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Annual Report

2072/73 (2015/16)

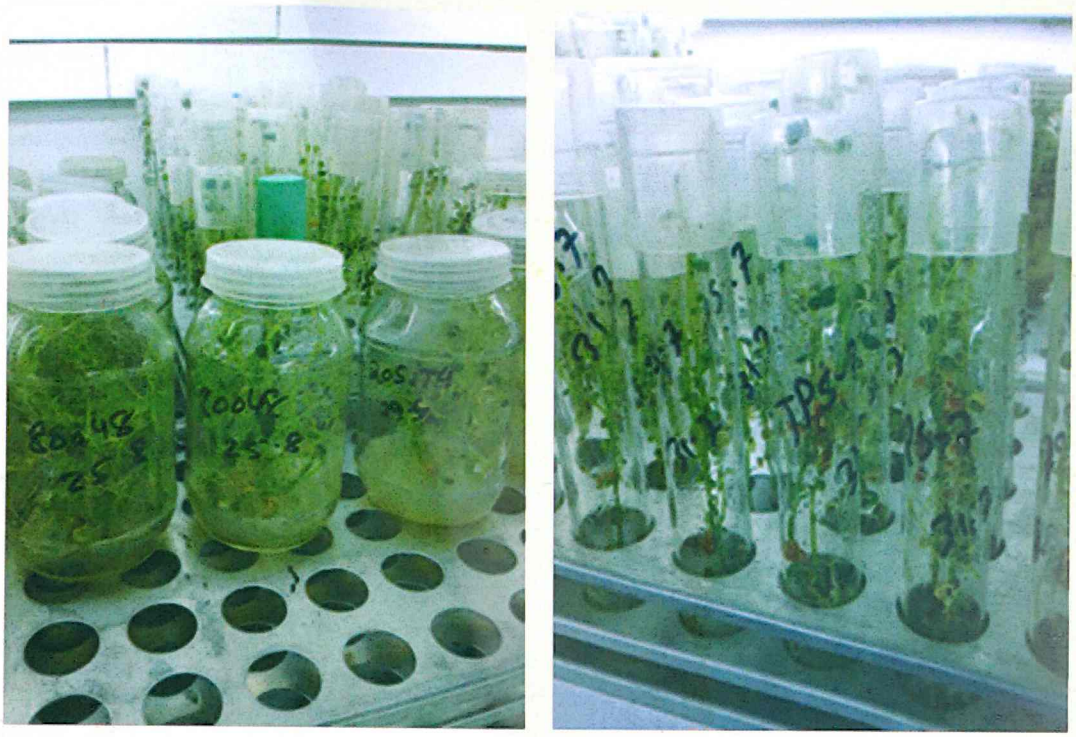
Government of Nepal

Nepal Agricultural Research Council

National Potato Research Program

Khumaltar, Lalitpur, Nepal

2016



In vitro plantlets of potatoes

Sweet potato research at Khumaltar

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FOREWORD

National Potato Research Programme (NPRP) is a nationally mandated commodity programme under Nepal Agricultural Research Council (NARC) for generating technologies on potato and for producing quality seed potatoes for the country. Since the time of its establishment, NPRP has been constantly involved in generating appropriate and stable technologies to increase the production and productivity of root and tuber crops (mainly potato and sweet potato) and source seed production to improve the livelihoods of Nepalese farmers. Annual documentation of such activities and outcomes is an integral part of NPRP's plan and program. Therefore, I am pleased to release the annual report of this programme for the fiscal year 2072/073 BS (2015/16 AD).

As in the past issues, this issue of the annual report gives a snapshot overview of lab, on-station and on-farm research works accomplished by NPRP in collaboration with RARSs, ARSs, disciplinary divisions, and commodity programs under NARC and status of quality seeds produced at NPRP Khumaltar during the year 2072/073 (2015/16).

I believe this issue of annual report will be a good reference for those who are involved in research, extension and education of potato crop. This issue will also be an excellent orientation to the students of horticulture, commercial and educated potato growers, and community based seed producers to know the annual status of research and seed production on potato.

On behalf of the programme, I extend my heart-felt thanks to NARC headquarter, all the collaborators and national and international organizations in supporting for the accomplishment of the various activities on time. I am also thankful to International Potato Center (CIP), Lima Peru and its regional office at New Delhi, India for their considerable assistance and cooperation received throughout the year 2015/16. Thanks are due to the staff of these establishments as well as to the staff members of NPRP for their assistance in conducting the various trials and activities.

I also appreciate participating farmers who engaged in on-farm trials in the various regions and assisted in promoting new varieties and technologies. I specially appreciate tireless efforts of Dr. KP Upadhyay, Senior Scientist and Ms Suprabha Pandey, technical officer for the compilation and editing of this annual report. I would like to thank Mr. Prakash Bhattarai, Senior Scientist; Mr. Sanjeev Gautam, Scientist; Ms. Santwona Ghimire, Technical Officer and all other technical and administrative staffs of NPRP for bringing this Annual Report in this form.

I am grateful to the National Potato Development Programme (NPDP), Nucleus Potato Seed Centre, Nigaley, Outreach Research Division, NARC and District Agriculture Development Offices of the concerned districts for their active role in promoting technologies and source seeds generated by NPRP. Last, but not the least, I thank to all those collaborative farmers, who participated in all the on-farm research activities undertaken during the year for their active involvement in selection of high yielding, nutritious and stress tolerant varieties.

Bhim Bahadur Khatri, PhD
Coordinator
National Potato Research Programme
Khumaltar, Lalitpur, Nepal
2016

ABBREVIATIONS

ABPSD	Agribusiness Promotion and Statistics Division
ARS	Agriculture Research Station
BS	Basic seed
CFFT	Coordinated Farmer's Field Trial
CIP	International Potato Center
CVT	Coordinated Varietal Trial
DADO	District Agriculture Development Office
DAS-ELISA	Double Antibody Sandwiched - Enzyme Linked Immuno orbant Assay
DOA	Department of Agriculture
F1C1	First clonal generation
F1C2	Second clonal generation
FAT	Farmer's Acceptance Test
FYM	Farmyard manure
GC	Ground coverage
IET	Initial Evaluation Trial
LSD	Least significant difference
MH	Malic Hydrazide
NARI	National Agricultural Research Institute
NASRI	National Animal Science Research Institute
NGOs	Non-government organizations
NPDP	National Potato Development Program
NPRP	National Potato Research Program
NS	Non-significant
NSPF	Nucleus Seed Potato Farm
PBS	Pre-basic seed
PGR	Plant Growth Retardants
PLRV	Potato Leaf Roll Virus
PPM	Parts Per Million
PTM	Potato tuber moth
PVA	Potato Virus A
PVM	Potato Virus M
PVS	Potato Virus S
PVS	Participatory Varietal Selection
PVX	Potato Virus X
PVY	Potato Virus Y
RARS	Regional Agriculture Research Station
RCBD	Randomized Complete Block Design
TPS	True Potato Seed
VDC	Village Development Committee

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१.१ आलुको जातीय उत्थान अध्ययन परीक्षण

- आ.व. २०७२।७३ मा आलुका नयाँ जातहरूको संकलन, पुराना जातहरूको संरक्षण एवं विभिन्न नयाँजातहरूको वीउ वृद्धि कार्य राष्ट्रिय आलुवाली अनुसन्धान कार्यक्रम खुमलटारको हात्तीवन फार्ममा र वागवानी अनुसन्धान केन्द्र मालेपाटन, कास्कीमा गरियो । प्रारम्भिक मूल्यांकन परीक्षण, समन्वयात्मक जातीय परीक्षण र कृषकको खेतवारीमा गरिने जातीय परीक्षणहरू पनि राष्ट्रिय आलुवाली अनुसन्धान कार्यक्रम, खुमलटार तथा परिषद् अन्तर्गतका अनुसन्धान केन्द्र र बाह्य अनुसन्धान स्थलहरूमा सञ्चालन गरिएको थियो ।

- आलुका जातहरूको प्रारम्भिक मूल्यांकन परीक्षणको समग्रमा विश्लेषण गर्दा CIP 393371.164, CIP 394608.52, र PRP 226567.2 जातहरू पहाडी हावापानी भएको हात्तीवन फार्ममा उत्पादनशील, उपयुक्त दाना भएका तथा रोगव्याधि कम लाग्ने पाइए भने मालेपाटन पोखरामा CIP 395017.229, PRP 136368.9 र CIP 395017.242 जातहरू उपयुक्त पाइए । यी जातहरूलाई आउँदा वर्षमा आलुको समन्वयात्मक जातीय परीक्षण अन्तर्गत सम्बन्धित हावापानी भएका फार्म, केन्द्रहरूमा सञ्चालन हुने परीक्षणमा समावेस गर्नु उपयुक्त देखिन्छ ।

- आलुको समन्वयात्मक जातीय परीक्षण अनुसार हात्तीवन फार्ममा CIP 396311.1, CIP 390663.8 पाखीबासमा CIP 399195.7, नेपालगञ्जमा CIP 276264.1, PRP 286265.22 र PRP 266265.1, तरहरामा CIP 399078.11, PRP 266265.1 र PRP 266265.15, जुम्लामा PRP 056267.1, PRP 296667.3 र CIP 399101.1, लुम्लेमा PRP 226267.11, CIP 39195.7 र CIP 396311.1, दैलेखमा CIP 384321.15, CIP 393073.179 र CIP 396286.6 जातहरू राम्रो उत्पादन दिने, डढुवा रोग कम लाग्ने तथा दाना र बोटको अवस्था राम्रो भएका पाइयो । यी जातहरूलाई आउँदा वर्षहरूमा कृषकको भूमिमा सञ्चालन हुने जातीय परीक्षणहरूमा समावेश गर्नु उपयुक्त हुनेछ ।

- कृषकको जग्गामा समन्वयात्मक जातीय परीक्षणहरूका आँकडाको विश्लेषण अनुसार पाखीवासमा CIP 385499.11 र CIP 39338539, लुम्लेमा CIP 399101.1 र CIP 396311.1, वाह्य अनुसन्धान स्थल नुवाकोटको ढिकुरेमा CIP 392280.64, नेपालगञ्जमा CIP 399101.1 र PRP 85861.11 तरहरामा CIP 388676.1, CIP 380606.6 र PRP 225861.1, डोटीमा CIP 384321.15, CIP 393077.159, CIP 393385.39 र बाह्य अनुसन्धानस्थल काठमाण्डुको जितपुरफेदीमा PRP 35861.11 जातहरू तुलनात्मक रूपले उच्च उत्पादन, बोट तथा दानाको

अवस्था राम्रो तथा डढुवा रोग कम लाग्ने खालका देखिए । आगामी वर्षहरूमा यी जातहरूलाई तत्तत् क्षेत्रमा थप अनुसन्धान तथा कृषकको रूचिभित्र पर्ने नपर्ने बारे थप अनुसन्धान गरिनेछ ।

- हात्तीवन फार्ममा असिंचित तर प्लाष्टिकको छापो राखेको र सिंचित अनि कुनै छापो नदिइएको अवस्थामा सुख्खा सहनसक्ने १२ वटा जातहरूलाई तुलनात्मक रूपले परीक्षण गर्दा दुबै अवस्थामा CIP 395195.7 र, CIP 396311.1 नामक जातहरूले राम्रो उत्पादन तथा अन्य विशेषताहरू देखाए । पटकपटकको सिंचाइबाट प्राप्त ओस भन्दा छापोले सुरक्षित गरेर विरूवालाई प्रदान गरेको ओसको असर उत्पादनमा प्रभावकारी देखियो ।

- आलुका दानामा परिरक्षणका लागि उपयुक्त विशेषता छन् कि छैनन् भनी जाँच्न १४ वटा जातहरूको स्पेसिफिक ग्राभिटी तथा सुख्खा पदार्थको मात्रा प्रयोगशालाको परीक्षणबाट प्राप्त गरिएको थियो जसको नतिजा अनुसार ती जातहरूमा CIP 384599.11, CIP 396311.1, CIP 388676.1 र CIP 395192.1 मा सबैभन्दा बढी स्पेसिफिक ग्राभिटी पाइयो । CIP 384599.11, CIP 388676.1 र CIP 395192.1 मा सबैभन्दा बढी मात्रामा सुख्खा पदार्थ पाइयो । CIP 396311.1 र CIP 399067.22 ले धेरै उत्पादन दिएका थिए ।

१.२ बीउ आलु अध्ययन परीक्षण

- आलुका विभिन्न जातहरु प्रयोगशालामा लामो अवधि सम्म संरक्षण गर्ने उदेश्यले गरिएको परीक्षणमा विभिन्न वृद्धि निरोधक रसायन (Plant Growth Retardents) को प्रयोग गर्दा एबिए (३० पिपिएम) प्रयोग गर्दा करिब ७ महिना सम्म बिरुवा बाँचेको र बिस्तारै बृदि भएको पाइयो भने मालिक हाइड्राजाइड (३० पिपिएम) ले ६ महिना सम्म राम्रो असर देखायो तर सिसिसि प्रयोग गरेको र केही पनि प्रयोग नगरेको (कन्ट्रोल) मा ९० दिन भित्रै बिरुवा छिट्टै बृदि भई पुरै मरेको पाइयो ।

- भाइरस उन्मूलन गर्ने कार्यक्रम अन्तरगत जुम्ली लोकल, खुमल रातो २, खुमल लक्ष्मी, रोजिटा, सिआइपि ३९३०७३१.१७९ र पिआरपि २५८६१.१ जातहरुलाई भाइरस मुक्त बनाउने काम गरियो ।

१.३ ब्यावसायिक र पूर्व मूल बीउ आलु उत्पादनको लागि दिगो र कुशल रणनीतिको विकास

- कालो प्लास्टिक मल्चको प्रयोग गर्दा खुमल उपहार (४६.५९ टन/हे) र खुमल सेतो - १ (४०.६७ टन प्रतिहेक्टर) जातहरुले बढी उत्पादन दिएको पाइयो । तर कार्डिनल जातले यो व्यवस्थापन अवस्था संग सबै भन्दा कम उपज (२४.४५ टन/हे) दियो । त्यस्तै माथि उल्लेखित जातहरु आकाशे खेती अर्थात् Rain-fed condition मा पनि राम्रो उत्पादन दिन सक्ने देखिए । खुमल उपहार र कुफ्री ज्योति जातहरु सिंचित अवस्थामा पनि सन्तोषजनक पाइए ।

