5 t/ha) in CVT-FAR (Table 148). Likewise, in CVT normal season, IR96321-558-64-B-4-1-1 followed by IR96322-34-202-13-2-1-2 produced the highest grain yield (Table 149).

Table 147: Performance of early rice genotypes in CVT at NMRP Rampur 2016/17

Genotype	Days to 50% flowering	Days to 85% maturity	Plant height, cm	Panicle length, cm	Panicle/ m^2	Grain yield, t/ha	1000 grains wt., g
08 FAN2	80	111	111	21	267	2.63	21
B11586-FMR-11-R-2-11	82	114	112	22	308	3.42	24.9
HARDINATH-1	73	109	104	22	319	2.26	22.1
HHZ10-DT7-Y1	84	115	106	20	353	4.67	26
HHZ12-SAL2-Y3-Y2	85	116	113	23	376	4.17	22.8
HHZ1-DT3-Y1-Y1	82	114	99	18	250	4.25	22.5
IR08L 181	82	113	112	19	322	4.07	26.1
IR09L 229	78	110	113	22	419	3.57	26.2
IR09L 270	83	115	116	21	295	3.96	24.8
IR09L 342	79	111	111	24	366	3.53	29
IR09N 542	86	116	109	21	347	4.08	29.2
IR10L 151	82	114	113	23	375	4.61	27.4
IR10L 182	81	113	115	21	359	3.03	26.6
IR11N400	86	115	114	22	371	4.59	24.1
IR55423-01	87	116	119	23	351	4.95	25.9
IR88965-39-16-4	83	115	110	22	346	4.41	25.7
Mean	82	114	111	22	339	3.89	25.3
F-test	**	**	**	**	*	**	*
LSD (0.05)	2.0	1.6	6.9	3.5	74.8	6.211	4.6
CV (%)	1.5	0.9	3.7	9.6	13.2	9.6	11.0

Table 148: Mean grain yield and other agronomic traits of rice genotypes in CVT-FAR at Rampur 2016/17

Genotype	Days to 50% flowering	Days to 85% maturity	Plant height, cm	Panicle length, cm	Panicle/ m^2	Grain yield, t/ha	1000 grains wt., g
Black Rice	73	104	65	16	246	1.14	30
HHZ10-DT5-L11-L1i	82	114	97	21	256	4.40	24
HHZ12-Y4-Y1-DT1	84	115	103	20	334	3.76	22
HHZ24-DT11-L1-L1	86	115	100	20	294	4.01	19
HHZ3-SAL4-Y1-Y1	80	110	109	19	293	3.69	26
IR 05N 170	86	125	118	21	377	3.90	28
IR 05N 359	88	120	103	20	345	3.15	27
IR 10N 270	81	114	83	20	325	3.18	24
IR 83388-B-B-8-3	84	115	109	21	370	3.42	27
IR 93405-B-B-96-2	84	120	109	22	299	3.80	24
NR2124-43-3-1-1-1	101	133	117	21	336	4.05	20
NR2154-8-1-1-1-1-1	98	133	154	24	343	1.21	24
NR2154-8-1-1-1-1-1-1	100	137	142	24	288	1.15	23
NR2160-47-1-3-1-1	93	127	100	20	346	2.98	22
NR2188-3-2-4-1	102	134	118	20	329	4.20	19
Sanbha Masuli Sub-1	104	138	89	19	357	3.42	16

Genotype	Days to 50% flowering	Days to 85% maturity	Plant height, cm	Panicle length, cm	Panicle/ m^2	Grain yield, t/ha	1000 grains wt., g
Sugandhit Dhan-1	84	120	106	21	339	3.97	28
Mean	89	122	107	20	322	3.26	24
F test	**	**	**	*	*	**	**
LSD (0.05)	2	6	15	3	72	4.90	4
CV (%)	1	3	8	9	13	9	10

Table 149: Performance of normal season rice genotypes evaluated in CVT-normal at NMRP Rampur 2016/17

Genotype	Days to 50% flowering	Days to 85% maturity	Plant height, cm	Panicle length, cm	Panicle/ m^2	Grain yield, t/ha	1000 grains wt., g
GSR 120	84	118	109	20	272	4.06	23.8
GSR 126	83	121	100	20	255	4.03	27.6
GSR 132	75	114	102	21	286	2.90	25
GSR 310	83	121	98	19	248	3.90	20.7
GSR102	85	122	111	19	252	3.74	26.1
GSR219	84	120	110	22	277	3.30	24.6
GSR336	83	120	104	19	283	4.04	24.8
IR 05N419	87	125	102	22	304	3.31	25.9
IR 06A146	94	124	109	20	275	3.65	24.2
IR09A133	87	122	108	22	255	3.30	25.3
IR80285-34-3-3-2	87	121	114	21	267	3.21	27.5
IR94391-131-353-19-B-1-1-1-1	92	124	111	22	295	3.04	25.9
IR96321-1447-651-B-1-1-2	97	125	109	21	299	3.98	23.8
IR96321-558-64-B-4-1-1	95	128	107	22	280	4.41	21.6
IR96322-34-202-13-2-1-2	98	128	112	22	274	4.31	23.3
Makawanpur-1	103	137	108	23	279	4.19	28.2
Masuli	104	136	136	21	266	4.08	20.4
NR2157-122-1-2-1--1-1-1	84	116	106	21	209	3.58	23.6
NR2157-144-1-3-1-1	92	123	100	20	312	3.44	20.1
NR2157-166-1-3-5-1	108	142	114	22	310	4.26	27.1
NR2157-66-2-3-1-1-1	97	131	115	22	304	3.57	18.9
NR2158-13-1-1-2-4	95	122	107	20	361	3.59	23.7
NR2158-13-1-2-4-5	94	130	100	21	331	3.41	24.4
Sabitri	98	131	112	19	273	3.97	24.1
Mean	91	125	109	21	282.0	3.72	24.2
F-test	**	**	**	ns	ns	**	*
LSD (0.05)	1.8	6.8	10.8	-	-	597.7	4.1
CV (%)	1.2	3.3	6.1	7.8	17.1	9.8	10.4

2.7.3 Lentil

2.7.3.1 Coordinated varietal trial (CVT)

A total of eighteen lentil cultivars including shital as a standard check were evaluated in coordinated varietal trial (CVT) at NMRP, Rampur during winter season of 2016/17. The design of the experiment was Randomized Complete Block having three replications. The unit plot size was 4m x 1.5m with 25cm row to row spacing and continues plant to plant spacing was maintained and net harvested plot was 4 square meters. The recommended dose of fertilizer was 20:40:20 N: P_2O_5:K_2O kg/ha. Other agronomic practices were followed as recommended.

Data revealed that statistically significant differences were observed in the traits days to flower, days to maturity and grain yield (Table 150). Lentil cultivars Black masuro (2.39 t/ha), ILL 3338 (2.39 t/ha), ILL 10265 (2.02 t/ha), ILL 6819 (2.00 t/ha) and WBL 77 (2.00 t/ha) were the high yielding compare to standard check Shital (1.57 t/ha).

Table 150: Performance of lentil genotypes under coordinated varietal trial (CVT) at NMRP, Rampur, during 2016/17 winter

Genotypes	EPS %	Fl_ days	Mat_ days	PHT, cm	Pod / plant	Seed / pod	FPS %	G Yld (t/ ha)	HSWt (g)	Stb (1-9)	Wilt (1-9)
Black masuro	85	83	130	49	82	2	77	2.39	3.93	3	3
RL-4	85	77	129	46	77	2	75	1.35	3.50	6	4
ILL 7979	83	78	129	43	69	2	73	1.81	3.85	4	3
ILL 6819	83	79	130	50	40	2	77	2.00	3.80	4	4
ILL 3490	88	75	128	49	82	2	80	1.66	3.68	6	4
ILL 6467	78	78	129	54	54	2	70	1.61	3.40	5	4
ILL 7723	80	79	132	50	52	2	73	1.11	4.06	6	4
X 945-48	83	77	134	42	68	2	73	1.88	4.11	6	3
ILL 3338	80	77	129	48	68	2	73	2.39	4.05	5	4
ILL 10265	83	79	131	47	60	2	77	2.02	3.81	6	4
ILL 2712	88	80	131	44	60	2	80	1.36	3.67	5	3
WBL 77	82	77	129	43	63	2	75	2.00	3.72	6	4
LN 0136	82	79	133	47	55	2	75	1.70	3.75	6	4
HUL-57	87	80	130	45	42	2	78	1.97	3.80	6	4
ILL 7715	88	81	133	47	66	2	75	1.53	3.77	5	5
PL 4	85	77	133	47	66	2	73	1.80	4.31	5	6
ILL 7163	85	80	132	45	63	2	77	1.80	3.74	5	4
Shital	85	78	130	51	63	2	75	1.57	4.28	6	4
Grand mean	84	79	131	47	63	2	75	1.78	3.85	5	4

Genotypes	EPS %	Fl_ days	Mat_ days	PHT, cm	Pod / plant	Seed / pod	FPS %	G Yld (t/ ha)	HSWt (g)	Stb (1-9)	Wilt (1-9)
F test	ns	*	*	ns	ns	ns	ns	*	ns	ns	ns
LSD (0.05)	8.89	3.73	3.60	8.48	38.05	0.53	9.65	0.61	0.58	2.21	1.67
CV,%	6.4	2.9	1.7	10.9	36.5	17.2	7.7	20.8	9.2	25.3	25.7

EPS- early plant stand, Fl_days – flowering days, Mat_days – maturity days, PHT- Plant height, FPS- final plant stand, G Yld- grain yield, HSWt- hundred seed weight, Stb- Stemphylium blight, %- percentage, cm-centimeter, t/ha- ton/hectare, g- gram

2.7.3.2 Pre-release varietal trial (PRVT)

In PRVT, a total of eight lentil cultivars including standard check Sagun were evaluated at Rampur during winter season of 2016/17. The unit plot size was 4m x 2m with 25cm row to row spacing and continues plant to plant spacing was maintained. The recommended dose of fertilizer was 20:40:20 N: P_2O_5:K_2O kg/ha. Other agronomic practices were followed as recommended.