२.० सखरखण्ड वाली अनुसन्धान

२.१ सखरखण्डको जातीय विकास सम्बन्धि अध्ययन परीक्षण

यस कार्यक्रम अन्तर्गत सी.आइ.पी. पेरुबाट संकलित सुन्तला रंग को गुदी भएका २१ र अन्य ५६ स्थानीय गरि जम्मा ७७ किसिमका सखरखण्डका जातहरु संकलन गरी अध्ययन, संरक्षण र वीउबृद्धि गर्ने कार्य खुमलटारमा भइरहेको छ ।

- सखरखण्ड को जातीय विकास अन्तर्गत प्रारम्भिक अनुसन्धानमा राष्ट्रिय उखुवाली अनुसन्धान कार्यक्रम, जितपुर, बारामा क्लोनहरु बेशीसहर सेतो, ठुटाबारी सेतो, परेवाटार सेतो, साँगाचोक रातो, सलांग सेतो र मोतीपुर सेतो उत्कृष्ट (१०.९ - ३४.६ टन प्रति हेक्टर) ठहरिएका छन् ।

- कृषकको खेतबारीमा गरिएको जातीय परीक्षणबाट सी.आइ.पी. ४४००१५ र सी.आइ.पी. ४४००१२ जातले तरहरा फार्मको कमाण्डमा रहेको तराई क्षेत्रको हरिपुर स्थलमा राम्रो उत्पादन दिएको पाइयो भने मध्यपहाडी क्षेत्र गोरखामा सी.आइ.पी ४४०३२८, सी.आइ.पी. ४४००१५ र सी.आइ.पी. ४४००१२ क्लोन उत्कृष्ट ठहरिए । त्यस्तै काभ्रेपलान्चोक जिल्लाको कुसादेवीमा सी.आइ.पी. ४४०२६७, ४४०३२८ र जापानिज् रातो क्लोनहरु उत्कृष्ट ठहरिएका छन् ।

३.० पूर्वमूल बीउ तथा मूलबीउ आलु उत्पादन

- शरद ऋतुमा र हिउदे ऋतुमा ३०४०० र २८,९८५ गरि जम्मा ५९,३८५ इन्भिट्रो बिरुवाहरु प्रयोगशालामा उत्पादन गरियो ।

- पूर्वमूल बीउ आलु (PBS) उत्पादन सम्बन्धमा शरद ऋतुमा ९४,७९१ र १,३२,३७८ गरी जम्मा २,२७,१६९ दाना PBS उत्पादन भयो ।

- आ.ब. २०७२ र ७३ को लागि PBS आलुको मूल्य निर्धारण सम्बन्धमा सबैभन्दा ठूलो (५ ग्राम भन्दा माथि) प्रतिदानाको रु. १३/००, १-५ ग्राम साइजको रु. ११/००, ०.५-१ ग्राम साइजको रु. ९/००, ०.२५-०.५ ग्राम साइजको रु. १.५० र सबैभन्दा सानो ०.२५ ग्रामको रु. ०.७५ मूल्य कायम भयो । आ.ब. २०७२/७३ मा जम्मा ३९०५ के.जी. मूलबीउ आलु हात्तीबन फार्ममा उत्पादन भयो ।

EXECUTIVE SUMMARY

1.0 Potato Research

1.1 Potato variety improvement

- In the fiscal year 2015-016 (2072/073 B.S.), Introduction, collection and maintenance and multiplication of new clones were carried out by NPRP at Hattiban Research Farm, Khumaltar and Horticultural Research Station, Malepatan in Kaski district. Initial evaluation trial, coordinated varietal trial and coordinated farmers' field trial were conducted at NPRP, research stations of NARC and outreach research sites of NARC in the country.

- In the Initial evaluation trial, the clones CIP 393371.164, CIP 394608.52 and PRP 226567.2 were promising for their yield, yield attributing parameters, tolerance against late blight and other plant performance in the hill condition of Hattiban farm. The clones CIP 395017.229, PRP 136368.9 and CIP 395017.242 were promising in Malepatan.

- Based on the results of coordinated varietal trials on potato with their high yield and promising yield attributing parameters, the superior clones were CIP 396311.1, CIP 390663.8 and CIP 395195.7 at Hattiban farm, CIP 395192.1 at Pakhribas, CIP 276264.1,PRP 286265.22 and PRP 266265.15at Nepalganj,CIP 399078.11, PRP 266265.1 and PRP 266265.15 at Tarahara, PRP 056267.1 and PRP 296667.3 at Jumla, PRP 226267.11 and CIP 395195.7 at Lumle,and CIP 384321.15, CIP 393073.179 and CIP 396286.6 at Dailekh. These clones will be included in Farmer's field in upcoming years.

- In coordinated farmer's field trials, the superior clones were CIP 385499.11 and CIP 39338539 at Pakhribas, CIP 393385.39 and PRP 25861.1 and CIP 394050.110 at Lumle, CIP 392280.64 and PRP 35861.18 at Dhikure (Nuwakot), CIP 399101.1 at Nepalgunj and CIP 385499.11 and PRP 35861.11 at Jitpurfedi (Kathmandu). These clones will be included in farmers' acceptance tests of next year's trials.

- Evaluation of 12 potato clones under non-irrigated condition with plastic mulch and irrigated condition without mulch revealed that the clones CIP 395195.7 and CIP 396311.1 were superior for drought and moisture stress. There was a positive effect of plastic mulch on conserving and supplying moisture continuously compared to the moisture given by periodic irrigation.

- From the 14 clones evaluated for specific gravity and dry matter content, the clones CIP 388599.11, CIP 396311.1, CIP 388676.1 and CIP 395192.1 had the highest specific gravity while CIP 384599.11, CIP 388676.1 and CIP 395192.1 showed the highest dry matter content. The yield was highest in CIP 396311.1 followed by CIP 399067.22.

1.2 Seed Potato Research

- In the case of long term preservation, result indicated that all tested plant growth regulators showed some effects on most of the parameters as compared to control or standard check. Among the chemicals, MH (30 ppm) showed better effect on retarding growth pattern with complete plant (leaf, node and root) of the incubated plantlets under in vitro condition followed by ABA (30 ppm) until 7 months. Maleic Hydrazide (30 ppm) showed good response till 360 days of sub-culture. Chlorocholine Chloride and control treatments showed overgrowth in around 90 days of sub-culture.
- During fiscal year 2072/73, virus cleaning of Jumli Local, Khumal Rato, Khumal Laxmi and Rosita was done with meristem culture. And the variety 393073.179 and PRP 25861.1 was also successfully cleaned according to the target.

1.4 Development of sustainable and efficient strategies for commercial and pre-basic seed potato production

- The use of black plastic mulch gave the highest yield (46.59 t/ha) in Khumal Upahar followed by Khumal seto-1 (40.67 t/ha). But in Cardinal, lowest yield (24.45 t/ha) was recorded with this management condition. Khumal Upahar and Kufri jyoti varieties were found better under rain-fed condition in Khumaltar conditions. Likewise, Khumal Upahar (38.74 t/ha) and Kufri Jyoti (33.18 t/ha) produced highest tuber yield in irrigated conditions. Variety cardinal gave the lowest yield in all three management condition.

2.0 Sweet Potato

2.0 Sweet potato variety improvement

- Under germplasm collection, maintenance and evaluation activity, 21 orange-fleshed sweet potato clones from CIP and other 56 local germplasm from different parts of the country were collected and maintained under *in vivo* conditions at NPRP, Khumaltar.

- In the initial evaluation trial (IET), at NSRP, Jitpur, Bara, sweet potato clones of Benshisahar White, Thutabari White, Parewatar White, Sangachok Red, Salang White and Motipur White were found to be promising with the yield ranging from 10.9-34.6 t/ha.
- In the coordinated farmers field trial (CFFT) of RARS Tarahara site, the promising clones CIP 440015 produced highest yield (7.45 t/ha) followed by CIP 440021 (7.13 t/ha). In Gorkha (site of RARS, Lumle) CIP clones 440328, 440015 and 440012 were found better with the yield (13.98 t/ha), (13.96 t/ha) and (11.62 t/ha) respectively. At Kusadevi VDC of Kabhrepalanchok district, CIP 440267 produced the highest yield (17.13 t/ha) followed by CIP 440328 (15.08 t/ha) and Japanese Red (14.59 t/ha).

3.0 Seed Production

- In case of PBS production, total of 30,400 in *vitro* plantlets of 15 cultivars were produced in autumn season (August, 2015) and total 28,985 in *vitro* plantlets of 17 cultivars were produced in spring season (January, 2015).
- During autumn season 2015/16, total of 2, 27,169 PBS comprising 17 cultivars were produced in glass/screen house.
- Price of PBS was fixed as Rs 13 for > 5 gm, Rs 11 for 1-5gm, Rs 9 for 0.5-1gm, Rs. 1.50 for 0.25-0.5 gm and Rs. 0.75 for <0.25gm.
- Total 3793 kg of basic seeds were produced during 2015/16. Categorically, BS1 176 kg, BS2 1927 kg and BS3 1690 kg were produced during the year.
- Total 3270 kg foundation seeds of rice were produced in Hattiban farm during the year.

1. WORKING CONTEXT

Potato (*Solanum tuberosum* L.) is one of the most important crops in Nepal. It is utilized as a major vegetable in *Terai* and mid- hills and used as a vegetable and staple food in high hills. In the year of 2013/14 area under potato was reported 197037 ha and total production 2586287 tons with an average productivity of 13.126 t/ha (Table 1). It occupies the fifth position in area coverage, second in total production and first in productivity among the food crops grown in Nepal. It serves as a staple food in the high hills and plays a vital role in the food security in the country. Out of the total area under potato, around 18% is in the high hills and mountains, 42% in the mid-hills and 40% in *Terai* (ABPSD, 2015).

Table 1 Area, production and productivity comparison of food crops in Nepal

Food crops	Area (ha)	Rank	Production (tons)	Rank	Productivity (t/ha)	Rank
Potato	197037	V	2586287	II	13.126	I
Paddy	1,425,346	I	4788612	I	3.36	II
Maize	8,82,395	II	2145291	III	2.43	IV
Wheat	7,62,373	III	1975625	IV	2.59	III
Millet	2,68,050	IV	308488	V	1.15	V

Source: Ministry of Agriculture Development, Agri-business Promotion and Statistics Division, Singh Durbar, Kathmandu, Nepal (2015).

The productivity of potato was in increasing trend from 2011/12 up to 2013/14 by 0.44 and 0.36 percent respectively.As area of potato production decreases by 4.22 percent in 2014/15 the productivity also decreases by 4.16 percent. (Fig 1)

Geographically, Nepal can be categorized into three geographical regions - southern lower belts Terai, central mid-hills and northern high-hills and mountains. Since eastern Nepal is humid and western Nepal is very dry, the country can, agro-ecologically, categorized into eastern wet hills and terai, central hills and terai, and western dry hills and terai. To cover up the almost all agro-ecological zones prevailing in the country, NPRP has been conducting its research projects, especially varietal improvement ones, in ARS, Pakhribas, Dhankuta (eastern wet hill), RARS, Tarahara, Sunsari (eastern wet terai), NPRP, Khumaltar, Lalitpur (central hill), RARS, Parwanipur, Bara (central terai), HRS, Malepatan, Kaski (western hill), HRS, Rajikot, Jumla (mid-western high hill), ARS, Surkhet (mid-western hill), RARS, Khajura, Banke (mid-western terai) and RARS, Bhagetada, Doti (far-western hill) (Annex 1.1).

This fiscal year the temperature of the Khumaltar, Lalitpur ranged from 3.19°C in January 2015 to the maximum 31.14°C in June 2015. Similarly, no rainfall at all was recorded in November 2014 and the highest of 270 mm in July 2014 (Annex 1.2).

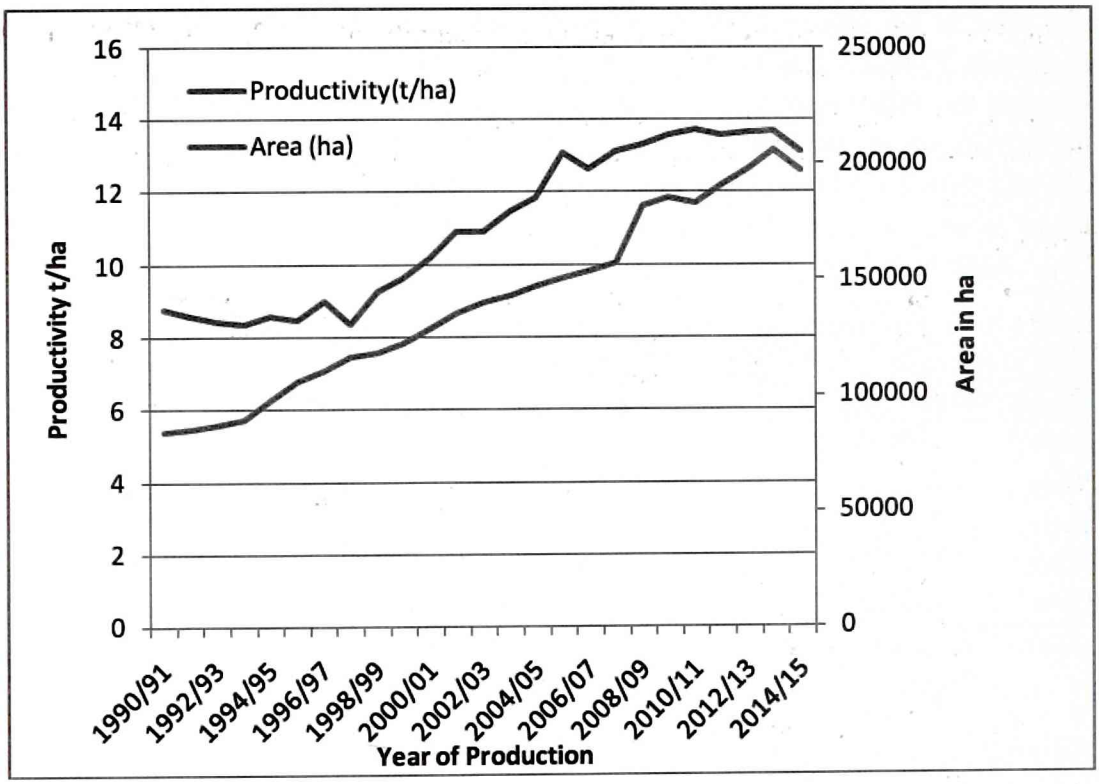


Figure 1: Index of potato area, production and yield in Nepal

2. INTRODUCTION

The first official attempt to improve potato production was initiated in 1962 under a joint program between Nepal and India. During its earlier phase (1960-75), several potato farms and other infrastructures were developed in Nepal. With the increased importance of potato crop in national food production, National Potato Development Program (NPDP) was incepted in 1972 at Kirtipur with a nationwide mandate to conduct potato research and development activities. Two potato farms, one at Jaubari, Ilam and another at Nigale, Sindhupalchowk, were established during 1980s. In 1974, NPDP was relocated to Khumaltar and linkages were established with International Potato Center (CIP) Lima, Peru, which is still effective.

During the early phase of the program, major focus was on seed potato production through contract system with the farmers. Later on in 1989, a tissue culture laboratory was established with the financial and technical support of Swiss government and the contract growers were encouraged to form a cohesive group for informal production of high quality seed. Source seed as pre-basic seed is to date being supplied by the tissue culture laboratory.

In 1991, with the establishment of Nepal Agricultural Research Council (NARC), NPDP was separated into two programs, National Potato Research Program (NPRP) and the then Potato Development Section (PDS), now National Potato Development Program (NPDP) with specific mandates on extension and development respectively. As a national commodity research program, NPRP is responsible for launching appropriate research projects on potato crop throughout the country to improve the livelihoods of Nepalese farmers.

2.1 Goal

To improve the livelihoods of Nepalese farmers through root and tuber crops.

2.2 Objectives

- Generate suitable and stable appropriate technologies to increase the production and productivity of root and tuber crops for different agro-ecological zones of the country through coordinated research approach,
- Identify and solve production constraints of seed and ware potatoes through on station and farmer's participatory multi location on-farm research,
- Produce high quality healthy source seed of released/recommended potato varieties,

- Identify and develop appropriate varieties for processing and storage under ordinary conditions.
- Establish coordination with potato stakeholders in the country,
- Develop and strengthen linkages between national and international potato R & D related organizations, and

To achieve above mentioned objectives following projects were conducted during the year 2014/15

- Potato variety development and improvement for different agro-ecologies of Nepal,
- Innovative community based agricultural development initiatives for increased climate resilience of people
- Study on post-harvest, value addition and crop husbandry of potato
- Develop low cost PBS production technologies under in-vitro and glass house condition
- Improving food security and nutrition of rural people in Nepal and Bhutan through collaborative potato breeding for yield stability and micronutrient density
- Pre basic and source (basic) seed production of potato, and
- Sweet potato variety development for food and nutrition security,
- Farm management project

NPRP also manages a full-fledged tissue culture laboratory for the pre-basic seed (PBS) potato production. About 150,000 to 200,000 minitubers of different varieties are produced each year under quarantine glasshouse conditions at Khumaltar and distribute to seed growers through National Potato Development Program/DOA. PBS is also further multiplied in Horticulture Farms under NARC and DoA for basic seed production to meet the farmer's demand of their respective command areas.

CIP Peru and its Regional Office, Delhi are supporting for potato research in Nepal in the field of technology generation and supply of potato germplasms. Farmer's participatory researches on adaptation of TPS families have also been implemented in collaboration with CIP Regional Office, Delhi.

2.3 Strategies

The strategy of NPRP is to carry out the research activities and support quality seed potato production program, for overall potato production improvement throughout the country.

2.4 Current thrust areas for research

- High yielding and late blight disease resistant potato variety development for different agro-ecologies of Nepal,
- High yielding and micronutrient (Zn and Fe) rich variety development on potato for high hills
- Determine the optimum practices of cultivation of potato in relation to the soil-cultivars-climate complex
- Identify and investigate on major diseases and pests of potato and devise their control measures
- Investigate on problems connected with post-harvest and processing
- Develop system based soil fertility management practices
- Socio-economic studies on adoption of new technological and cost effectiveness in farming communities
- Develop improved farm equipment and implement on potato cultivation
- Make existing quality seed production activities sustainable
- Use of biotechnology in crop improvement
- High yielding and β-carotene enriched sweet potato variety development for different agro-ecologies of Nepal, and
- Pre-basic and source (basic) seed production on potato.

2.5 Infrastructure and facilities

The program has its own office building in Khumaltar, NARI complex; a glasshouse and screen house complex in NASRI complex and a research farm in Hattiban (Annex 2.1).

Altitude:	1350 masl	Land type: Alluvial terraces
Dominant soil type:	Silty loam	Dominant soil pH: 5.5
Climate type:	Sub-tropical	

Area	Ropani*
Total cultivated area	32
Area covered by glasshouse complex	20
Area covered by office buildings and laboratories	5
Area covered by housing/quarters	¼
Area covered by irrigation & drainage channels	3

- 1 ropani = 500 m^2

The office building is equipped with a tissue culture laboratory, a pathology laboratory, a postharvest laboratory, a plant physiology laboratory and a screen house (Annex 2.1).

2.6 Organization structure and human resource

The organizational structure of NPRP (Fig. 2) explains the working modality and human resources strength that is adopted to help in achieving the objectives and strategies of the program. The programme has altogether 27 staffs composed of scientists, technical officers, technicians, helpers, administrative officer and account officer (Annex 2.2).

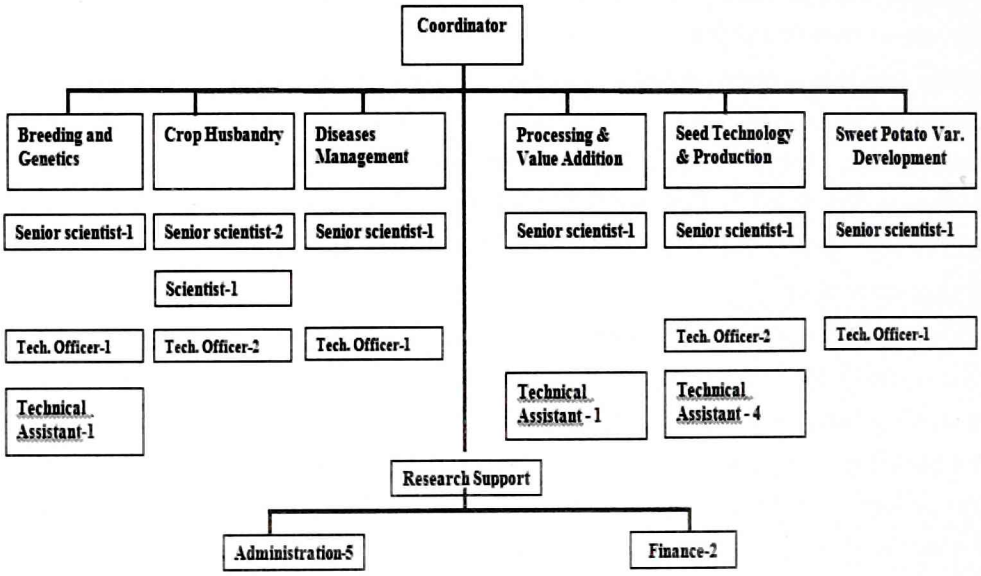


Figure 2. Organogram of the National Potato Research Programme

3. RESEARCH HIGHLIGHTS

3.1 Potato

3.1.1 Variety Improvement/Development

Variety improvement and development works have been continued by National Potato Research Programme (NPRP) since 1980 with the objectives of high tuber yield, pest and disease resistance, consumers' preference as well as processing, and industrial needs. With the rigorous efforts of NPRP, ten potato varieties have been released for commercial production so far for different agro-ecological regions of Nepal. Two true potato seed (TPS) progenies have been registered for commercial seed production. Several other are in pipeline.

Collection, introduction, hybridization, evaluation and selection are exploited breeding methods for potato by NPRP. Collected local and exotic germplasms are multiplied by virus free meristem culture and either used for selection or hybridization with existing and imported promising varieties. Germplasms are mainly introduced with the collaboration of International Potato Center (CIP), Lima, Peru since 1980s. Clones bred by CIP or NPRP are multiplied in-vitro or in field or in screen house and these multiplied tubers are planted in observation nurseries (PON) at Khumaltar and HRS Pokhara as exploratory experiments. The superior clones are bulked at both locations and the clones selected from this stage are further tested as Initial Evaluation Trials (IETs), and later as Coordinated Varietal Trials (CVTs) in different collaborative farms and stations throughout the country.

Most promising lines from CVT are further tested in Coordinated Farmers' Field Trials (CFFTs) which is carried out at out-reach research sites of command areas of different research stations. In on-station trials, performance of the tested clones is recorded, whereas in on-farm trials farmers' preferences are additionally recorded. After two or more than two years' of farmers' field trials, the most preferred clones are recommended for commercial cultivation in respective ecological domains of the country, and then a proposal is submitted to Variety Release Committee for wider recommendation and release of a particular variety.

3.1.1.1 Initial evaluation trial (IET)

IET is the first step of variety screening of potato for selecting high yielding, disease resistance (particularly late blight) as well as pest resistance and wide adaptability in different agro-ecological zones. IETs were conducted at Hattiban Research Farm, Khumaltar and Horticulture Research Station (HRS) Malepatan, Pokhara.

In NPRP Khumaltar, twenty-nine potato clones were evaluated for their vegetative and yield performance in 2072/73. Similarly, thirty-seven clones were tested at HRS Pokhara with check varieties Desiree and Kufri Jyoti at Khumaltar and Desiree and Kufri Sindhuri at HRS Malepatan. In all the locations, trials were laid out in randomized complete block design (RCBD) with three replications. The plots were fertilized @100:100:60 kg N:P2O5:K2O together with 20 tons of compost per hectare. All the fertilizers and farm yard manure was applied at the time of planting as basal dose. Well-sprouted tubers ranging from 20 to 50 gm sizes were planted at 60 cm row to row and 25 cm plant to plant spacing. Following parameters were recorded in the trials:

Growth parameters

1. Emergence (%) at 15 and 30 days after planting in winter season trial and 30 and 45 days in summer season trials
2. Plant height (average of 5 plants /clone in each replication)
3. Plant uniformity (after 6 weeks of planting at 1-5 scale)
4. Plant vigor (after 6 weeks of planting at 1-5 scale)
5. Number of main stems per plant (average of 5 plants in each replications), and
6. Late blight rating (using 1-9 scale)

Yield and Yield parameters

1. Number of plants harvested
2. Number and weight fraction of the tubers in three grades (over size, seed size and under size categories)
3. Total number and weight of tubers/plot
4. Yield tons per hectare, and
5. Color, shape and eye depth of the tubers

In the initial evaluation trial at Hattiban Research Farm, Twenty- nine potato clones were evaluated including Desiree and Kufri Jyoti as check (Table 1.1). The highest (100%) tuber emergence was recorded in CIP 395017.229 and the lowest (53.7 %) in CIP 392973.48. The plant uniformity ranged from 2 to 3 (1-5 Scale) in all tested clones. The ground cover was highest (88.3%) in PRP 016567.12 and the lowest (40%) in CIP 379706.27. Less than 80 percent ground cover in most of the clones indicated that there was growth potential of stems and leaves. The highest (66.06 cm) plant height was measured in CIP 399079.22 and the lowest (29 cm) in CIP 304394.56. The average number of main stems per plant was varied from 2 to 5 among tested clones. The clones significantly differed for their yield potential. Among the tested clones, CIP 393371.164, CIP 394608.52 and PRP 226567.2 were promising for their yield, tuber and plant

characters (Table 3.1.1.1). Most of the clones had low infection of late blight. Check variety Kufri Jyoti was comparable to the promising above-mentioned clones in terms of their yield and other characters.

In Malepatan, thirty-seven clones were evaluated in IET for their yield and vegetative performance as winter season crop. The ground cover was highest (81.6%) in PRP 136368.9 and PRP 296667.2 and the lowest (25%) in CIP 391002.6. The plant uniformity ranged from 2 to 5 (1-5 scale) in all tested clones. The highest (49.7 cm) plant height was measured in PRP 136368.9 and the lowest (23.06 cm) in CIP 392759.1.There was a little infection of late blight in most of the clones which was insufficient to cause economic damage. The clones were significantly different for yield (Table3.1. 1.2). Among the clones, CIP 395017.229, PRP 136368.9 and CIP 395017.242 were superior to local checks and rest of the clones in yield, tuber size and plant performance .