The high yielding genotypes were ILL 8006 (2.78 t/ha), Black masuro (2.40 t/ha), ILL 7164 (2.40 t/ha), ILL 6467 (2.35 t/ha) and ILL 7723 (2.00 t/ha) than standard check Sagun (1.30 t/ha) (Table 151).

Table 151: Performance of lentil genotypes under pre-release varietal trial (PRVT) at NMRP, Rampur, during 2016/17 winter

Genotypes	EPS %	Fl_ days	Mat_ days	PHT, cm	Pod / plant	Seed / pod	FPS %	G Yld (t/ ha)	HSWt (g)	Stb (1-9)	Wilt (1-9)
Black masuro	80	84	125	39	85	2	70	2.40	3.9	5	3
RL-4	75	76	118	32	52	2	65	1.04	3.61	5	3
ILL 6467	85	78	119	42	46	2	80	2.35	3.62	7	5
ILL 6819	90	79	119	33	54	2	80	2.22	4.11	7	5
ILL 7164	70	77	119	34	83	2	65	2.40	3.91	5	5
ILL 8006	75	76	123	33	62	2	70	2.78	3.61	7	3
ILL 7723	70	80	130	47	64	2	65	2.00	3.16	7	3
Sagun	70	79	121	35	53	2	60	1.30	3.64	5	3

EPS- early plant stand, Fl_days – flowering days, Mat_days – maturity days, PHT- Plant height, FPS- final plant stand, G Yld- grain yield, HSWt- hundred seed weight, Stb- Stemphylium blight, %- percentage, cm-centimeter, t/ha- ton/hectare, g- gram

3. SOURCE SEED PRODUCION

3.1 Seed Production of Maize, Rice, and Wheat and Sun hemp

National Maize Research Program produced 53.43 tons of maize seed, 43.99 tons of rice seed, 3.1 tons of wheat seed and 0.15 tons of sun hemp seed in the fiscal year of 2016/17. Seed production details are shown in following tables (Table 152 and 153).

Table 152: Seed production of different maize varieties at NMRP, Rampur in 2016/17.

S.N.	Varieties	Breeder Seed (t)	Foundation Seed (t)	Improved Seed (t)	Total (kg)
1	Rampur Composite	7.37	13.02	5.110	25495
2	Arun-2	1.34	3.93	2888	8162
3	Arun-4	0.36	0.51	0	862
4	Manakamana-3	3.19	11.10	612	14901
5	Deuti	1.24	2.60	0	3835
6	Poshilo Makai-1	0.06	0.11	0	174
	Sub Total	13.55	31.27	8610	53429
	Mixed maize				38573
	Grand Total				92002

Table 153: Seed production of rice, wheat and sunhemp at NMRP, Rampur in 2016/17

S.N.	Crop	Varieties	Foundation Seed (kg)	Improved Seed (kg)	Total (kg)
1	Rice	Ramdhan	9116	0	9116
2		Sabitri	34881	0	34881
3	Wheat	Bijay	2050	0	2050
4		Gautam	1050	0	1050
5	Sun hemp	Sun hemp	150	0	150
	Sub Total				47247
	Mixed Rice				18590
	Mixed Wheat				453
	Grand Total				66290

4. SPECIAL PROJECTS

4.1 Kisan Ka Lagi Unnat Biu Bijan Karyakram

Kisan ka lagi Unnat Biu bijan Karyakram (KUBK) is a several year project. In fiscal year 2072/73, there was no target for breeder seed production of rice. In Salyan, foundation seed production of rice was 9 ton (Sabitri 8 ton and Ramdhan 1 ton) and in Pyuthan foundation seed production was 4 ton (Sabitri 3 ton and Sukha-3 1 ton). In fiscal year 2072/73, rice nucleus seed couldn't be obtained

from NRRP. Foundation seed production program is ongoing in 5 ha each in Salyan (Ramdhan) and Pyuthan (Sabitri). Crop is at tillering stage.

In fiscal year 2072/73, there was no maize breeder seed target. In Gulmi, foundation seed production was 14.5 ton (Rampur Composite 8 ton, Manakamana-3 4.5 ton and Deuti 2 ton), in Arghakhachi, foundation seed production was 8.5 ton (Rampur Composite 2 ton and Manakamana-3 6.5 ton), in Pyuthan, foundation seed production was 1.4 ton (Rampur Composite) and in Rolpa, foundation seed production was 4 ton (Manakamana-3). In fiscal year 2073/74, total production of breeder seed of Rampur Composite and manakamana-3 was 3 ton (1.5 ton each) .Foundation seed production program of Rampur Composite is ongoing in 5 ha in each of Gulmi and Arghakhachi district. The crop of Gulmi and Arghakhachi is at post flowering stage.

In fiscal year 2072/73, there was no breeder and foundation seed target of wheat. In fiscal year 2073/74, 1 ton foundation seed of wheat (Gautam) was produced.

In fiscal year 2072/73, two PVS trials of rice were completed in Triveni and Bhotechaur VDCs of Salyan district. Sukha-5 produced the highest yield (6.992 t/ha) followed by Radha-13 (6.27 t/ha) and Makawanpur-1 (5.89 t/ha). Six PVS trials of maize were completed in Gulmi and Arghakhachi district. BGBYPOP produced the highest yield (5.76 t/ha) followed by ZM 401 (5.47 t/ha) and Across 9942/Across 9944 (4.82 t/ha). In fiscal year 2073/74, one PVS trial of rice is at tillering stage in Pyuthan. Maize PVS sets are at post flowering stages in Rolpa (5 sets) and Pyuthan (5 sets). Two PVS trials of wheat were completed in Rolpa district. NL 1179 produced the highest yield (4.51 t/ha) followed by NL 1231 (4.37 t/ha) and WK 2430 (3.93 t/ha).

4.2 Maintenance of released maize varieties

This is a regular project of NMRP which is run to maintain the characteristics of released maize varieties. For the maintenance of released maize varieties, in first year, we conducted grid selection and in the second year, we conducted half sib family selection. In grid selection, we prepared 100 grids and selection of 6 ears was done in each grid. In each grid, there were 6 rows and from each row one ear was selected. Length and width of each grid was 5m and 4.5m respectively. In half sib family selection, male and female lines were planted in 1:3 ratio. Male lines were prepared by bulking seeds of all ears and each selected ear was used as a female line. After crossing, selected ears of the female lines were bulked to make nucleus seed.

Grid selection was completed in Arun-2, Manakamana-3 and Poshilo Makai-1. Half sib family selection was completed in Rampur Composite and Deuti and 3.5 kg and 2.3 kg nucleus seed was produced in those varieties respectively.

4.3 Multinational company's hybrids

In this project, 53 hybrids including 2 checks were evaluated where 26 hybrids were received from 9 companies so called first set and 27 hybrids from 8 Agrovets were considered as second set experiment. Experiments were designed in RCBD at 4 locations (NMRP Rampur, RARSs Parwanipur,Tarahara and Nepalgunj). Two replications of both the sets were planted at Parwanipur,Tarahara and Nepalgunj, and 3 replications at NMRP Rampur. Trials were planted in November 2016 at RARS, Parwanipur and NMRP Rampur, where as in December 2016 at Tarahara and Nepalganj.

The highest grain yield was recorded on P 3377 (12 t/ha) followed by PPS 4291 and KMH 1311 (11.7 t/ha) at RARS Parwanipur in set I (Table 154). Similarly, at Rampur and Parwanipur LG 3405 (12.29 t/ha) and at Tarahara NK 7720 (10.14 t/ha) were found the highest yielded multinational company hybrids in set II (Table 155) during 2016/17.