Table 3.1.1.1a: Plant characters of potato clones tested in IET at Khumaltar, 2072/73

Clones	Emergence (%)	Ground cover (%)	Plant uniformity (1-5)	Plant vigor (1-5)	Plant height (cm)	No. of Stem/ plant
CIP 393371.164	85	71	2	3	49	3
CIP 394608.52	91	78	3	4	41	4.
CIP 392025.7	76	53	2	4	42	2.
CIP 395445.16	75	58	3	3	48.	2
CIP 393613.2	87	60	2	3	37	3
CIP 392973.48	53	41	2	2	29	2
CIP 395443.103	89	56	2	2	46	3
CIP 392797.22	76	51	2	3	51	3
CIP 303381.106	83	51	2	3	36	3
CIP 396012.266	66	45	3	2	47	4
CIP 379706.27	76	40	2	2	41	2
CIP 393371.159	72	48	2	2	44	3
Kufri Jyoti (ch)	100	75	3	3	38	3
CIP 304394.56	89	48	2	2	29	1
CIP 397067.2	85	50	2	2	30	1
CIP 391002.6	78	71	2	3	46	5
CIP 395017.242	87	73	2	4	48	4
CIP 392820.1	95	61	2	3	44	1
CIP 399067.22	95	53	2	3	57	3
CIP 393617.1	81	65	2	3	45	2
CIP 399078.11	97	56	2	3	75	3
CIP 399079.22	97	56	2	2	66	2
CIP 395017.229	100	73	3	3	42	3
CIP 394613.139	95	65	2	3	40	2
PRP 016567.1	97	90	3	5	62	2
PRP 016567.12	97	88	3	5	56	2
PRP 226567.2	97	75	3	3	52	2
PRP 286365.6	95	71	2	3	47	3
Desiree (Check)	95	65	3	3	39	2
Mean	87	61	2	3	46	2

Table 3.1.1.1b: Yield characters of potato clones tested in IET at Khumaltar, 2072/73

Clones	Tuber size distribution (No. and Wt., kg)						Adj. yld (t/ ha)
	US		SS		OS		
	No.	Wt.	No.	Wt.	No.	Wt.	
CIP 393371.164	50	0.4	61	2.4	10	1.2	17.2
CIP 394608.52	142	0.7	115	3.4	1	0.1	17.9
CIP 392025.7	109	0.6	55	1.4	3	0.3	9.5
CIP 395445.16	26	0.3	50	1.6	2	0.2	9.0
CIP 393613.2	12	0.1	22	0.7	0	0	3.7
CIP 392973.48	32	0.2	22	0.5	0	0	3.3
CIP 395443.103	24	0.2	47	1.5	5	0.3	8.8
CIP 392797.22	47	0.3	62	1.8	4	0.4	10.9
CIP 303381.106	37	0.3	32	1.0	1	0.0	6.1
CIP 396012.266	50	0.3	17	0.4	0	0	3.3
CIP 379706.27	9	0.1	27	0.9	0	0	4.4
CIP 393371.159	43	0.2	38	1.4	5	0.5	9.4
Kufri Jyoti (ch)	31	0.2	60	2.5	17	2.1	20.5
CIP 304394.56	22	0.3	53	2	3	0.4	11.6
CIP 397067.2	35	0.3	37	1.0	1	0.1	5.9
CIP 391002.6	30	0.3	42	1.6	4	0.4	9.8
CIP 395017.242	52	0.4	62	1.8	6	0.5	12.0
CIP 392820.1	22	0.2	34	1.4	15	1.7	14.1
CIP 399067.22	15	0.2	7	0.2	0	0	2.2
CIP 393617.1	20	0.2	9	0.3	1	0.1	2.9
CIP 399078.11	7	0.1	14	0.5	0	0	2.9
CIP 399079.22	17	0.2	16	0.4	0	0	2.6
CIP 395017.229	29	0.2	56	2.2	6	0.6	12.7
CIP 394613.139	8	0.2	14	0.5	10	1.1	7.9
PRP 016567.1	12	0.2	38	1.6	11	1.4	13.7
PRP 016567.12	17	0.2	39	1.6	9	1.1	12.9
PRP 226567.2	28	0.3	84	3.1	5	0.5	16.2
PRP 286365.6	14	0.2	42	1.8	9	0.9	12.3
Desiree (Check)	28	0.2	60	2.4	3	0.3	12.6
Mean	33	0.3	42	1.4	4	0.5	9.5
F-Test							**
LSD (0.05)							2.3

Table 3.1.1.2a: Plant and yield characters of potato clones tested in IET at HRS, Malepatan, 2072/73

Genotypes	Plant uniformity (1-5)	Ground cover (%)	Plant height (cm)	Stem/ Plant (no.)
PRP 136368.10	3	63	39	4
PRP 22567.2	3	65	40	3
PRP 016567.13	2	66	26	2
PRP 226567.1	4	80	41	3
PRP 136368.8	3	76	39	4
PRP 136368.1	3	63	37	3
PRP 136268.3	3	51	39	5
PRP 306668.1	3	71	42	2
PRP 136368.6	4	70	40	4
PRP 136368.9	4	81	49	4
PRP 296667.2	3	81	43	3
PRP 136769.1	4	60	33	2
PRP 336769.1	3	60	33	3
PRP 136769.3	3	73	39	3
CIP 395017.229	3	76	44	4
CIP 395017.242	3	71	44	3
CIP 393617.1	3	55	42	5
CIP 399067.22	2	65	42	3
CIP 393371.164	3	61	39	3
CIP 394600.52	3	68	40	3
CIP 304394.56	3	55	32	3
CIP 395445.16	3	50	38	2
CIP 393371.159	4	63	37	2
CIP 393613.2	3	48	34	3
CIP 395443.103	3	40	33	1
CIP 391002.6	3	25	25	2
CIP 392759.1	3	33	23	1
CIP 396012.266	3	51	29	3
CIP 392973.48	4	53	28	2
CIP 391011.17	4	63	33	2
CIP 392633.54	4	41	34	2
CIP 397067.2	3	4 0	28	1
CIP 396033.102	3	61	42	5
CIP 392797.22	3	33	26	2
CIP 391046.14	4	48	33	3
K.Sindhuri (Ch)	4	58	36	5
Desire (Ch)	4	46	36	3
Mean	3	58	36	3
F Test				
LSD (0.05)				

Table 3.1.1.2b: Plant and yield characters of potato clones tested in IET at HRS, Malepatan, 2072/73

Genotypes	Tuber size distribution (no. and wt., kg)						Total yield (t/ha)
	US		SS		OS		
	No.	Wt.	No.	Wt.	No.	Wt.	
PRP 136368.10	45	0.3	59	2.3	0	0	11.1
PRP 22567.2	39	0.4	87	3.6	3	0.4	18.9
PRP 016567.13	26	0.3	33	1.1	2	0.2	7.3
PRP 226567.1	48	0.6	90	3.7	4	0.3	19.8
PRP 136368.8	45	0.5	78	3.7	9	1.0	22.0
PRP 136368.1	28	0.2	64	2.2	1	0.1	11.2
PRP 136268.3	58	0.6	60	2.1	2	0.2	12.5
PRP 306668.1	30	0.3	68	3.3	10	1.0	19.6
PRP 136368.6	60	0.6	110	4.4	5	0.6	23.7
PRP 136368.9	19	0.2	112	4.0	3	0.3	19.2
PRP 296667.2	69	0.8	69	2.6	1	0.1	14.9
PRP 136769.1	37	0.4	77	3.4	2	0.2	17.3
PRP 336769.1	64	0.6	75	2.2	4	0.3	13.4
PRP 136769.3	18	0.1	59	2.7	10	1.0	16.2
CIP 395017.229	63	0.5	96	4.2	16	1.6	26.7
CIP 395017.242	41	0.4	72	3.3	9	1.1	20.3
CIP 393617.1	75	0.8	107	3.6	2	0.1	19.5
CIP 399067.22	41	0.4	62	2.3	1	0.1	12.2
CIP 393371.164	27	0.3	67	3.3	8	0.8	19.1
CIP 394600.52	68	0.7	85	3.0	1	0.0	16.3
CIP 304394.56	24	0.2	39	1.3	0	0	6.5
CIP 395445.16	53	0.3	32	0.7	0	0	4.7
CIP 393371.159	18	0.4	39	2.1	12	1.1	16.0
CIP 393613.2	60	0.4	35	1.0	0	0	6.6
CIP 395443.103	69	0.5	68	2.1	0	0	11.3
CIP 391002.6	28	0.2	46	1.2	0	0	6.1
CIP 392759.1	26	0.2	30	0.9	3	0.3	6.4
CIP 396012.266	70	0.7	87	2.7	4	0.3	15.7
CIP 392973.48	24	0.2	26	0.9	0	0	4.7
CIP 391011.17	16	0.1	58	2.9	8	1.0	17.3
CIP 392633.54	27	0.2	38	1.3	6	0.5	9
CIP 397067.2	28	0.2	24	0.9	0	0	5.2
CIP 396033.102	35	0.3	89	3.0	2	0.2	15.0
CIP 392797.22	27	0.2	62	2.3	5	0.4	12.9
CIP 391046.14	36	0.3	45	1.2	1	0.1	6.8
K.Sindhuri (Ch)	88	0.6	74	1.6	0	0	9.4
Desire (Ch)	28	0.3	48	1.8	3	0.3	10.5
Mean	42	0.4	64	2.4	3	0.4	13.7
F Test							**
LSD (0.05)							1.8

3.1.1.2 Coordinated varietal trial (CVT)

CVT is the second step of multi-location on-station testing of varietal evaluation. The clones selected from IETs are included in this step for further selection in different research stations of the country. Under this trial, the selected clones from IET are generally assessed for two years and only the most promising ones are recommended to test in farmers' field trials (FFTs).

In 2072/73, CVTs were conducted at RARS Nepalganj, RARS Tarahara, RARS Lumle and ARS Dailekh for terai and river basin conditions while hill sets of CVT were evaluated at HRS Jumla, NPRP Khumaltar, and ARS Pakhribas. In all the research stations, the trials were laid out in randomized complete block design (RCBD) with four replications. The plot size was maintained at 7.2 m^2 in all the locations, with the spacing of 60 x 25 cm between the rows and plants, respectively.

The data collected were:

Growth parameters

1. Emergence (%) at 15 and 30 days after planting in winter season trial and 30 and 45 days in summer season trials
2. Plant height (average of 5 plants/clone in each replication)
3. Plant uniformity (after 6 weeks of planting at 1-5 scale)
4. Plant vigor (after 6 weeks of planting at 1-5 scale)

Yield and Yield parameters

1. Number of plants harvested
2. Number and weight fraction of the tubers in three grades (oversize, seed size and under size)
3. Total number and weight of tubers/plot
4. Yield tons per hectare
5. Color, shape and eye depth of the tubers

There were seventeen clones including Desiree and Kufri Jyoti tested in CVT at Hattiban farm, Khumaltar in 2072/073.The highest tuber emergence (98.9%) in PRP 056267.5 and the lowest (85.8%) in CIP 395192.1. Ground cover ranging from 70 to 93 percent indicated that the plants still growth potential. The plant uniformity ranged from 3 to 5 (1-5 scale) in all tested clones. The highest (82.2 cm) plant height was measured in PRP 29667.3 and the lowest (32 cm) in CIP 396311.1. The average number of main stems per plant varied from 2 to 5 among all tested clones. The results revealed that clones were significantly different for yield potential (Table 3.1.1.3). Among the clones CIP

396311.1, CIP 390663.8 and CIP 395195.7 were superior to check varieties and rest of the clones.

In the hill CVT set of Pakhribas, the highest tuber emergence (40.2%) in PRP 056267.5 and Desiree and the lowest (29.8%) in CIP 395195.7. The plant uniformity ranged from 2 to 5 (1-5 scale) in all tested clones. The tallest (56.3 cm) plants were measured in PRP 296667.3 and the dwarfest (29.4 cm) in PRP 226265.1. The average number of main stems per plant varied from 1 to 4 among tested clones. The significant differences were observed between the clones for yield potential of sixteen tested clones. The clones CIP 395192.1 and CIP 056267.9 were superior to others and check varieties for their yield and tuber size (Table 3.1.1.4). Kufri Jyoti was also superior to rest of the clones. In this experiment, most of the clones including farmer's local had low tuber yield which indicated that particular field condition was unfavorable for growth and development of tubers. The clone CIP 395192.1 will be tested in CVTs and FFTs for further confirmation.

At RARS Nepalgunj, fourteen clones were evaluated. (Table 3.1.1.5) The varieties Kufri Sindhuri, Desiree and Kufri Jyoti were used as the checks. The highest tuber emergence was (98.9%) in Kufri Jyoti and lowest (91.04%) in PRP 25861.1. The plant uniformity ranged from 3 to 5 (1-5scale) in all the tested clones. The ground cover was highest (85%) in Desiree and Kufri Jyoti and lowest (51.2%) in CIP 393016.7. Among the tested clones PRP 25861.11, PRP 276264.1, CIP 395112.32 and CIP 399078.11 found highly resistant to late blight disease with the score range 1-1.5 in 1 to 9 scale whereas CIP 393016.7 and CIP 394613.139 were susceptible. Late blight infection was less in tested clones compared to the check varieties. The clones were significantly different for their yield (Table 1.5). Most of the clones had higher ground cover compared to the check varieties. The yield was the highest in CIP 276264.1 followed by PRP 286265.22 and PRP 266265.1. These potential clones will be further tested in FFTs in upcoming years.

At RARS Tarahara, twelve clones were evaluated. (Table 3.1.1.6)The varieties Kufri Sindhuri and Desiree were used as the check. The highest tuber emergence (100%) was in PRP 266265.1 and lowest (96.8%) in PRP 286265.22 and PRP 25861.11. The plant uniformity ranged from 3 to 4 (1-5 scale). The highest (45.2 cm) plant height was found in CIP 393016.7 and lowest (36.2 cm) in PRP 286265.22 and Kufri Sindhuri. CIP 399078.11, PRP 266265.1and PRP 266265.15 were superior among the twelve tested clones. These clones were also significantly different from check varieties in terms of yield and were potential for promoting into FFTs. PRP 276264.1 produced high yield with no late blight infection (0 scale) indicating resistant to this disease.

At ARS Jumla, seventeen clones were tested in CVT. The varieties Kufri Jyoti, Desiree and Jumli local were used as the check. The highest tuber emergence (73.9%) was in Kufri Jyoti and lowest (68.7%) in CIP 380606.6. The Plant uniformity ranged from 2 to 4 (1-5 scale). The greatest (49.5 cm) plant height was found in PRP 286265.22 and lowest (23.9 cm) in CIP 396311.1. All the tested clones showed less late blight score than the check variety Desiree. Yet, the yield was low in all clones; the clones were significantly different from each other in terms of yield (Table 3.1. 1.7). Among them, PRP 056267.1, PRP 296667.3 and CIP 399101.1 had better performance than the others. In Jumla, yield and plant performance was not encouraging due to the adverse field management condition.

Likewise, nine clones were tested in Lumle (Table 3.1.1.8) and their yield performance was encouraging. The varieties Kufri Jyoti and Desiree were used as the check. The highest (95.8%) tuber emergence was recorded in Kufri Jyoti and the lowest (57.2%) in Desiree. The ground cover ranged from 4-9 (in 1 to 9 scale) among all the tested clones. The highest (45.7 cm) plant height was measured in Kufri Jyoti and lowest (40.7 cm) in CIP 399101.1. The average number of stems ranged from 2 to 5 among all tested clones. The clones were significantly different for yield indicating the highest yield in PRP 226267.11 followed by CIP 395195.7 and CIP 396311.1.These clones will be included in FFTs in upcoming years based on their better plant and yield performance.