Table 154: Grain yield of selected three hybrids in set 1 at various locations 2016

NMRP Rampur		RARS Parwanipur		RARS Tarahara		RARS Nepalgunj	
Genotype	Grain yield, t/ha	Genotype	Grain yield, t/ha	Genotype	Grain yield, t/ha	Genotype	Grain yield, t/ha
P 3377	11.61	P 3377	12.00	P 3377	10.91	Trinath 806	6.81
P 3355	10.78	PPS 4291	11.70	KMH 2589 DRONA	10.57	TMMH 826	6.7769
KMH 1311	10.68	KMH 1311	11.70	KMH 1311	10.13	KMH 1311	6.72

Table 155: Grain yield of selected three hybrids in set 2 at various locations 2016

NMRP Rampur		RARS Parwanipur		RARS Tarahara		RARS Nepalgunj	
Genotype	GY, t/ha	Genotype	GY, t/ha	Genotype	GY, t/ha	Genotype	GY, t/ha
L. G 34.05	10.29	L. G 34.05	12.29	NK 7720	10.14	S 6217	7.13
MM 2562	9.74	NK 7720	11.31	MM 2562	9.30	MM 2525	7.06
NK 6240	9.64	NK 6607	11.25	NK 6607	8.52	MM 2030	7.00

Based on two years multi-location trials, 13 multinational company hybrids (PL-3300, HP-222, PL-3331, 9784, 951 Super, P-3533, JM-4, JM-1, LG 33.01 (LG 32.71), Bisco Jumbo 65, JKMH 502, Corn King 9522(M9292), Suprim 9063 (Bikas)) were registered in NSB in 2074 (Table 156).

Table 156: Grain yield and other traits of multi-national company hybrids registered in 2074 BS.

SN	Hybrid	Company	Grain yield, t/ha	Plant height cm	Days to (50% Flower-ing)	Maturity	ASI	Diseases (1-5)	Insect (1-5)
1	PL-3300	Proline Seeds Com.P. Ltd. Ind.	8.74	200	110	160	2.83	2.17	2.34
2	HP-222	Proline Seeds Com.P. Ltd. Ind.	8.90	182	106	160	3.33	2.04	2.14

SN	Hybrid	Company	Grain yield, t/ha	Plant height cm	Days to (50% Flower-ing)	Maturity	ASI	Diseases (1-5)	Insect (1-5)
3	PL-3331	Proline Seeds Com.P. Ltd. Ind.	8.80	188	107	165	3.50	2.05	2.21
4	9784	Shree Ram Bioseed genetics India	7.79	214	110	145	3.50	2.15	1.82
5	951 Super	Chand Hybrid Seed Com. India	7.27	265	110	155	2.00	1.92	1.71
6	P -3533	Pioneer Seed Com. Ind	7.40	210	108	165	3.00	2.05	2.25
7	JM-4	Deyue seed Com. Pvt. Ltd.	7.27	196	81	140	3.00	1.78	1.46
8	JM-1	Deyue seed Com. Pvt. Ltd.	7.16	173	82	150	3.00	2.07	1.96
9	LG 33.01(LG 32.71)	Bisco Bio Science Pvt.Ltd	8.01	190	105	165	3.00	1.09	2.01
10	Bisco Jumbo 65	Bisco Bio Science Pvt.Ltd	8.17	200	107	160	3.50	2.13	1.97
11	JKMH 502	JK Seeds Com. Ind	7.21	200	100	150	3.50	1.55	1.60
12	Com King 9522(M9292)	Renova Seed Science Ind,Pvt. Ltd.	7.21	182	107	165	2.91	0.84	2.42
13	Suprim 9063 (Bikas)	Renova Seed Science Ind,Pvt. Ltd.	7.11	170	106	160	3.00	1.79	2.38

5. TECHNOLOGY TRANSFER AND SERVICES

5.1 Training/Workshops

Village level workshops and farmers training on "CA based crop management practices on rice-maize system" were organized in the year 2073/74. A total of 65 farmers and maize stakeholders were benefited from trainings and workshops organized by NMRP Rampur. The detail is provided in annex 5.1.

5.2 Services

Both field and laboratory diagnosis and also counseling cervices regarding the problems associated with maize, rice and wheat cultivation were provided to the altogether 160 farmers during the year 2073/74. The detail is provided in annex 5.2.

5.3 Publications

A total of 200 copies (100 copies of annual report and 100 copies of journal of maize research and development in Nepal) were published in English language. The detail is provided in annex 5.3.

5.4 Information through media

Two interviews, about maize research and production technology were broadcasted by FM radio. The detail is provided in annex 5.4.

5.5 Visits

A total of 1485 stakeholders including 650 farmers, 485 students, 95 extension workers, 220 staffs and 35 international scientists visited NMRP Rampur during 2073/74. The detail is provided in annex 5.5.

5.6 Fair and Exhibitions

NARC day and Rice day was celebrated in NMRP with different activities. Cleansing of office boundary, plantation of some ornamental plants, recreational activities and Dipawali were made during the celebration period with the involvement of technicians and administrative staffs. Rice plantation with recreational activities with the participation of NMRP staffs was organized on the occasion of Rice day at NMRP, Rampur.

6. OTHER ACHIEVEMENTS

6.1 Training/Workshop attended

National and international trainings and workshops were attended by scientists and technicians of National Maize Research Program at different period. The detail is given in annex 6.1.

6.2 Paper presented/published

A total of 11 papers regarding the maize research technology were published in journal (Journal of Maize Research and Development, 2015, vol. 2, No. 1) during 2016/17. The detail is given in annex 6.2.

7. KEY TECHNOLOGIES

7.1 Varietal

Production domain	Recommended variety
High hills (>1500 m. asl)	Ganesh-1 and Ganesh-2
Mid hills (>1000 m. asl)	Mankamana-1 Mankamana- 3, Mankamana-4, Mankamana- 5, Mankamana- 6, Manakamana-7, Deuti, Shitala, Khumal Hybrid-2, Poshilo makai-1 and Poshilo makai-2
Foot hills (Spring maize)	Rampur Composite, Arun-1, Arun-2, Arun-3, Arun-4, Arun-6 and Rampur-4
Terai/foot hills	Rampur Composite and Rampur-4
Terai (Winter maize)	Rampur Hybrid-2, Rampur Hybrid -4, Rampur Hybrid -6, Rampur Hybrid-8, Rampur Hybrid-10 and Rampur Composite
Promising NMRP hybrids:	RML-86/RML-96 and RML-95/RML-96.

7.2 Crop management

No tillage with retention of previous crop residue i.e. conservation tillage (CT) under rice-maize system found superior in terms of grain yields of respective crops and their system yields, soil nutrient status (soil organic matter, nitrogen, phosphorus and potassium), cost of cultivation and hence net return, and non lodging plants over the farmer's tillage practice of conventional tillage without crop residue (FP).

Conservation tillage in maize reduced the impact of drought by lowering soil temperature and surface evaporation, hence increased grain yield. In case of conservation tillage in maize, application of Atrazine (50%WP) @1.5 a.i. kg/ha within 24 hours of seeding and in case of no tilled dry direct seeding of rice, Pendimethalin 30% EC @ 6ml/l of water i.e 550 l/ha within 48 hours of direct seeding found profitable. Planting geometries of 60cm between rows and 25cm between plants for hybrids found suitable in Terai.

Tank mixture of Atrazine and Glyphosate (Atrazine @ 0.75 a.i. kg /ha + Glyphosate @ 2.5 ml/l of water) or Atrazine (Atrazine @1.5 a.i. kg/ha as pre emergence) + one hand weeding at 40 days after seeding during spring season found better for higher maize yield and net economic return in Terai, Nepal.

Nitrogen application @ of 180 kg N/ha in four splits (10% at planting, 30% at five leaf stage, 30% at 10 leaf stage and 30% at tasseling resulted the significantly higher grain yield of maize. Best time of planting for winter maize was last fortnight of September and for spring it was mid February in uplands of Terai.

For both tilled and no tilled condition, Chinese maize planter that drills the single seed per hill with 100% seed drilling efficiency found suitable for Terai and flat lands.

7.3 Plant protection

The gray leaf spot (GLS) disease resistant/tolerant maize varieties are Manakamana-3, Manakamana-5, Manakamana-6, Ganesh-1 & Ganesh-2, ZM 401, ZM 627, O5SADVI, BGBYPOP and O7SADVI.

Rampur Composite (Thai Composite x Suwan-1) was released in 1975 for Downy mildew resistant. Tilt (propiconazole) or Bayleton (triademeform) @ 2 g/kg seed has been found effective for the control of head smut disease.

Maize stalk rot disease severity was reduced significantly when the crop was sprayed with streptocyclin @ 2 g/l and insecticide (cypermethrin + chloropyrifos @ 2.5 ml/l) of water during knee height and subsequent spray after 15 days

interval. Maize stalk rot tolerant varieties are Rampur Composit, Arun 2, Rampur 34, RamS03F08, TLBRS07F16 and Rampur 24.

At Chitwan, early planting prior to 14th of May resulted in low borer infestation and less subsequent injury from the maize stem borer.

For maize stem borer and armyworm management, spinosad (45%) @0.25ml/l of water performed better as compare to Confidor 200SL and Furadan 3G whorl placement.