Similarly, in Dailekh, eleven clones were tested in which ten clones were compared to check variety Kufri Jyoti (Table 3.1.1.9).The highest (95.8%) tuber emergence was recorded in CIP 388676.1 and lowest (76%) in CIP 377957.5. The highest ground cover (82.5%) in CIP 396286.6 and lowest (43.7%) in CIP 392244.3. The highest (38 cm) plant height was measured in CIP 388676.1 and lowest (25.2 cm) in CIP 393073.179. The average number of stems ranged from 3 to 5 among all the tested clones. There were significant differences in clones for their total yield. The clones CIP 384321.15, CIP 393073.179 and CIP 396286.6 were high yielding with better tuber number and size and plant performance. The yields of promising clones were significantly higher than the check variety Kufri Jyoti.

Table 3.1.1.3: Plant and yield characters of potato clones tested in CVT at Khumaltar, 2072/73

Clones	Emg. (%)	Ground cover (%)	Plant unif. (1-5)	Plant vig. (1-5)	Plant height (cm)	Stem/ plant (no.)	Plt hvst	Tuber size distribution (No. and Wt., kg)						Adj. yield (t/ha)
								US		SS		OS		
								No.	Wt.	No.	Wt.	No.	Wt.	
CIP 397077.16	87	78	3	3	39	2	43	80	1.1	168	6.7	41	5.0	17.9
CIP395195.7	96	95	3	4	65	3	46	75	0.7	183	7.4	56	6.5	20.3
CIP 390663.8	95	93	4	4	40	3	46	36	0.4	159	7.0	63	7.5	20.9
CIP 380606.6	96	83	2	4	54	3	45	166	1.4	233	6.9	13	1.3	13.3
CIP 399101.1	90	82	3	4	65	2	43	88	0.8	137	5.1	10	1.0	9.6
CIP 396311.1	97	87	3	3	32	2	47	69	0.7	183	7.4	57	7.2	21.4
CIP 395192.1	85	76	3	4	53	2	43	44	0.6	153	6.6	31	3.6	15.0
PRP056267.9	94	83	3	3	53	4	43	199	1.6	241	7.2	6	0.7	13.3
PRP056267.5	98	83	3	3	53	3	47	101	0.8	184	5.6	8	0.8	10.1
PRP056267.6	94	88	3	4	55	3	46	65	0.7	142	4.9	6	0.6	8.8
PRP226267.11	94	88	3	4	71	2	45	127	1.2	208	6.4	10	1.1	12.2
PRP 226265.1	92	78	3	4	71	2	45	63	0.5	12	4.2	9	0.9	7.8
PRP286265.22	98	93	4	5	75	3	46	96	0.7	153	5.5	18	1.8	11.3
PRP 29667.3	96	91	4	4	82	4	47	58	0.4	132	4.6	17	1.9	9.6
PRP 056267.1	97	82	3	3	54	4	47	121	0.8	171	5.8	25	2.7	13.0
Kufri Jyoti(ch)	96	86	4	4	39	4	47	90	1.0	205	8.2	54	6.0	21.2
Desiree(ch)	98	86	4	3	37	4	47	100	0.9	234	8.0	30	3.1	16.8
Mean	94	85	3	4	55	3	45.8	93	0.8	177	6.3	27	3.0	14.3
F-Test														**
LSD (0.05)														2.1

Table 3.1.1.4: Plant and yield characters of potato clones tested in CVT at ARS Pakhribas, 2072/73

Clones	mergence (%)	Ground cover (%)	Plant unif. (1-5)	Plant vig. (1-5)	Stem/ pt (no.)	Plant ht. (cm)	Tuber size distribution (No. and wt (kg))						Adj. yield (t/ha)
							US		SS		OS		
							No.	Wt	No.	Wt.	No.	Wt.	
CIP 395195.7	29	51	3	3	1	31	105	1.1	45	1.8	56	4.2	10.4
CIP 390663.8	32	56	2	5	1	41	208	1.9	59	2.8	59	5.7	14.5
CIP 056267.9	31	58	3	4	2	34	151	1.5	83	3.4	95	8.5	18.8
CIP 380606.6	32	56	3	4	1	44	182	1.2	32	1.4	79	6.7	13.1
CIP 396311.1	31	58	3	4	1	54	259	2.1	69	2.7	32	2.7	10.7
CIP 395192.1	39	68	3	4	3	50	236	2.8	69	2.9	135	10.6	22.8
PRP 056267.9	33	63	3	3	1	30	101	0.8	51	2.0	51	3.8	9.4
PRP 056267.5	40	71	3	4	2	36	169	1.5	57	2.1	106	7.8	16.0
PRP 056267.6	39	67	3	5	2	42	210	3.1	93	3.1	81	5.6	16.6
PRP226267.11	34	65	3	4	1	47	218	1.3	53	2.4	74	5.8	13.3
PRP 226265.1	32	59	3	4	1	29	121	0.7	40	1.8	52	4.3	9.6
PRP286265.22	38	70	3	4	1	38	163	1.5	59	2.3	54	4.5	11.8
PRP 296667.3	31	69	3	4	2	56	257	2.6	59	2.7	39	2.5	11.1
PRP 056267.1	37	68	4	4	2	45	195	2.3	80	3.3	49	4.5	14.2
K.Jyoti(ch)	34	67	4	4	3	46	213	2.9	120	4.3	50	4.3	16.2
Desiree (ch)	40	73	4	4	2	44	204	1.4	75	3.7	96	6.6	16.5
Mean	34	64	3	4	2	42	187	1.8	65	2.7	69	5.5	14.0
F-Test													**
LSD (0.05)													2.1

Table 3.1.1.5: Plant and yield characters of potato clones tested in CVT at RARS Nepalgunj, 2072/73

Genotypes	Emg. (%)	Plant unif. (1-5)	Ground cover (%)	Plant vigor	Plant ht. (cm)	LB disease (1-9)	Stem/ Plant (no.)	Tuber size distribution (no. and wt., kg)						Total yield (t/ha)
								US		SS		OS		
								No.	Wt.	No.	Wt.	No.	Wt.	
PRP 146267.6	93	3	73	4	52	2	2.	47	0.4	84	3.3	71.7	7.9	16.29
PRP 25861.1	91	3	68	2	47	3	2	47	0.2	67	12.3	30.0	2.59	8.82
PRP 286265.22	94	4	77	4	58	2	3	54	0.4	127	5.1	85.7	8.42	19.7
PRP 266265.1	95	4	73	4	60	2	2	129	1.1	168	10.6	82.5	7.13	19.3
PRP 266265.15	98	4	63	4	56.	4	3	70	0.7	112	4.3	116.2	10.5	19.1
PRP 25861.11	98	4	82	2	34	1	3	129	1.4	174	5.9	80.5	6.05	18.6
CIP 393016.7	93	3	81	2	42	8	3	104	0.9	147	4.8	55.5	4.43	14.2
CIP 394613.139	92	4	76	3	44	8	3	78	0.8	112	4.0	99.5	7.83	17.6
CIP 399078.11	92	3	65	3	80	1	2	135	1.3	122	4.1	69	5.94	15.8
CIP 395112.32	93	3	66	3	63	1.	2	72	0.8	74	3.1	64.7	8.02	16.4
PRP 276264.1	96	4	77	4	62	1	2	151	1.8	17	5.8	88.7	7.57	21.1
Kufri Sindhuri (Ch)	98	4	81	3	49	8	2	233	2.2	147	3.7	21.7	1.22	9.9
Desiree (Ch)	98	4	85	3	46	9	3	42.5	0.4	116	4.2	64.5	5.01	13.4
Kufri Jyoti	98	4	85	3	35	9	4	137	1.2	195	6.4	61	4.28	16.7
Mean	95	4	76	3	51	4	3	105	1.6	134	5.5	68.5	5.93	16
F-test														**
LSD (0.05)														1.60

Table3.1. 1.6: Plant and yield characters of potato clones in CVT at RARS Tarahara, 2072/73

Genotypes	Emg. (%)	Pl. unif. (1-5)	Pl. ht. (cm)	LB disease (1-9)	Tuber size distribution (no. and wt., kg)						Total yield (t/ha)
					US		SS		OS		
					No.	Wt.	No.	Wt.	No.	Wt.	
PRP 146267.6	99	3	38	2	72	1.6	55	4.7	32	5.4	16.3
PRP 25861.1	98	3	41	3	81	1.2	45	2.2	14	1.2	6.5
PRP 286265.22	96	3	36	3	85	6.6	103	32	18	4.3	5..8
PRP 266265.1	100	3	37	0	106	2.6	83	6.4	53	7.6	23.1
PRP 266265.15	97	3	41	3	126	1.9	75	4.6	51	7.0	18.8
PRP 25861.11	96	3	41	4	117	2.2	73	3.9	15	1.5	10.7
CIP 393016.7	98	3	45	4	125	2.0	90	4.3	32	4.0	14.4
CIP 399078.11	97	3	42	4	161	2.1	83	5.0	55	7.4	20.1
PRP 276264.1	97	3	37	0	95	2.0	89	6.2	47	9.0	24.0
Kufri Sindhuri (Ch.)	98	3	36	5	103	1.5	54	2.0	16	1.1	6.5
Desire	99	3	33	9	139	2.3	78	3.0	18	1.4	9.6
PRP 056267.1	97	3	35	5	81	1.4	73	3.8	32	3.4	12.0
Mean	98	3	38	3	107	2.3	75	6.5	32	4.4	18.5
F Test											**
LSD (0.05)											4.7

Table 3.1.1.7: Plant and yield characters of potato clones in CVT at ARS Jumla, 2072/73

Genotypes	Emg. (%)	Plant unif. (1-5)	Ground cover (%)	Plant ht. (cm)	Stem/ Plant (no.)	LB disease (1-9)	Tuber size distribution (no. and wt., kg)						Total yield (t/ha)
							US		SS		OS		
							No.	Wt.	No.	Wt.	No.	Wt.	
CIP397077.16	71	3	42	30	1	2	44	0	48	2.5	19	2.5	8.0
CIP 395195.7	72	3	55	38	2	3	34	0	10	5.7	25	3.9	14.1
CIP 390663.8	72	3	55	40	3	2	87	1	19	5.9	19	1.6	12.6
CIP 380606.6	68	4	50	3	2	3	31	0	88	5.8	17	2.6	12.4
CIP 399101.1	69	3	65	4	1	2	10	1	12	6.6	20	2.9	15.0
CIP 396311.1	68	3	32	2	1	6	39	0	55	3.0	12	1.9	7.7
CIP 395192.1	73	3	47	4	1	5	28	0	51	2.6	11	1.4	6.4
PRP 056267.9	72	3	48	37	2	4	10	1	13	5.9	15	1.5	12.5
PRP 056267.5	71	4	47	33	2	2	66	0	12	7.1	17	2.3	14.4
PRP 056267.6	74	4	52	32	2	4	26	0	62	4.3	15	2.1	9.6
PRP 056267.11	69	2	58	43	2	2	11	1	14	9	19	2.0	17.7
PRP 226265.1	75	2	52	40	2	2	54	1	76	4.8	19	2.9	12.2
PRP 286265.22	72	3	60	49	2	2	73	1	97	5.5	18	2.8	13.3
PRP 296667.3	70	3	62	47	2	2	89	1	11	6.5	29	4.3	16.8
Kufri Jyoti	73	3	45	36	2	3	11	1	14	5.9	18	2.2	13.4
Desiree (Check)	71	3	35	31	2	6	37	1	65	3.9	18	2.5	10.5
Jumli Local	71	3	42	34	2	4	23	1	81	2.7	5	0.5	6.1
Mean	71	3	50	37	2	3	75	1	97	5.2	17	2.4	11.9
F Test													**
LSD (0.05)													2.03

Table 3.1.1.8: Plant and yield characters of potato clones in CVT at RARS, Lumle, 2072/73

Genotypes	Emg. (%)	Plant unif. (1-5)	Ground cover (1-9)	Plant ht. (cm)	Stem/ Plant (no.)	Tuber size distribution (no. and wt., kg)						Total yield (t/ha)
						US		SS		OS		
						No.	Wt.	No.	Wt.	No.	Wt.	
CIP 399101.1	73	2.	5	40	3	146	1.5	105	3.1	87	6.8	16.0
CIP 396311.1	90	3	6	42	3	110	1.2	110	4.0	114	9.3	20.3
CIP 380606.6	85	3.	7	43	4	146	1.4	120	3.2	106	7.4	16.9
CIP 395195.7	79	3.	7	43	3	88	1.1	99	3.3	116	10.1	20.3
PRP 226267.11	77	4	8	43	4	134	1.8	140	3.8	125	10.5	22.5
PRP 266265.1	86	4	8	41	3	263	2.8	201	5.8	84	5.5	19.7
PRP 276264.1	90	4	9	42	3	247	2.3	215	6.2	91	5.9	20.0
Kufri Jyoti	95	3	7	45	5	167	1.8	150	4.4	140	10.0	22.6
Desiree (Check)	57	2	4	44	2	63	0.6	27	0.7	32	2.3	5.2
Mean	81	3	7	43	3	152	1.6	130	3.8	99	7.5	18.2
F Test												**
LSD (0.05)												2.2

Table3.1. 1.9: Plant and yield characters of potato clones in CVT at HRS Dailekh, 2072/73

Genotypes	Emg. (%)	Plant unif. (1-5)	Ground cover (%)	Plant ht. (cm)	Stem/ Plant (no.)	Tuber size distribution (no. and wt., kg)						Total yield (t/ha)
						US		SS		OS		
						No.	Wt.	No.	Wt.	No.	Wt.	
CIP 392244.3	81	3	43	25	3	92	1.0	47	1.2	16	1.1	4.7
CIP 395195.7	62	3	72	34	4	80	1.1	47	2.1	24	2.8	8.3
CIP 396286.6	77	3	82	34	4	147	1.7	61	2.4	25	2.0	8.7
CIP 384321.15	85	4	76	30	3	124	1.7	90	3.0	23	2.0	9.4
PRP 35861.18	69	3	36	26	4	69	0.7	40	1.3	13	1.0	4.3
PRP 25861.1	66	3	32	27	3	70	1.0	35	1.3	14	1.1	4.9
PRP 056267.9	76	2	63	32	4	105	0.5	3	1.0	14	0.9	3.5
Kufri Jyoti	66	4	77	28	3	54	0.9	43	2.1	18	1.9	6.9
CIP 377957.5	76	4	80	36	3	67	1.1	49	2.0	19	1.9	6.9
CIP 388676.1	95	3	66	38	4	56	1.0	35	1.7	18	2.3	6.9
CIP 393073.179	87	4	66	25	3	134	1.8	61	2.6	25	2.1	9.2
Mean	77	3	63	30	3	91	1.1	49	1.9	19	1.7	6.7
F Test												**
LSD (0.05)												2

3.1.1.3 Co-ordinated farmers field trials (CFFTs)

Clones selected from CVTs were tested as CFFTs in different outreach research sites of the command areas of respective research stations throughout the country. In addition, NPRP also conducted some on-farm trials in its own initiative. The most important plant and yield parameters, farmers' feedback on the plant and tuber appearance, foliage characteristics and taste of assessed clones in comparison to the existing popular varieties from respective locations were obtained from the CFFTs. The highly preferred clones in CFFTs are further verified under farmers' field conditions as farmer's acceptance tests (FATs) prior to release as the commercial varieties.