In case of maize storage pests, Bojho (10 g/kg seed) was found effective control to maize weevil, where the infestation was only 1.43% during the period of six months of storage. Furthermore, super grain bag and PICS bag was found free from storage insect pests up to 6 months.

7.4 Soil fertility management

For spring and summer season maize, the recommended doses of Nitrogenous fertilizer can be applied in splits i.e. at 30, 45 and 60 days after seeding for obtaining higher grain yield.

Hybrids maize produced significantly higher grain yield with chemical fertilizer 200:60:40 N_2: P_2O_5: K_2O kg /ha during winter in Terai.

In case of full season maize varities the fertilizer requirement was 180: 90: 60 N_2: P_2O_5: K_2O kg /ha along with 10 t FYM /ha for higher yield.

Incorporation of sun hemp as green manure @ 7 t/ha of dry biomass within two months of sowing produced the good yield of winter maize and enhanced the soil nitrogen.

8. BUDGET AND EXPENDITURE

The total budget released from NARC Source during the year 2016/17was NRs 58940000. The total expenditure was NRs 55564300 and that constituted about 44.30 % staff expense, 42.05 % operational cost, 9.76 % administrative cost and 3.89 % capital expense. The other funding sources were AFSP (IDA), HTMA/CIMMYT, KUBK-GoN, Multinational hybrid-Private companies, EU. NARC regular fund remained the major source and therefore, the funding source should be sustainable and the amount needs to be increased with time to run this program smoothly. The detail budget and expenditure of regulars as well as special projects are provided in Annex 7.1 and 7.2.

The total revenue generated was NRs. 5922450.5 and the beruju amount cleared on this fiscal year was NRs. 3,29,927 (52.34%). The details of revenue generated and beruju status is provided in Annex 7.3 and 7.4 respectively.

9. KEY PROBLEMS

9.1 Biological constraints

9.1.1 Diseases and pests in maize fields and stores

Smut (*Sphacelotheca reiliana*) and turcicum blight (*Helminthosporium turcicum*) in the eastern and mid western/far-western mid hills and high hills; ear rot in the central/western and mid-western/far-western mid hills; stalk rot in the mid-western/far-western mid hills, Terai, and high hills; and downy mildew (*Peronasclerospora spp*.) and leaf firing in the terai were important diseases mentioned by farmers. Banded leaf and Sheath blight (*Rhizoctonia solani*) was increasing in severity and prevalence in all environments. Turcicum Leaf Blight is ubiquitous in hill environments and can cause severe losses if the variety does not have good genetic resistance. Gray leaf spot disease is emerging as problematic during rainy season in the hills.

White grubs (*Phyllophaga spp*. and *Cyclocephala spp*.), stem borers (*Chilo partellus*), and termites (*Microtermes spp. and Macrotermes spp*.) were major maize field insects in all agro-ecologies. Army worms (*Spodoptera spp*.,*Mythimna spp*) and cutworms (*Agrotis spp*. and other species) were also major problems in all agro ecologies except the eastern mid hills. Blister beetle was a major problem in the central/western and mid-western/ far-western mid hills and the terai, and field cricket a serious pest in the eastern and mid-western/far western mid-hills and high hills. Aphid (*Rhopilosiphum spp*.), locust, red ant, and tassel beetle were also reported by farmers. Weevils (*Sitophilus* spp.) and Angoumois grain moth (*Sitotrogacerealella*) were major problems in stored grain throughout the country.

9.2 Management

9.2.1 Soil fertility

Among important recent changes are a reduction in livestock numbers, forest degradation, and reduced availability of labor, development of community forest and stall-feeding of cattle led to reduction in amount of manure. The reasons for low use of chemical fertilizer included high cost, non-availability at key times and a lack of knowledge of their use. There are no updated recommendation on the doses of fertilizer for high yielding hybrids, winter, spring and summer season, rainfed and irrigated maize.

9.2.2 Plant population at harvest

One factor that contributes to low system productivity is faulty thinning practices that lead to sub-optimal plant populations at harvest. However, information on optimal plant populations is lacking for maize-millet systems in these regions. Farmers generally plant higher seed rates and keep the higher densities of plant (92000) during vegetative growth stage and later on reduce up to 30,000 plants per hectare at harvest. The recommended plant density of 53,333/ha seems quite low in case of hybrid and spring maize. Therefore, there is a need to recommend the appropriate plant population for different seasons, practices and varieties.

9.2.3 Weed infestation

Weed cause major yield losses worldwide with an average of 12.8 % despite weed control applications and 29.2% in the case of no weed control. The loss caused by weed in maize ranges 40-70% and yield loss depend on type of weed flora and its severity. At ARS Pakhribas (eastern mid hill of Nepal) experimental result showed weedy environment resulted yield reduction up to 70% in maize. None of the weed management practices are being adopted by farmers except manual weeding in maize.

9.2.4 Seed

Seed replacement rate (SRR) has remained very low against the desirable seed replacement rate for crops at 25% to 30%, average SRR is 9.00 % for wheat, 9.00 % for rice and 7 % for maize in 2009. Of the total requirements of the cereal crop seeds, contribution of the formal sector is less than 10% and quality is a constraint to productivity. Large volume of low quality hybrid and other seeds are imported from India and distributed to the farmers through agrovets, especially in the bordering districts causing occasional crop failure in the past.

9.2.5 Water management

The total irrigated area in Nepal is only about 1331521 ha. More than two thirds of the maize is produced in the mid hills and high hills during summer season and is mostly grown under rainfed condition. Delay in monsoon during planting, uneven distribution of rainfall and prolonged drought during crop season may affect the crop yield adversely. Water stress due to drought is probably the most significant abiotic factor limiting plant and also crop growth and development. The very limited area under winter and spring maize in Terai is irrigated.

9.3 Socio-Economic

Maize is predominantly grown in the hills and the farm sizes are also quite smaller compared to Terai region. Maize farming is therefore considered as subsistence farming in Nepal. It is regarded as a staple food of hill people. Staple commodities such as rice, wheat, potato and vegetables have higher commercialization rates (30-50%) than maize and fruits (15-25%). The productivity is adversely affected by the shortage of agricultural labor. Due to an inadequate policy intervention for prioritization of agriculture research, NARC, is suffering from inadequate operational budget as a consequence maize research is also being affected.

10. WAY FORWARD

10.1 Opportunities

There are tremendous opportunities to increase the maize production there by narrowing down the wider yield gap and horizontal expansion in winter season. Although maize yields increased slightly (0.5% per annum), the present level (2.5 mt/ha) has not kept pace with the rapid growth of the population (1.35 per annum). Poultry industries need about 664,000 mt of feed annually in the country where maize is a major source of it. Maize demand is increasing at the rate of 11% per annum in Nepal. To fulfill the growing demand of milk, meat and meat productions, we are importing about 45% of maize to be used for feed from India. while the import of food? items is reduced, the only option we have is to increase the production through vertical and horizontal expansion of agricultural commodities. Under such condition, maize can play the role of economic engine of the country due to maize being a high yielding cereal, its area in Terai can be expanded during winter to feed the people and livestock. Furthermore, the special purpose maize like quality protein maize, sweet corn, baby corn and pop corn can also be grown in accessible areas to substitute the imports.

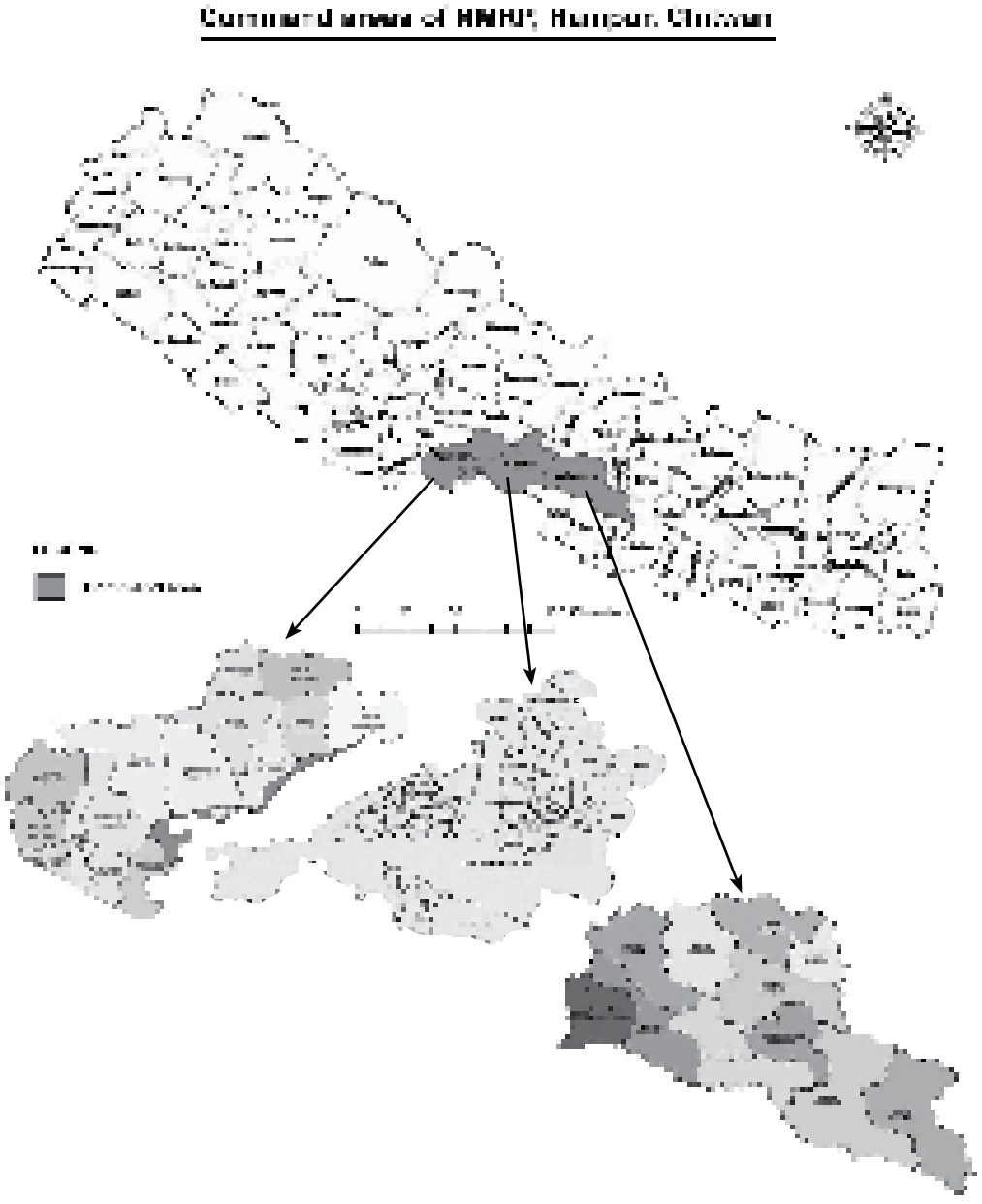
10.2 Emerging issues in maize production

The conventional maize production system needs to be converted into modern, resource use efficient and climate smart under the pretext of stagnant productivity as a result of limited area expansion, low yield potential of the existing genotype, imported hybrid seed, declining soil fertility, and emergence of new pest species, labour and water. Therefore, the research should focus on utilizing the latest tools of plant breeding for the development of stress resilient maize genotype, hybrid seed production effort, climate smart, and resource conserving agro-techniques like conservation agriculture.

1. Germplasm collection, exchange, evaluation and utilization
2. Development of stress (drought, heat, cold, low nutrient and high density resilient high yielding hybrids and open pollinated varieties of maize for different production ecologies
3. Long term research to develop the improved pest resistant germplasm that is adapted to nutrient deficiencies and other stresses need to be enacted
4. Application of modern tools of breeding like Marker-Assisted and Genomics for the fast track and precision breeding program in collaboration with CIMMYT and other concerned organizations
5. Low cost resource conserving production technologies
6. Source seed production and distribution system throughout the country
7. Development of quality protein maize for nutritional enhancement
8. Bridging the technology generation and delivery system through outreach research program
9. Collaboration with international CGIAR organizations and multinational companies
10. Strengthen the public-private partnership for technology generation and dissemination

Annex 1.1

Map of the Command Area of NMRP



Annex 1.2

Monthly Agro-meteorological Data of the NMRP, Rampur 2016/17

Month/Year	Max. Temp (0C)	Min. Temp (0C)	Precipitation (mm)	Humidity (%)
July 2016	32.41	24.1	618.4	93.69
August 2016	34.27	24.76	157.2	92.09
September 2016	32.27	23.46	631.4	92.15
October 2016	31.83	19.05	42.7	92.63
November 2016	28.3	11.07	0	94.5
December 2016	23.89	8.85	0	97.76
January 2017	23.97	6.14	13.8	95.24
February 2017	26.91	10.38	3.4	92.51
March 2017	29.58	13.45	64.5	87.08
April 2017	33.46	18.77	77.6	88.17
May 2017	34.77	21.29	86.3	86.81
June 2017	35.39	24.83	179.7	90.03

Annex 1.3

Maize Area (ha), Production (ton) and Productivity (kg/ha) by Seed Type

Ecological Belt	Seed Type				
	Improved	% Area	Local	% Area	Total
MOUNTAIN					
Area	71857	92	6248	8	78105 (8.76%)
Production	151617		10418		162035 (7.26%)
Yield	2110		1667		2075
Yld. Increment over Local (%)	26.57				
HILLS					
Area	605812	94	38669	6	644481 (72.29%)
Production	1520588		65497		1586085 (71.08%)
Yield	2510		1694		2461
Yld. Increment over Local (%)	48.18				
TERAI					
Area	163927	97	5070	3	168997 (18.95%)
Production	471618		11779		483397 (21.66%)
Yield	2791		2323		2725
Yld. Increment over Local (%)	20.15				
NEPAL					
Area	841596	92	49987	8	891583
Production	2143824		87693		2231517
Yield	2547		1754		2503
Yld. Increment over Local (%)	45.21				

Annex 2.1

Map of the Office/Station

Annex 2.2

List of Laboratory Facilities

SN	Name of laboratory	Major instruments	Manpower in laboratory	Testing facilities
1.	Pathology Laboratory	Autoclave, Laminar flow, Microscopes, Incubator, Oven, Water bath, Fridge, grinder, micropipette, digital balance etc.	Senior Scientist (S3), Technical officer (T6), Technical assistant (T4)	Fungi and bacteria isolation, culture inoculation, disease diagnosis, pathological experiments
2.	Entomology laboratory	Insect rearing and preservation tools, insect monitoring tools, fridge, centrifuge, grinder, oven, laminar flow etc	Senior scientist (S3), Scientist (S1), Technical Assistant (T5)	*Trichogramma* production, Identification and preservation of major maize insect pests
3.	Agronomy, plant breeding and soil science laboratory	Seed storage refrigerator, moisture meter, Digital balance, seed counter, ph meter, light meter, chlorophyll meter , micro volt meter, crossing tools, petriplates, soil kit box etc	Senior Scientist (S3), Scientist (S1), Technical officer (T6)	Germplasm seed storage, soil analysis, agronomical experiments, crossing of genetic lines

Annex 2.3

Human Resource of NMRP, Rampur in 2073/74 (2016/17)

S.N	Name	Position	Qualification	Specialization/ Working area	Remarks
1	Dr. Keshab Babu Koirala	Senior Scientist S4	Ph.D.	NMRP Coordinator, Plant Breeding	
2	Mr. Gobind KC	Senior Scientist S4	M.Sc. Ag.	Agronomy	Deputed to RARS, Banke
3	Mr. Chitra Bahadur Kunwar	Senior Scientist S4	M.Sc. Ag.	Agronomy	
4	Mr.Tirtha Raj Rijal	Senior Scientist S3	M.Sc. Ag.	Plant Pathology	
5	Mr. Bhanu Bhakta Pokhrel	Senior Scientist S4	M.Sc. Ag.	Agronomy	Deputed to RARS,Banke
6	Mr. Hari Prasad Subedi	Senior Tech. Officer T8	B.Sc. Ag.	Horticulture	Retired
7	Mr. Krishna Prasad Dhital	Senior Tech. Officer T8	B.Sc. Ag.	Agronomy	Retired
8	Mr. Balaram Bhandari	Scientist S1	M.Sc. Ag.	Plant Breeding	
9	Mr. Ghanashyam Bhandari	Scientist S1	M. Sc. Ag	Entomology	Study leave

S.N	Name	Position	Qualification	Specialization/ Working area	Remarks
10	Mr. Jiban Shrestha	Scientist S1	M.Sc.Ag	Plant Breeding	Deputed to NCARP, Pakhribas
11	Mr. Mahendra Tripathi	Scientist S1	M.Sc. Ag	Plant Breeding	
12	Dr. Shiva Kumar Jha	Scientist S1	Ph.D.	Agri-Engineering	
13	Mr. Jagat Bandhu Adhikari	Scientist S1	M. Sc. Ag	Agronomy	
14	Dr. Saraswati Neupane	Scientist S1	Ph.D.	Entomology	
15	Dr. Subash Subedi	Scientist S1	Ph.D.	Plant Pathology	
16	Mr. Devraj Chalise	Scientist S1	M.Sc. Ag.	Soil Science	Study leave
17	Mrs. Reena Sharma	Scientist S1	M.Sc. Ag	Soil Science	
18	Mr. Buddhi Bahadur Achhami	Technical Officer T6	M.Sc. Ag.	Entomology	Study leave
19	Mr. Tek Nath Ghimire	Technical Officer T6	SLC	Plant Pathology	
20	Mr. Shailendra Kumar Thapa	Technical Officer T6	I.Sc. Ag.	Agronomy	
21	Mr. Govinda Bahadur Hamal	Technical Officer T6	B.Com	Commerce and management	
22	Mr. Ambika Aryal	Technical Officer T6	TCL	Outreach	
23	Mrs. Parbati Adhikari	Technical Officer T6	B.Sc. Ag.	Soil Science	Study leave
24	Mr. Jitendra Prasad Yadav	Technical Officer T6	I.Sc. Ag.	Plant Pathology	
25	Mrs. Sheela Devi Sharma	Technical Officer T6	M.Sc. Ag.	Entomology	
26	Mr. Surendra Prasad Yadav	Technical Officer T6	B.Sc. Ag.	Entomology	
27	Mr. Khil Prasad Panta	Account Officer A6	M.Com	Account	Deputed to NARI, Khumaltar
28	Mr. Binod Chandra Adhikari	Account Officer A6	B.Com/MA	Account	
29	Mrs. Puspa Prava Bhandari	Administrative Officer A6	IA	Administration	
30	Mr. Raju Subedi	Administrative Officer A6	IA	Administration	
31	Mrs. Nandakala Sapkota	Administrative Officer A6	IA	Administration	Deputed to NCRP,Rampur
32	Mr. Janardhan Khanal	Chief Admin. Assistant A5	IA	Administration	Deputed to GRP Bandipur
33	Mr. Shyam Prasad Ghimire	Chief Admin. Assistant A5	IA	Administration	