In all the locations, plots consisted of four rows, each planted with 12 tubers. Row to row and plant to plant spacing was maintained at 60 x 25 cm. The trials were designed as RCBD with four replications. Plots were fertilized at the rate of 100:100:60 kg NPK and 20 tons FYM per hectare as basal dose in furrow/ridge line. The seed tuber size was ranged from 25 to 50 g in all the experiments. All other cultural practices were followed as per NPRP recommendations.

The data collected were:

Growth parameters

1. Emergence (%) at 15 and 30 days after planting in winter season trial and 30 and 45 days in summer season trials
2. Plant height (average of 5plants/clone in each replication)
3. Plant uniformity (after 6 weeks of planting at 1-5 scale)
4. Plant vigor (after 6 weeks of planting at 1-5 scale)
5. Number of main stems per plant (average of 5 plants in each replications), and
6. Late blight rating (using 1-9 scale)

Yield and Yield parameters

1. Number of plants harvested
2. Number and weight fraction of the tubers in three grades (over size, seed size and under size)
3. Total number and weight of tubers/plot
4. Yield tons per hectare
5. Farmers' reaction
5. Color, shape and eye depth of the tubers

CFFTs were conducted at ARS Jumla, ARS Pakhribas, and Outreach site Jitpurfedi as hill sets and at outreach site Dhikure (Nuwakot), RARS Nepalganj, RARS Lumle and as terai and river basin sets in 2072/073 B.S.

There were seven clones tested in CFFT at ARS Pakhribas including three checks Kufri Jyoti, Desiree and farmer's Local (Table 3.1.1.10). Kufri Jyoti and Farmer's Local were comparable to the tested clones while Desiree had poor performance in terms of yield, tuber and plant parameters. The clone CIP 385499.11 had the highest yield followed by CIP 393385.39. These two clones were promising for promoting into wider adaptation and further verification in farmers' field.

Table 3.1.1.10: Plant and yield characters of potato clones tested at CFFT, ARS Pakhribas, 2072/73

Clones	Emg. (%)	Pl. unif. (1-5)	Ground cover (%)	Pl. ht. (cm)	Plant vig. (1-5)	Stem/ plant (no.)	Tuber size distribution (No. and wt (kg).)						Adj. yield (t/ha)
							US		SS		OS		
							No.	Wt	No.	Wt.	No.	Wt.	
CIP 393385.39	93	4	72	26	3	2	77	1.6	36	2.3	71	6.6	14.9
PRP 25861.1	94	4	70	24	3.	2	79	1.6	29	1.8	57	5.5	12.6
CIP 385499.11	90	4	73	32	4	2	125	3.1	47	2.2	150	13.2	25.8
CIP 388676.1	89	3	60	23	3	3	179	3.4	32	1.5	50	3.5	11.7
Desiree	96	4	74	34	4	4	298	5.8	92	4.1	148	12.6	31.5
Kufri Jyoti	97	5	74	38	5	2	171	4.1	50	2.2	85	6.7	18.2
Farmer's Local	75	4	70	32	4	2	273	4.0	62	2.8	61	6.5	18.6
Mean	91.1	4.4	70	30	4	2.9	172	3.4	50	2.4	89	7.8	19.0
F-Test													**
LSD (0.05)													3.3

Table 3.1.1.11: Plant and yield characters of potato clones tested at CFFT, ARS Jumla, 2072/73

Clones	Emg. (%)	Plant unif. (1-5)	Ground cover (%)	Plant ht (cm)	Stem/ plant (no.)	LB score (1-9)	Tuber size distribution (No. & wt (kg)						Adj. yield (t/ha)
							US		SS		OS		
							No.	Wt	No.	Wt.	No.	Wt.	
PRP 55861.6	99	4	80	45	3	1	149	1.3	102	5.1	52	4	18.3
CIP 394050.110	97	3	47	32	4	1	148	2.5	67	4.3	18	2	13.4
CIP 392228.66	91	4	91	44	4	1	212	2.9	214	9.1	24	2	20.7
PRP 25861.1	97	4	85	46	3	1	105	1.6	124	5.3	22	1.7	12.1
CIP 388676.1	96	3	42	30	3	1	134	1.6	78	3.6	18	2.07	10.2
Kufri Jyoti	92	3	81	47	4	2	117	2.1	138	6.2	40	4.47	17.8
Desiree	97	4	70	33	3	2	99	1.5	131	5.5	43	5.1	16.9
Jumli Local	96	3	83	51	3	3	319	2.4	103	3.8	16	1.4	10.7
Mean	96	3	72	41	3	2	160	2.0	120	5.4	29	3	15.0
F-Test													**
LSD (0.05)													2.3

At HRS Jumla, the clones CIP 392228.66 and PRP 55861.6 were superior to existing check varieties such as Desiree, Kufri Jyoti and Jumli Local (Table 3.1.1.11). There were significant differences between checks and good performing clones. Field condition favorable for check varieties was found adverse for new clones. The emergence data showed that there was a problem in germination of new clones which could be the main reason of low tuber yield of the clones. Yet, the late blight infection was low in all clones.

At RARS Lumle, seven clones were tested including Kufri Jyoti as check varieties (Table 3.1. 1.12). The clones differed significantly for their yield potential. Based on tuber yield, tuber size and plant parameters, CIP 393385.39, PRP 25861.1 and CIP 394050.110 were similar and superior to other clones for their yield and other characters. The check variety Kufri Jyoti had comparable yield to the promising clones. The clones CIP 399101.1 and CIP 396311.1 need to be verified in Lumle and similar low hill conditions for further confirmation of their yield potential.

At outreach site Dhikure of Nuwakot district, a CFFT was conducted with the collaboration of Outreach Research Division of NARC. There were six clones including Kufri Jyoti as a check (Table 3.1.1.13) which were statistically different for their yield potential. The clones CIP 392280.64 and PRP 35861.18 were s superior to the other clones for yield potential which was less than as compared to the check.

Table 3.1 1.12: Plant and yield characters of potato clones tested at CFFT, RARS Lumle, 2072/73

Clones	Emg. (%)	Plt unif. (1-5)	Ground cover (%)	Pl h.t (cm)	Stem/ plant (no.)	Tuber size distribution (No. and wt (kg).)						Adj. yield (t/ha)
						US		SS		OS		
						No.	Wt	No.	Wt.	No.	Wt.	
CIP 392244.3	28	4	82	26	3	109	2.8	43	2.1	16	1.0	8.4
PRP 55861.6	36	3	77	23	3	131	2.2	50	2.3	17	1.6	8.6
CIP 393385.39	69	4	81	27	3	202	3.3	44	2.2	18	1.7	10.3
CIP 394050.110	38	3	80	22	3	150	2.7	41	2.1	14	1.4	8.8
PRP25861.1	56	4	90	34	3	175	3.1	45	2.3	16	1.5	9.8
CIP 385499.11	61	3	70	21	3	143	2.1	35	1.7	21	1.8	8.2
Kufri Jyoti	66	3	70	20	3	125	2.5	43	1.7	10	0.8	7.0
Mean	50	3	78	25	3	147	2.1	43	2.0	16	1.4	8.7
F-Test												**
LSD (0.05)												2.4

Table 3.1.1.13: Plant and yield characters of potato clones tested at CFFT, Dhikure, 2072/73

Clones	Emg. (%)	Plant unif. (1-5)	Ground cover (1-9)	Plant vig. (1-5)	Plant height (cm)	Tuber size distribution (No. and wt (kg))						Adj. yield (t/ha)
						US		SS		OS		
						No.	Wt	No.	Wt.	No.	Wt.	
CIP 392280.64	90	4	6	4	53	139	1.7	125	7.2	69	7.2	22.4
CIP 392271.58	91	4	6.5	4	44	100	1.1	130	5.8	63	6.3	18.5
PRP 35861.18	90	4	6.5	4	46	110	1.0	155	7.1	79	8.1	22.6
PRP 85861.12	88	4	6.5	3	42	97	1.5	90	3.9	7	7.0	17.3
CIP 392206.35	90	4	6.5	3	44	85	0.9	135	6.0	58	5.4	17.2
Kufri Jyoti	90	5	6.7	3	43	83	1.3	134	7.0	122	11.5	27.5
Mean	90	4	6.5	4	45	102	1.2	128	6.1	66	7.6	20.9
F-Test												**
LSD (0.05)												3.1

Likewise, eight clones were evaluated at RARS Nepalgunj for their yield, tuber and plant characters (Table 3.1.1.14). Local check varieties were Desiree, Kufri Sindhuri and Cardinal. Among the tested clones, CIP 399101.1 was high yielding with good plant performance followed by PRP 85861.11.

Table 3.1.1.14: Plant and yield characters of potato clones tested at CFFT, RARS Nepalgunj, 2072/73

Clones	Emg. (%)	Plant unif. (1-5)	Ground cover (%)	Plant height (cm)	No. of stems	Tuber size distribution (No. and wt (kg).)						Adj. yield (t/ha)
						US		SS		OS		
						No.	Wt	No.	Wt.	No.	Wt.	
CIP 393619.8	91	3	80	51	2	45	0.3	102	0.56	5	0.56	3.7
CIP 380606.6	83	4	71	80	2	74	0.4	216	0.6	8	0.6	5.8
CIP 397012.22	93	5	83	42	2	58	0.4	151	0.3	4.2	0.3	5.1
CIP 399101.1	97	4	78	53	2	52	0.4	141	1.81	13.5	1.81	7.3
PRP 85861.11	96	1	66	49	4	123	0.3	262	2.3	25.2	2.3	10.3
Kufri Sindhuri	98	4	78	61	2	167	1.2	149	0	0	0	4.7
Desiree	98	5	63	53	4	72	0.5	148	0.5	6.2	0.5	5.1
Cardinal	100	3	80	63	4	85	0.6	181	0.7	8.5	0.7	6.4
Mean	95	3.9	75.3	56	3	84	0.6	168	0.8	8.8	0.8	6.1
F-Test												**
LSD (0.05)												2.25

With the collaboration of ORD of NARC, another CFFT set was conducted at Jitpurfedi of Kathmandu valley. Eight clones including Kufri Jyoti, Desiree and Farmer's Local were evaluated for the tuber yield, tuber size and plant parameters (Table 3.1.1.15). The highest yielding clone CIP 385499.11 had similar tuber yield to Kufri Jyoti. Among the other clones, PRP 35861.11 was promising for yield and yield attributing parameters.

Table 3.1.1.15: Plant and yield characters of potato clones tested at CFFT, ARS Jitpurfedi, 2072/73

Clones	Emg. (%)	Plant unif. (1-5)	Ground cover (1-9)	Plant vig. (1-5)	Plant height (cm)	Tuber size distribution (No. and wt (kg)						Adj. yield (t/ha)
						US		SS		OS		
						No.	Wt	No.	Wt.	No.	Wt.	
PRP 35861.18	76.	4	7	4	72	166	4.1	128	5.3	57	5	20.0
CIP 392244.3	78	4	6	3	49	294	3.2	165	6.2	92	6	21.5
CIP 393385.39	71	3	5	3	34	202	2.4	90	2.1	56	3.2	10.9
PRP 25861.1	90	4	7	3	61	199	2.2	72	2.7	52	3.7	12.05
CIP 385499.11	90	4	7	4	66	174	2.6	16	6.9	116	10.1	27.2
Kufri Jyoti	94	4	6	3	56	238	2.2	136	5.6	130	11.2	26.5
Desiree	90	3	6	3	50	158	2.5	135	6.1	79	7.8	22.9
Farmer's Local	84	3	6	3	58	241	2.9	124	4.4	63	4.5	16.5
Mean	84	4	6	3	56	210	2.8	127	4.9	81	6.4	19.7
F-Test												**
LSD (0.05)												3.05

Likewise, seven clones were evaluated at ARS Doti for their yield, tuber and plant characters. Local check varieties were Desiree and Farmer's Local. The results revealed that all the tested clones exceeded the yield of Farmer's Local (Table 3.1.1.16). CIP 384321.15 had highest yield and good performance followed by CIP 393077.159 and CIP 393385.39.