S.N	Name	Position	Qualification	Specialization/ Working area	Remarks
34	Mr. Samrat Regmi	Accountant A5	BBS	Account	Deputed to Khumaltar
35	Mr. Bhim Bahadur Parajuli	Technician T5		Workshop	Deputed to RARS, Doti
36	Mr. Dil Bahadur Gurung	Technician T5		Workshop	
37	Mr. Anjan Pathak	Technician T5	I.Sc. Ag.	Entomology	
38	Mrs. Mira Shrestha	Technician T5	SLC	Plant Breeding	
39	Mr. Hari Prasad Sharma	Technician T5	M.Sc.Ag	Plant Breeding	Deputed to Jumla
40	Mr. Tirtha Subedi	Technician T5	B.Sc.Ag	Plant Breeding	
41	Miss. Jharana Upadhyaya	Technician T5	B.Sc.Ag	Plant Breeding	
42	Mr. Dhruba Regmi	Technician T5	B.Sc.Ag	Agronomy	
43	Mr. Sujan Karki	Technician T5	B.Sc.Ag	Agronomy	
44	Mr. Nanda Lal Dhakal	Technician Assistant T4	Literate	Plant Breeding	Retired
45	Mr. Jhamlal Subedi	Technician Assistant T4	Literate	Seed Production	
46	Mrs. Maiya Giri	Technician Assistant T4	SLC	Plant Breeding	
47	Mr. Sunaram Titung	Technician Assistant T4	+2	Seed production	
48	Mr. Binod Prasad Acharya	Technician Assistant T4	SLC	Soil Science	
49	Mrs. Debumaya Bhandari	Technician Assistant T4	SLC	Plant Breeding	
50	Miss. Mina Karki	Technician Assistant T4	SLC	Plant Pathology	
51	Mr. Kham Bahadur Praja	Technician Assistant T4	SLC	Agronomy	Study leave
52	Mr. Narendra Bahadur Gurung	Driver	Literate	Workshop	
53	Mr. Budha Bahadur Rana	Driver	Literate	Workshop	
54	Mr. Parsuram Ghimire	Technician 5th	Literate	Administration	Retired
55	Mr. Juddha Bahadur Rai	Technician 5th	Literate	Seed Production	Retired
56	Mr. Hari Bahadur Khadka	Technician 5th	Literate	Agronomy	
57	Mr. Ganesh Prasad Ghimire	Technician 5th	Literate	Administration	
58	Mr. Bishnu Prasad Devkota	Technician 5th	Literate	Outreach	
59	Mr. Purna Bahadur Tamang	Admin. Assistant 5th	Literate	Workshop	
60	Mr. Shambhu Prasad Bhatta	Technician 4th	Literate	Administration	
62	Mr. Bal Krishna Ghimire	Admin. Assistant 4th	Literate	Workshop	

S.N	Name	Position	Qualification	Specialization/ Working area	Remarks
63	Mrs. Sunmaya Tamang	Technician 4th	Literate	Seed Production	
64	Mr. Krishna Prasad Dawadi	Technician 3rd	Literate	Workshop	
65	Mrs. Tara Ghimire	Technician 3rd	Literate	Breeding	
66	Mr. Gagan Bahadur Kathayet	Admin. Assistant 3rd	Literate	Administration	
67	Mr. Bidur KC	Technician 4th	Literate	Breeding	
68	Mrs. Nanu Karki	Technician 1st	Literate	Soil	
69	Mrs. Laxmi Maharjan	Technician 1st	Literate	Plant Pathology	
70	Mrs. Goma Basnet	Technician 1st	Literate	Breeding	

Annex 3.1

Summary Progress of NARC Research Projects and Activities of NMRP in 2073/74 (2016/17)

Project code number	Name of project/ activity	Project/ Activity leader	End year	Budget allocated for this year (000)	Major progress/ achievements
	Maize Research and development in Nepal	KB Koirala	OG	3521	High yielding genotypes Full season hill set- BGBYPOP (5.63t/ha),QPM-S01SIYQ, Early SO3TEY-LN (5.16 t/ha), High value corn- pop corn Lumle yellow (3.73 t/ha),sweet corn- ID 9193 W, genotypes for Karnali region- Karnali pool yellow (4.92 t/ha).
	Development of conventional and non- conventional hybrids for different production environments in Nepal	KB Koirala	OG	1518	Two heat tolerant hybrids, Rampur Hybrid-8 (CAH-151) and Rampur Hybrid-10 (CAH-153) were registered. RML-95/RML-96, RML-86/RML-96, CAH-153 / RML-4/RML-17 gave the high yield and preferred by farmers.

Project code number	Name of project/ activity	Project/ Activity leader	End year	Budget allocated for this year (000)	Major progress/ achievements
	Participatory Technology Development At NMRP Outreach Research Sites	JB Adhikari	OG	607	Farmers preferred variety Hybrid- CAH-151 (12.3 t/ha), CP-808 (11.6 t/ha), CAH 1515 (11.1 t/ha), RML-95/RML-96 (10.7 t/ha). Early maize - S03TEY-IN (7.2 t/ha) Full season set, HG-AB (5.5 t/ha). QPM - SO3 TLYQ-AB-O2 (5.5 t/ha) , Poshilo Makai 1 (5.4 t/ha) Rice- Samba Masuli Sub -1 (3.9 t/ha), TOX322-6-5-2-2-2-2 (3.8 t/ha) Wheat- NL 1164 (3.6 t/ha)
	Breeder and Foundation seed production of maize and other crops	B. Bhandari	OG	4000	In FY 2073/74, 53.43 tons of maize seed (Breeder and foundation) was produced. In case of, foundation seed production in rice, wheat and sun hemp was 43.99 ton, 3.10 ton and 0.15 ton, respectively.
	Intercropping rice maize cropping system	KP Dhital	TB	477	The higher maize yield (5.27 t/ha) was recorded when maize intercropped with Rajma. The maize sole yield was 4.9 t/ha.
	Evaluating the performance of hybrid and OPVs maize varieties under conventional and no tillage with residue management practices in the Terai of Nepal	JB Adhikari	TB	285	The maize genotype RML-95/RML-96 gave significantly higher grain yield (10.3 t/ha) when grown under mulching on no tilling method of practices.

Project code number	Name of project/ activity	Project/ Activity leader	End year	Budget allocated for this year (000)	Major progress/ achievements
	Enhancing maize productivity through improvement and agronomic management practices in Terai and inner Terai of Nepal	JB Adhikari	TB	643	The maize grain yield and weed dry matter accumulations were significantly influenced by the weed management practices. Significantly higher grain yields were recorded in black plastic mulched (7.97 t/ha) and weed free (7.36 t/ha) treatments which were at par with rice straw mulched (6.06 t/ha).
	Evaluating and verification of the conservation agriculture based crop management practice on productivity of rice maize system in Nepal	JB Adhikari	TB	651	Sukkha Dhan-2, produced comparatively higher yield in broadcasting method compare with transplanting method.
	Evaluation and verification of the conservation agriculture-based practices under upland maize based system in Nepal	JB Adhikari	TB	1023	Maize variety Rampur Composit showed higher performance in terms of grain yield i.e. 9.25 kg/plot in conventional tillage system with the urea application based on leaf color chart reading
	Management of maize storage pest in Rampur condition	S. Sharma	TB	301	Among the tested botanicals, Bojho rhizome dust @10 g/kg of maize seed was found effective against weevil and on the other part, Super grain bag and PICS (Purdue Improved Crop Storage) bag was found superior against maize weevil at both 12% and 15% level of moisture, kept for a period of six months.
	Exploration and catloguing of parasitoids found in maize based agro-ecosystem in Chitwan, Nepal	S. Neupane	TB	249	A total of 25 natural enemies of maize were collected reared and preserved and prepared permanent slides.