Table 3.1.1.16: Plant and yield characters of potato clones tested at CFFT, ARS Doti, 2072/73

Clones	Emg. (%)	Plant unif. (1-5)	Ground cover (1-9)	Plant vig. (1-5)	Plant height (cm)	Tuber size distribution (No. and wt (kg).)						Adj. yield (t/ha)
						US		SS		OS		
						No.	Wt	No.	Wt.	No.	Wt.	
CIP 393077.159	65	3	8	3	43	49	0.7	143	5.2	40	3.7	13.5
CIP 384321.15	79	3	6	3	35	107	1.07	156	5.1	51	4.5	14.9
CIP 393385.39	79	4	7	3	38	112	1.2	101	3.9	53	4.4	13.4
CIP 388676.1	83	3	7	3	36	73	0.7	131	4.5	29	2.7	11.2
PRP 25861.1	81	4	6	2	32	57	0.6	129	4.6	38	3.4	12.1
Desiree (check)	62	3	6	2	33	88	1.05	116	3.8	32	3.0	11.1
Farmers Local	97	3	8	3	36	125	1.2	159	4.4	25	2.2	10.9
Mean	78	3	7	3	36	87	0.9	133	4.5	38	3.4	12.4
F-Test												**
LSD (0.05)												1.8

3.1.1.4 Evaluation of potato clones for abiotic stress tolerance (Moisture stress trial)

This experiment was set up to evaluate potato clones for abiotic stress particularly moisture stress or drought considering the need of appropriate potato variety suitable for upland rainfed areas where mulching could be used as moisture management practice. Field evaluation was done by applying all recommended intercultural practices except mulching with plastic in rainfed and non-mulching in irrigated field condition. Growth character and yield characters were measured in the experiment.

Twelve potato clones were tested against moisture stress adopting similar materials and methods applied to the variety improvement trials mentioned above. There were two sets of experiment in which the first experiment consisted of the clones tested under irrigated condition without plastic mulch and the second trial consisted of the clones tested under non-irrigated condition with plastic mulch. The experimental design, lay out, fertilizer and other intercultural operations were similar to the CVTs and FFTs explained above.

In non-irrigated condition with plastic mulch trial, the tested clones were significantly different for most of the recorded yield, yield attributing parameters and plant characters (Table 3.1.1.17). The clones CIP 395195.7, CIP 396311.1 were promising for their high marketable yield, tuber characters, low late blight infection, good ground coverage and other plant characters. Khumal Seto-1, Janak Dev and LBr-40 were also comparable to these clones for yield performance.

In irrigated condition without plastic mulch trial, the tested clones were significantly different for most of the parameters including, yield attributing parameters and plant characters (Table 3.1.1.18). The clones CIP 396311.1, CIP 395195.7and CIP 395192.1were promising in this experiment for their high marketable yield, tuber characters, low late blight infection, good ground coverage and other plant characters. Khumal Seto-1, Janak Dev was also comparable to these clones for yield performance.

Comparing these two experiments, effect of plastic mulch on tuber yield and other parameters was positively greater than irrigated condition confirming that plastic mulch could conserve and help supply moisture regularly so that plant performance would be better than that accelerated by periodic irrigation in irrigated field.

Table 3.1. 1.17: Plant and yield characters of potato clones in non-irrigated condition with plastic mulch, 2072/73

Clones	Emg. (%)	Plt. Uni(1-5)	Ground cover (%)	Plant vig. (1-5)	Plant height (cm)	Stem/ plant (no.)	Marketable tubers (no.)	Marketable tubers (wt.)	Non-marketable tubers (no.)	Non-marketable tubers (wt.)	Totla yield t/ha
CIP 393385.39	19	2	75	3	59	3	118	3.3	155	1.1	9.9
CIP 395195.7	19	4	95	2	85	2	141	10.3	60	0.6	24.2
CIP 388676.1	19	2	81	3	54	3	107	6.4	74	0.5	15.4
CIP 395192.1	19	4	85	2	78	2	108	7.8	30	0.2	17.8
CIP 396311.1	18	3	85	3	67	3	179	9.6	67	0.7	23.1
PRP 25861.1	19	3	86	3	75	3	115	6.1	56	0.5	14.8
CIP 392242.25	19	3	83	3	76	3	180	7.5	145	1.1	19.1
CIP 385499.11	17	3	91	3	75	3	139	8.6	83	0.8	21.1
CIP 394611.112	20	3	93	4	98	4	148	5.7	177	1.2	15.4
Khumal Seto-1	19	4	90	3	77	3	211	10.6	108	1.2	26.3
Janak Dev	19	4	86	2	91	2	108	5.1	65	0.6	12.8
LBr-40	19	3	88	3	78	3	102	5.8	54	0.6	14.3
Mean	19	3	86	3	76	3	138	7.2	89	0.8	17.8
F-Test											**
LSD (0.05)											2.1

Table 3.1.1.18: Plant and yield characters of potato clones in irrigated non-plastic mulch, 2072/73

Clo nes	Emg	Plant unif. (1-5)	Ground cover (%)	Plant vig. (1-5)	Plant ht (cm)	Stem/plant/	Marke-table tubers (no.)	Marketable tubers (wt kg)	Non-marketable tubers (no.)	Non-marketable tubers (wt kg)	Marketable yield (t/ha)	Non-marketable yield (t/ha)	Totla yield t/ha
CIP 393385.39	19	3	81	3	38	5	73	2.1	154	1.2	4.6	2.8	7.4
CIP 395195.7	19	3	96	5	57	3	92	6.9	42	0.4	15.4	1	16.4
CIP 388676.1	20	3	88	3	31	5	93	4.1	62	0.9	9.1	2	11.1
CIP 395192.1	20	4	95	3	51	3	82	4.7	19	0.3	10.5	0.7	11.2
CIP 396311.1	19	4	100	4	39	3	103	7.5	54	0.5	16.7	1.3	18.0
PRP 25861.1	20	4	96	4	47	3	75	3	50	0.5	6.8	1.27	8.0
CIP 392242.25	19	3	95	3	48	4	135	5.1	90	1.2	11.3	2.77	14.0
CIP 385499.11	20	4	100	4	48	3	116	5.6	41	0.4	12.5	1.0	13.5
CIP 394611.112	19	4	96	3	48	5	115	3.2	182	1.3	7.2	3.0	10.2
Khumal Seto-1	19	3	95	4	46	4	133	5.8	67	0.5	13.0	1.1	14.2
JanakDev	18	4	86	4	65	2	74	3.5	42	0.7	7.7	1.6	9.4
LBr-40	19	4	95	4	52	3	68	3.2	41	0.3	7.1	0.7	7.8
Mean	19	3	93	4	47	4	96	4.5	70	0.7	12.1	1.6	11.8
F-Test													**
LSD (0.05)													2.1

3.1.1.5 Evaluation of processing qualities of potato genotypes

This experiment was designed to assess processing quality (chipping) of the potato clones developed by CIP and NPRP. 14 genotypes were tested in this experiment. The experiment was conducted in Randomized Complete Bloch Design (RCBD) with three replications. The crop was planted at Hattiban Farm (1340 m asl), Lalitpur in the third week of January 2012. Tubers were planted in 3 m^2 (1.2 m x 2.5m) plot size at a spacing of 60 x 25. Fertilizers were applied @ 100:100:60 kg NPK ha^{-1} plus with 20 t/ha FYM. All doses of manure and fertilizers were applied before planting the crops. Irrigation was given at 45 and 60 days after plating and while earthing –up was done at 47 and 62 days after planting. The crop was harvested 122 days after planting. Observations were recorded on vegetative characters, as well as yield and chips quality parameters like dry matter and specific gravity. Data recordings were made according to the Field Book for Standard Evaluation of Potato and Sweet Potato Germplasm.

Vegetative parameters

Emergence and Number of plants harvested were statistically insignificant among the different genotypes however genotypes differed significantly on parameters like uniformity, Vigour, Ground Cover, Number of stems per plant and plant height. (Table 3.1.1.19).

Yield Parameters and Processing quality

Clones differed significantly for production of total tuber yield, where clone CIP 396311.1 produced the significantly the highest tuber yield of 32.56 t/ha and clone CIP 399067.22 produced the lowest yield of 5.11 t/ha.

The highest dry matter (21.87 %) was recorded in clone-CIP 384599.11 whereas highest specific gravity (1.081) was recorded for clone- CIP 388676.1. However the lowest specific gravity (1.066) and the lowest dry matter (17%) was recorded for PRP 25861.1.

Table No: 3.1.1.19. Vegetative characters for 14 genotypes evaluated for processing quality

Clones	Emergence	Uniformity (1-5)	Plant vigor (1-5)	Ground cover(%)	Plant Height (cm)	No. of Stems/plant
CIP 393382.44	19.7	3.7	5	100	65.9	3
CIP 395195.7	20.0	3.7	5	100	70.1	3
CIP 399067.22	19.7	3.3	4	87	73.3	3
K.UJJWAL	20.0	3.0	4	97	39.3	3
CIP395192.1	19.7	3.3	4	97	57.4	3
K.UPAHAR	19.7	3.3	4	97	43.1	3
CIP384866.5	19.7	3.3	4	100	57.1	5
CIP377957.5	20.0	3.0	3	92	37.1	4
CIP 388676.1	20.0	3.3	3	85	31.7	5
K.SETO-1	20.0	4.0	5	100	46.9	4
CIP 399101.1	19.3	3.7	4	93	62.7	3
CIP 396311.1	20.0	4.0	4	100	44.3	3
PRP 25861.1	19.7	3.3	4	97	50.5	3
CIP 385499.11	20.0	4.0	4.33	100	58.1	4
Grand mean	19.8	3.5	4.2	95.9	52.7	3.5
F-test	NS	NS	**	**	**	**
LSD(0.05)			0.9	2.8	3.0	1.1
C.V (%)	2.1	13.1	12.0	4.7	9.8	17.6

Table3.1.1.20 : Yield and Processing quality Parameters of 14 Potato genotypes

Clones	USN	USW	SSN	SSW	OSN	OSW	TTYPH	SG	DM
CIP 393382.44	49.33	0.33	74.33	2.63	15.00	1.50	14.89	1.07	20.07
CIP 395195.7	28.33	0.33	81.33	3.60	27.00	3.20	23.78	1.07	19.83
CIP 399067.22	33.00	0.23	41.67	1.30	0.00	0.00	5.11	1.07	19.80
K.UJJWAL	77.00	0.40	143.67	4.73	18.33	1.77	23.00	1.07	17.97
CIP395192.1	16.33	0.17	64.33	2.90	22.67	2.23	17.67	1.08	20.57
K.UPAHAR	24.33	0.23	43.00	1.83	41.67	4.53	22.00	1.06	17.93
CIP384866.5	43.67	0.27	92.00	3.03	11.00	0.87	13.89	1.07	18.00
CIP377957.5	61.67	0.50	112.00	3.23	2.67	0.33	13.56	1.08	19.63
CIP 388676.1	53.00	0.77	106.00	3.27	11.33	0.90	16.44	1.08	20.90
K.SETO-1	59.00	0.37	151.67	4.50	14.67	1.23	20.33	1.07	19.60
CIP 399101.1	53.00	0.27	109.00	3.60	15.67	1.40	17.56	1.08	20.00
CIP 396311.1	35.33	0.37	88.67	3.23	50.00	6.17	32.56	1.08	20.03
PRP 25861.1	27.67	0.30	89.67	3.03	10.00	0.83	13.89	1.07	17.00
CIP 385499.11	37.67	0.40	114.00	4.00	30.00	2.57	23.22	1.08	21.87
Grand mean	42.81	0.352	93.667	3.207	19.286	1.967	18.42	1.07	19.51
F-test	**	**	**	**	**	**	**	**	**
LSD(0.05)	4.987	0.6028	7.317	1.189	3.911	1.231	2.778	0.0611	0.9694
C.V(%)	32.34%	57.39%	31.82%	24.54%	44.14%	42.91%	23.39%	0.19%	2.68%

USN: under size Tuber Number, USW: under Size Tuber Weight, SSN: Seed Size Tuber Number, SSW: Seed Size tuber weight, OSN: Over size Tuber Number, OSW: Over size Tuber Weight, TTN : TTYPH: Total Tuber Yield Per Hectare, SG: Specific Gravity, DM : Dry matter

3.1.1.6 Potato Diseases

3.1.1.6.1 Late blight

3.1.1.6.1.1 Initial Evaluation of potato clones against late blight

A total of 72 potato clones were evaluated against late blight disease (Table 3.1.1.21). Emphasis was given to late blight resistance along with higher yield and red skinned clones as desirable character. The performance of the clones compared with released and recommended cultivars Janakdev, Kufri Jyoti and LBR-40.

The experiment was planted during autumn season which provides most conducive atmosphere for the late blight disease development at Hattiban Farm, Khumaltar, Lalitpur. Plot size was 2.5 m x 0.6 m (1.5 m^2) with one replication. Single row of susceptible variety Desiree was planted on both sides of experimental plots to exert more disease pressure. Compost 20 t/ha and chemical fertilizer was applied at 100:100:60 Kg NPK/ha as basal. Row to row distance 60 cm and plant to plant 25 cm maintained. Irrigation was applied at 40 and 60 days after planting followed by weeding and earthing-up. No fungicides were sprayed throughout the crop period. Late blight damage was recorded as foliage damage % for five times starting from 40 up to 70 DAP.

Out of 72 clones tested in Hattiban Farm, Khumaltar almost 28 clones observed resistant to late blight disease with score (1) in 1 to 9 scale in late blight scoring. This could be due to the lack of ambient atmosphere for late blight development. Among them PRP 056267.6, PRP 286265.22, PRP 146267.6 and PRP136368.8 has highest yield and good performance.