Project code number	Name of project/ activity	Project/ Activity leader	End year	Budget allocated for this year (000)	Major progress/ achievements
	Study on bionomics of army worm and their eco-friendly management through the use of bio-rational alternatives	S. Sharma	TB	356	Spinosad @ 0.5ml/l of water was found most effective against armyworm. A higher damage of armyworm was observed before tasseling compared to knee height stage in a survey carried out in farmers' field.
	Screening of Elite germplasm of maize against Stem borer (*Chilo partellus* Swinhoe) in glass house condition	S. Neupane	TB	298	Out of the screened genotypes, the minimum damage was recorded on KKT 03 (4.33%) followed by S00TLYQ-B (5.67%), KEW-POP (6.67%) and Rampur Composite (6.67%) at tasseling stage. The high yielding genotypes were RML-86/RML-96 (2.60 t/ha), Rampur hybrid-4 (2.40 t/ha), RPOP 14 (2.33 t/ha), S00TLYQ-B (2.18 t/ha) and S03TLYQ-AB-02 (2.05 t/ha).
	FMP/AOE	KB Koirala	OG	6790	Research support, improvement of soil fertility of farm, security of farm, frontline demonstration of improved technologies, establishment and maintenance of field gene bank, maintenance of outlook office premises
	Collaborative experiments on different crops (Multi-location)	KB Koirala	OG	1391	Wheat: NL1324 (4.17 t/ha), NL1312 (4.10 t/ha), NL1253 (4.73 t/ha), NL1254 (4.62 t/ha) Rice: IR-96322-34-202-13-2-1-2 (4.6 t/ha), Makwanpur-1 (4.47 t/ha) and NR-2157-166-13-5-1 (4.58 t/ha) Lentil: In CVT, ILL 6819 (2.01t/ha) In PRVT, Black masuro (1.80 t/ha)

Project code number	Name of project/ activity	Project/ Activity leader	End year	Budget allocated for this year (000)	Major progress/ achievements
	Integrated Management Of Major Disease Of Maize	S. Subedi	TB	565	The higher percent disease control (52.36 %) and yield increase (40.29 %) were recorded from the plot sprayed with Streptocyclin @ 2 g/l and insecticide (Cypermethrin + Chloropyrifos @ 2.5 ml/l of water during knee height and subsequent spray after 15 days interval as compared to farmers practice. Out of 30 genotypes, Rampur Composit, Arun 2, Rampur 34, RamS03F08, TLBRS07F16 and Rampur 24 were found resistant against stalk rot complex with higher yield at Rampur, Chitwan.
	Improvement of soil acidity through management of soil and fertilizer in maize tori cropping system	R. Sharma	TB	433	Plot treated with the combination of cattle urine, urea and FYM along with other recommended fertilizer revealed the highest grain yield of 3.55 t/ha. The effect of biochar and woodash on maize grain yield. The plots treated by the combination of biochar@5 t/ha and woodash @10 t/ha and FYM along with other recommended fertilizer revealed the highest grain yield i.e. 3.03 t/ha.
	Impact of land degradation on maize yield in the midhills of Nepal	R. Sharma	TB	813	The trial conducted at GRP, Salyan showed that the highest yield of Manakamana-4 (7.2 t/ha) was recorded with the treatment no tillage + mulch during 2016/17.
	Training and interaction meeting program for promotion of improved maize technologies	KB Koirala	TB	570	Village level workshop was completed at Suping Makwanpur and the total no of farmers presented in the workshop were 30.

Project code number	Name of project/ activity	Project/ Activity leader	End year	Budget allocated for this year (000)	Major progress/ achievements
	China-Nepal technical cooperation project for development of hybrid crop varieties (3)	J. Shrestha	TB	293	The maximum grain yield was recorded in Rampur Composite (10.57 t/ha) followed by LPM-154 (10.52 t/ha) and LPM-155 (10.19 t/ha) and lowest grain yield in LPM-160 (4.89 t/ha) followed by RML-32/RML-17 (5.44 t/ha) and LPM-151 (6.30 t/ha) .

Annex 3.2

Summary Progress of Special Research Projects and Activities of NMRP in 2073/74 (2016/17)

Name of project/activity	Project/ Activity leader	Budget allocated for this year (‘000)	Major progress/ achievements
Agriculture and Food Security Project (AFSP)	KB Koirala	2065	3 ton breeder seed and 2.6 ton foundation seed of maize was produced at NMRP Rampur. In the evaluation of promising genotypes, RML-95/RML-96 produced the highest grain yield (8.72 t/ha) followed by Across 9942/Across 9944 (7.68 t/ha) and Pro-Vitamin-A (7.12 t/ha). The participants of the exposure visit ranked ZM 627 as the best genotype followed by Rampur S10F20 and Rampur S03F04.
Kisan ka lagi Unnat Biu bijan Karyakram (KUBK)	KB Koirala	4600	A total of 1.5 ton breeder seed of Rampur Composite and 1.5 ton breeder seed of Manakamana-3 was produced. NL 1179 produced the highest yield (4.51 t/ha) followed by NL 1231 (4.37 t/ha) and WK 2430 (3.93 t/ha) in Rolpa.

Name of project/activity	Project/ Activity leader	Budget allocated for this year (‘000)	Major progress/ achievements
Multinational company hybrid (MNCH)	CB Kuwar	1728	The highest grain yield was recorded on P 3377 (12 t/ha) followed by PPS 4291 and KMH 1311 (11.7 t/ha) at RARS Parwanipur in set I. Similarly, at Rampur and Parwanipur LG 3405 (12.29 t/ha) and at Tarahara NK 7720 (10.14 t/ha) were found the highest yielded multinational company hybrids in set II during 2016/17. Based on two years multi-location trials, 13 multinational company hybrids (PL-3300, HP-222, PL-3331, 9784, 951 Super, P -3533, JM-4, JM-1, LG 33.01(LG 32.71) , Bisco Jumbo 65, JKMH 502, Corn King 9522(M9292), Suprim 9063 (Bikas)) were registered in NSB in 2074.

Annex 4.1

Production of maize, rice and wheat at NMRP in FY 2073/74 (2016/17)

S.N	Commodities (Varieties)	Target (BS and FS) Total (ton)	Production (BS and FS) Total (ton)
1	Maize (Rampur Composit, Arun2, Arun 3, Arun 4, Arun 6, Deuti, Manakamana 3, Poshilo makai 1)	34	43.36
2	Rice (Sabitri, Ramdhan)	20	30.3
3	Wheat (Gautam, Bijaya)	4	4
4	Sunhemp	1.5	0.15
	Grand Total	59.5	77.81

Annex 4.2

Distribution of maize, rice and wheat seed from NMRP in FY 2073/74

SN	Commodity/ product	Type (Breeder/Foundation)	Quantity (Kg)	Major stakeholder(s)	Distributed districts
1	Maize	Breeder	8051	NARC stations, cooperatives, seed company, seed increase groups	Most of the districts from mid hills and Terai
		Foundation	21804	cooperatives, seed company, farmers, DADO	Most of the districts from mid hills and Terai
2	Rice	Foundation	14307	RARS, ARS, cooperatives, NGOS, farmers, DADO	Doti, Dailekh, Surkhet, Tanahu, Kaski, Rupandehi, Makwanpur, Chitwan, Nawalparasi, Kathmandu, Banke
3	Wheat	Foundation	3100	NARC stations, seed companies, NGOs, cooperatives Farmers, DADO	Doti, Dailekh, Surkhet, Tanahu, Kaski, Rupandehi, Makwanpur, Chitwan, Nawalparasi, Kathmandu, Banke

Annex 5.1

Training/Workshop/Seminar Organized in FY 2073/74 (2016/17)

SN	Name of Training/ Workshop/ Seminar	Duration	Target group	Location	No. of participants
1	Village level workshop	1 day	Farmers, seed production groups	Suping, Makwanpur	30
2	Farmers training on "CA based crop management practices on rice-maize system"	1 day	Farmers, seed production groups	Madi, chitwan	35

Annex 5.2

Services Provided in FY 2073/74 (2016/17)

SN	Laboratory/field test/ counseling services provided	Numbers	Major clients
1	Laboratory diagnostic services of maize, rice and wheat disease, pests and counseling of management practices	100	Farmers (Chitwan and Nawalparasi)

SN	Laboratory/field test/ counseling services provided	Numbers	Major clients
2	Field diagnostic services of maize disease and counseling of management practices	25	Farmers (Chitwan, Nawalparasi, Dang, Surkhet, Bara, Sarlahi
3	Counseling services of Integrated Nutrient management practices in maize	35	Farmers (Chitwan, Nawalparasi, Dang, Surkhet, Bara, Sarlahi

Annex 5.3

Publications in FY 2073/74 (2016/17)

SN	Name of publications	Type *	Language	Authors	No. of copies
1	Annual Report 2072/73	Books	English	NMRP	100 copies
2	Journal of Maize Research and Development	Journal	English	NMRP	100

**Books, leaflet, brochure, manuals, pamphlets, audio visual etc*

Annex 5.4

Information Disseminated Through Media in FY 2073/74 (2016/17)

SN	Information disseminated/Media coverage	Type*	Name/ Type of media#	Date/Time
1	Interview about major maize disease pest management	Interview	Synergy FM 91.6	2073/11/5
2	Improved maize production technologies	Interview	Synergy FM 91.6	2074/2/8

**news, interview, feature article, feature story, case story etc.*

#specifies print/radio/ TV etc.

Annex 5.5

Visits of the NMRP, Rampur by Farmers, Extension Officials /Technicians, Entrepreneurs, Cooperatives, Farmer Groups, NGO/CBO Officials during 2016/17

SN	Category	Number	Country / Districts	Area of major interest
1	Farmer	650	Mahottari, Sunsari, Myagdi, Parbat, Kailali, Kaski, Makwanpur, Lalitpur, Doti, Baglung, Rolpa	Improved maize technology study and visit tour
2	Student	485	Chitwan, Nawalparasi, Jhapa, Dailekh, Doti, Gorkha, Rolpa	Improved maize technology study and observation visit tour
3	Extension worker	95	Lalitpur, Jhapa, Bara, Parsa, Kailali, Doti, Dailekh, Rukum, Rolpa	Improved maize technology study and observation visit tour

SN	Category	Number	Country / Districts	Area of major interest
4	Staff	220	Kaski, Kathmandu, Lalitpur, Bara, Parsa, Kailali, Doti, Dailekh, Rukum, Rolpa	Maize Program monitoring and visit
5	International Scientists	35	Bangladesh, China, India, CIMMYT	Maize Program study visit tour

Annex 6.1

Training/Workshop/Seminar Attended by Staff in FY 2073/74 (2016/2017)

SN	Name of staff	Position	Name of Training / seminar/ workshop	Duration	Place/ Country	Organizer
1	Govind K.C.	S4	Hybrid Maize training observation visit	7 days	China	Government of China
2	Chitra Bahadur Kunwar	S4	Hybrid Maize Training	22 days	China	Government of China
3	G. Hamal	T6	Hybrid rice training	22 days	China	Government of China
4	Jiban Shrestha	S2	Hybrid maizeTraining	18 days	China	Government of China
5	Jagat Bandhu Adhikari	S1	Hybrid maize Training	22 days	China	Government of China
6	Reena Sharma	S1	GIS Training	6 days	Kathmandu	Soil Science Division

Annex 6.2

Paper Published in FY 2073/74 (2016/17)

SN	Title of paper	Authors	Name of proceedings, journal etc.
1	Performance evaluation of commercial maize hybrids across diverse Terai environments during the winter season in Nepal	M.P. Tripathi, J. Shrestha and D.B. Gurung	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 1-12
2	Management of stem borer (Chilo partellus Swinhoe) in maize using conventional pesticides in Chitwan, Nepal	S. Neupane, G.S. Bhandari, S. Sharma, S. Yadav and S. Subedi	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 13-19
3	Status of maize stalk rot complex in western belts of Nepal and its integrated management	S. Subedi, H. Subedi and S. Neupane	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 30-42
4	Studies on food preferences of maize weevil, Sitophilus zeamais Mots. to different crops in Chitwan, Nepal	S. Sharma, R.B. Thapa, G.B. K.C., G.S. Bhandari and S. Tiwari	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 58-65

SN	Title of paper	Authors	Name of proceedings, journal etc.
5	Genotype * environment interaction of quality protein maize grain yield in Nepal	J. Shrestha, C.B. Kunwar, J. Upadhyaya, M. Giri, R.B. Katuwal, R. Acharya, S.B. Gurung, B.N. Adhikari, A. P. Paudel and R.B. Paneru	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 66-73
6	Maize response to time of nitrogen application and planting seasons	P. Adhikari, B.R. Baral and J. Shrestha	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 83-93
7	Grain yield stability of early maize genotypes	C.B. Kunwar, R.B. Katuwal, S. Thapa and J. Shrestha	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 94-99
8	Phosphorous as the major yield limiting nutrient for maize in the river basin areas of western Nepal	B. B. Pokhrel, S.R. Sharma, G.B. Pun, N.S. Chhetri	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 100-108
9	Evaluation of maize genotypes for Turcicum leaf blight (Exserohilum turcicum) in Terai and inner Terai of Nepal	T.R. Rijal, G. K.C., K.B. Koirala and J. Shrestha	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 109-116
10	Estimation of heterosis in yield and yield attributing traits in single cross hybrids of maize	H.P. Sharma, K.H. Dhakal, R. Kharel and J. Shrestha	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 123-132
11	Differential resistance reaction of maize genotypes to maize stem borer (Chilo partellus Swinhoe) at Chitwan, Nepal	G.S. Bhandari, B.B. Achhami, S. Neupane and S. Sharma	Journal of Maize Research and Development, 2015, vol. 2, No. 1, 133-143

Annex 7.1

Regular Annual Budget and Expenditure Record of FY 2073/74 (2016/17)

(in 000 Nepalese Rupees)

Code	Budget Heads	Annual budget released	Expenses	Balance	Achievement percentage
	Operational expenses				
40*	Staff expenses	26110	26041.74	68.26	99.73
41**	Operational expenses	24784	22863.67	1920.33	92.25
42**	Administrative expenses	5754	4735.79	1018.21	82.30
	Sub total	56648	53641.2	3006.8	94.69
43**	Capital expenses	2292	1923.10	368.9	83.90
	Grand Total	58940	55564.3	3375.7	94.30

Annex 7.2

Special Project Budget and Expenditure Record of FY 2073/74 (2016/17)

(in Nepalese Rupees)

Name of the project	Funded by	Annual budget	Expenses
AFSP	World bank, IDA	2065000	1301793.88
EU (national reconstruction authority fund-capital expenses)	EU	2400000	1066128.00
EU (national reconstruction authority fund-current expenses)	EU	5440000	1739768.72
KUBK	GoN	4600000	2676940.76
HTMA/ CIMMYT	CIMMYT	830872	746857.99
Multinational company hybrid	Multinational companies	1728000	1557164.72

Annex 7.3

Revenue Status of FY 2073/74 (2016/17)

(in Nepalese Rupees)

Source	Amount	Remarks
crop	5323408	
Others	599042.5	
Total revenue	5922450.5	

Annex 7.4

Beruju Status of FY 2073/74 (2016/17)

Beruju	Amount	Remarks
Total beruju	6,30,347	
Beruju clearance	3,29,927	
Remaining beruju	3,00,420	
Cleared beruju percentage	52.34%	

Annex 8.1

Maize hybrids released in 2017

Description	Released Hybrids	
	Rampur Hybrid-8	Rampur Hybrid-10
Parentage	ZL 26632/ CML-451	ZL 109126/ CML-451
Plant height (cm)	183.08	181.7
Ear bearing height (cm)	85.5	72.15
Tasseling days	111 (winter)/ 62 (Rainy)	109 (winter)/ 77 (rainy)
Silking days	115(winter)/ 64(Rainy)	113(winter)/ 68 (rainy)

Description	Released Hybrids	
	Rampur Hybrid-8	Rampur Hybrid-10
Number of leaf below ear/cob	8	8
Number of lead above ear/ cob	4	5
Grain color	Turmeric yellow	Pink
Yield potential (t/ha)	7.8	8.05
Recommendation domain	Inner/ Inner Terai	Inner/ Inner Terai
Specialty	Stay green, moderately resistant to borer, resistant to NLB and SLB and heat stress resilient	Stay green, moderately resistant to borer, resistant to NLB and SLB and heat stress resilient

Annex 8.2

Cultivation practices for newly released hybrids of maize (Rampur hybrid 8 and Rampur hybrid 10)

Practices	Description
Planting time	Winter, spring
Spacing	60 cm x 25 cm
Fertilizer dose	180:60:40 kg NPK/ha along with 10-15 ton FYM/ ha, Nitrogen splited into three i.e. ½ at basal , ¼ at knee height stage and ¼ th at pre tasseling stage
Irrigation	Three times: at knee height, at tasseling/silking and at grain filling stage
Weed control	Weeding/hoeing at 20-25 days after sowing (DAS) and earthing up at 40-45 DAS, Atrazine @ 1.5-2 kg a.i./ha (50 WP) within 48 hours of planting
Insect control	chloropyriphos 50% EC + cypermethrin 5% EC @ 1.5 ml/l of water
Disease control	Dithane M-45 (2.5 g/l of water), propiconazole (tilt) (1.5ml/lof water for foliar spray, Bavistin (2g/kg of seed) treatment
Harvesting	Black layer formation at base/tip of kernel, at physiological maturity

Maize source seed production activities

CFFT on Hybrid maize at Jayamangala

Village level workshop, Suping, Makawanpur

Maize varietal research activities at NMRP

Maize plant protection research activities at NMRP

Geo map of NMRP Rampur