Table 3.1.1.21: Initial evaluation of clones for resistance to late blight and tuber yield at Hattiban farm, 2072/73

Genotypes	Emergence (%)	Uniformity (1-5)	Plant Vigour (1-5)	Late Blight (1-9)			No. of stems/plant	Plant height (cm)	No. of plants harvested	Tuber size Distribution (No. and weight)						Total yield (t/ha)
				I	II	III				US		SS		OS		
										No.	Wt.	No.	Wt.	No.	Wt.	
PRP 016367.7	91	2	3	1	1	1	2	68	12	61	0.6	44	2.6	5	0.9	23.3
PRP 016567.1	91	4	4	1	1	2	3	50	8	60	0.6	54	1.9	5	0.9	19.2
PRP 016567.2	100	2	2	1	1	3	2	60	11	62	0.5	60	2.5	2	0.3	18.6
PRP 016568.3	100	3	3	1	1	1	4	55	12	80	1.0	66	3.4	11	1.5	33.1
PRP 016567.5	91	2	3	1	1	1	3	63	11	22	0.3	42	2.8	7	1.2	23.9
PRP 016567.6	91	4	4	1	1	2	3	60	11	51	0.5	71	3.5	16	2.8	37.8
PRP 016567.10	100	3	2	1	1	1	2	53	9	45	0.4	60	2.4	3	0.5	18.3
PRP 016567.11	91	3	3	2	2	2	2	47	12	13	0.2	40	2.8	18	2.1	28.4
PRP 016567.12	91	4	4	1	1	3	2	59	12	17	0.4	44	2.2	18	2.6	29.0
PRP 016567.13	100	3	2	1	1	2	4	46	12	21	0.4	41	2.4	8	1.2	22.3
PRP 85861.8	100	3	3	1	1	1	3	65	12	70	0.6	75	3.3	14	1.6	30.6
LBR 40	100	4	4	1	1	1	2	62	12	35	0.5	17	2.1	21	3.9	36.1
PRP 056267.1	100	4	4	1	1	1	3	52	12	80	0.7	82	3.9	9	1.2	32.2
PRP 056267.6	91	4	4	1	1	1	3	65	11	88	0.8	93	4.6	18	2.6	44.4
PRP 016267.9	100	3	4	1	1	1	3	65	12	145	1.1	92	3.7	9	1.2	33.3
PRP 146267.6	91	3	3	1	1	1	2	66	11	56	0.8	53	2.4	21	3.6	37.8
PRP 146267.7	83	3	2	1	1	1	3	41	9	20	0.4	24	1.3	18	2.3	22.2
PRP 146267.8	100	3	2	1	1	1	3	43	12	23	0.6	48	2.4	15	2.1	28.3
PRP 146267.11	100	3	4	1	1	2	2	60	12	33	0.4	59	3.0	32	4.8	45.6

Genotypes	Emergence (%)	Uniformity (1-5)	Plant Vigour (1-5)	Late Blight (1-9)			No. of stems/plant	Plant height (cm)	No. of plants harvested	Tuber size Distribution (No. and weight)						Total yield (t/ha)
				I	II	III				US		SS		OS		
										No.	Wt.	No.	Wt.	No.	Wt.	
CIP 394050.119	100	4	4	1	1	4	4	47	12	37	0.3	97	3.4	4	0.5	23.3
Janakdev	100	3	4	1	1	3	3	60	12	18	0.4	32	1.3	14	1.8	19.4
PRP 226265.1	100	2	2	1	1	1	3	49	12	50	0.4	54	2.2	14	1.6	23.3
PRP 226265.4	83	2	2	1	1	1	2	50	9	14	0.3	29	1.4	9	1.3	16.7
PRP 226267.1	100	3	4	1	1	2	3	57	12	35	0.7	99	4.2	19	2.2	39.4
PRP 226567.10	91	3	4	1	1	2	4	63	11	42	0.3	82	3.2	20	2.3	32.2
PRP 226267.11	100	4	4	1	1	2	4	84	11	60	0.7	72	3.7	25	3.4	43.3
PRP 226567.10	91	4	4	1	1	1	2	55	11	35	0.3	70	3.0	25	4.1	41.1
CIP 399078.11	91	3	3	1	1	1	3	91	11	33	0.3	34	1.4	23	3.1	26.7
PRP 226567.2	91	2	3	1	1	3	4	50	10	41	0.3	65	2.6	12	1.7	25.6
K.Jyoti	100	4	3	2	2	8	3	44	12	17	0.4	32	1.3	13	1.1	15.6
CIP 393077.54	91	4	3	2	2	3	4	49	11	19	0.3	48	1.8	17	1.7	21.1
PRP 286265.22	91	3	3	1	1	1	3	63	11	21	0.6	64	3.2	24	3.8	42.2
PRP 286365.6	100	4	3	1	1	2	3	52	11	20	0.4	51	2.6	7	1.0	22.2
PRP 296667.2	100	4	4	1	1	1	4	66	12	40	0.4	80	3.4	20	2.2	33.3
PRP 296667.3	91	4	4	1	1	2	4	59	11	101	0.8	91	4.6	23	3.4	48.9
PRP 296668.4	100	3	3	1	1	2	3	55	12	27	0.2	46	2.4	10	1.2	21.1
PRP 396668.1	91	4	4	2	2	2	2	54	11	60	0.5	75	3.5	24	3.1	42.1
CIP 391058.175	75	4	3	1	1	1	2	62	11	11	0.2	25	1.4	12	2.8	24.6
CIP 393073.179	91	4	3	1	2	2	4	49	11	9	0.2	27	1.4	19	3.4	27.9
CIP 393617.1	100	4	4	1	3	5	4	62	12	49	0.6	98	4.6	8	1.0	34.4

Genotypes	Emergence (%)	Uniformity (1-5)	Plant Vigour (1-5)	Late Blight (1-9)			No. of stems/plant	Plant height (cm)	No. of plants harvested	Tuber size Distribution (No. and weight)						Total yield (t/ha)
				I	II	III				US		SS		OS		
										No.	Wt.	No.	Wt.	No.	Wt.	
PRP 25861.1	91	4	4	1	1	1	3	65	11	24	0.4	65	3.0	17	2.4	32.2
CIP 38549.11	100	3	4	1	3	4	3	67	12	43	0.6	74	3.2	12	1.6	30.0
CIP 395112.32	75	3	3	1	1	1	3	66	12	18	0.2	27	1.3	7	1.2	15.1
CIP 395017.229	100	3	3	1	1	1	5	48	12	55	0.6	63	3.2	8	1.4	28.9
CIP 395017.242	91	3	3	1	1	1	4	53	11	40	0.4	53	2.6	17	2.6	31.1
CIP 399067.22	100	3	3	1	1	1	3	70	12	48	0.4	68	2.4	11	1.2	22.2
												11				
PRP 136368.7	100	4	3	1	1	1	4	47	11	65	0.6	1	3.6	5	0.6	26.7
PRP 136368.1	100	3	3	1	6	8	4	46	12	31	0.4	70	2.8	3	0.4	20.3
PRP 136268.2	100	4	4	1	2	2	3	60	12	23	0.2	51	2.6	13	1.6	24.5
PRP 136268.1	100	4	4	1	1	2	3	58	11	18	0.2	63	3.2	27	3.6	39.1
K.Surya	100	3	4	1	4	6	3	47	12	14	0.2	44	2.0	14	1.7	21.7
CIP 389746.2	91	3	3	1	2	2	3	60	11	15	0.4	41	2.4	25	4.3	39.4
PRP 136368.6	91	3	3	1	1	1	4	49	11	55	0.6	80	3.4	11	1.6	31.2
PRP 136368.8	91	4	4	1	1	1	6	48	12	42	0.4	75	4.0	14	2.0	35.6
PRP 136268.5	91	3	3	1	3	3	2	45	12	21	0.3	40	1.8	4	0.6	15.0
PRP 136368.8	100	4	4	1	1	2	6	54	12	60	0.6	81	4.0	17	2.4	38.9
PRP 136268.4	100	3	3	1	1	1	2	54	12	40	0.4	64	2.8	9	1.2	24.5
PRP 136368.3	100	3	4	1	4	6	3	52	12	12	0.2	60	2.6	8	1.3	22.8
PRP 136368.4	92	3	3	1	3	3	3	49	11	42	0.4	53	2.2	9	1.3	21.7
Ktm local x LBR	92	3	4	1	2	2	2	79	10	22	0.4	57	2.7	22	2.8	32.8

Genotypes	Emergence (%)	Uniformity (1-5)	Plant Vigour (1-5)	Late Blight (1-9)			No. of stems/plant	Plant height (cm)	No. of plants harvested	Tuber size Distribution (No. and weight)						Total yield (t/ha)
				I	II	III				US		SS		OS		
										No.	Wt.	No.	Wt.	No.	Wt.	
K.Sadabahar	100	3	2	1	3	5	3	42	12	11	0.2	32	1.3	3	0.4	10.6
K.Pushkar	100	4	3	1	6	7	3	41	11	26	0.5	54	1.8	3	0.5	15.6
PRP 136368.10	100	4	3	1	2	2	3	61	12	17	0.2	80	3.3	11	1.3	26.7
PRP 136368.9	100	4	4	1	2	3	4	57	12	20	0.4	78	3.5	16	2.2	33.9
PRP 136368.5	100	4	4	2	7	8	4	41	12	25	0.4	42	1.7	8	1.0	17.2
CIP 3907	100	4	4	1	6	7	5	52	9	65	0.6	65	2.3	12	1.4	23.9
PRP 136368.2	92	4	4	2	7	8	3	46	12	21	0.4	95	3.0	3	0.4	21.1
PRP 136368.3	83	3	3	1	4	4	3	51	10	64	0.6	68	2.6	5	0.7	21.7
PRP 346769.3	100	4	4	1	2	3	4	49	12	17	0.4	60	2.4	25	2.8	31.1
PRP 336769.1	100	3	3	1	3	4	3	66	12	40	0.4	85	2.2	2	0.2	15.6
PRP 136769.3	92	3	4	1	1	2	4	62	9	85	0.6	13 5	5.6	20	2.5	48.4
PRP 136769.1	75	3	3	1	1	1	4	44	9	25	0.4	60	2.8	16	2.4	31.1

3.1.1.6.2 Screening of potato clones against late blight disease in NSPF Nigale Sindhupalchowk conditions

Experiment was carried out at Nigale, Sindhupalchowk (2450 masl) field condition in order to identify genotypes resistant to late blight and high yield for high hills. The experiment was laid out in randomized complete block design with two replications. The plot size was 2.5 x 0.6 m (1.5 m^2). Row to row distance was maintained at 60 cm and plants were 25 cm apart. Compost @ 20 t/ha and chemical fertilizer was applied at 100:100:60 Kg NPK/ha as basal. The trial was conducted in rainfed conditions. Other cultural practices were carried out as per the requirements. Fungicides were not applied throughout the growth period and late blight severity was recorded in percentage foliage damage at 7 to 10 days interval from the first date of symptoms appearance and continued up until susceptible check reached at 100% foliage damage.

Altogether 42 clones were checked against Kufri Jyoti, Janakdev, LBR 40 and Rosita (Table 3.1.1.22). The late blight damage % ranged from 30% - 80% in all the clones tested. PRP 016567.5, PRP016567.10 and PRP 056267.6 showed late blight resistant performance compared to other tested clones. Hailstorm damage % was also observed and clones PRP 16567.1, PRP 056267.1, PRP 25861.1, PRP 296668.1, PRP 146267.6 and PRP 016567.12 showed no any hailstorm damage among the tested clones. In tuber yields, clones PRP 296668.4, PRP 056267.6, PRP 25861.1 and PRP 296667.3 have higher yields and performance compared to the check varieties (Table 3.1.1.22).

Table 3.1.1.22 Performance of potato genotypes to tuber number, yield and late blight severity at Nigale farm, Sindhupalchok, 2072/73

Genotypes	Emergence (%)	Ground cover(%)	Uniformity (1-5)	Plant vigor (1-5)	Late Blight(%)	Hailstorm Damgae (%)	Tuber size Distribution						Total Yld (t/ha)
							US		SS		OS		
							No.	Wt.	No.	Wt.	No.	Wt.	
PRP 85661.8	85	62	3	3	55	42	23	0.30	15	0.61	4	0.25	7.73
CIP 394050.110	85	55	3	3	67	30	11	0.53	12	0.48	4	0.34	9.00
PRP016567.5	85	67	3	3	37	12	4	0.25	10	0.48	3	0.29	6.83
PRP 016567.13	100	55	3	2	70	55	13	0.22	17	0.70	4	0.41	8.87
PRP 146267.8	85	50	2	2	55	57	22	0.34	16	0.69	9	0.96	13.30
PRP 16567.1	95	90	3	3	72	0	8	0.45	17	0.90	11	1.97	22.17
PRP 226267.10	100	77	2	2	72	35	18	0.32	27	1.32	7	0.85	16.70
PRP 056267.6	90	72	2	3	50	2	9	0.38	21	1.13	20	2.82	28.93
PRP 056267.6	75	50	2	3	55	40	8	0.56	14	0.66	9	1.16	15.93
PRP 146267.7	85	45	3	3	65	37	5	0.23	14	0.81	4	0.49	10.30
PRP 296668.4	100	60	2	3	75	52	19	0.32	28	1.59	12	1.58	23.33
PRP 226567.2	95	57	3	2	75	62	22	0.41	27	1.30	3	0.36	13.88
PRP 296667.3	95	70	3	3	82	20	30	0.44	35	1.57	9	1.13	20.97
CIP 395017.242	100	65	3	3	57	20	11	0.19	15	0.78	2	0.33	8.70
CIP 393077.54	100	70	4	3	75	35	4	0.01	24	1.14	8	1.00	14.37
PRP 226267.11	95	100	1	4	52	2.5	21	0.36	29	1.37	9	1.22	19.67
CIP 385499.11	75	27	3	1	82	85	19	0.33	23	0.91	1	0.15	9.27
PRP 056267.1	95	97	3	4	72	0	6	0.03	14	0.97	3	0.62	10.87
PRP 25861.1	100	92	3	4	72	0	21	0.23	29	2.12	6	0.84	21.33
PRP 286265.22	90	87	3	3	67	2	12	0.15	21	0.97	3	0.41	10.27
PRP 296668.1	100	87	3	3	77	0	20	0.25	31	1.75	5	0.63	17.57

Genotypes	Emergence (%)	Ground cover(%)	Uniformity (1-5)	Plant vigor (1-5)	Late Blight(%)	Hailstorm Damgae (%)	Tuber size Distribution						Total Yld (t/ha)
							US		SS		OS		
							No.	Wt.	No.	Wt.	No.	Wt.	
PRP 016567.11	90	85	4	3	85	2	9	0.07	17	0.97	2	0.25	8.63
PRP 146267.6	95	97	3	4	77	0	18	0.28	22	1.38	5	0.78	16.38
Janakdev	90	77	3	2	72	47	19	0.31	20	1.41	3	0.38	14.03
LBR 40	100	75	3	3	65	17	16	0.26	10	0.66	8	1.15	13.83
CIP 395112.32	90	67	3	3	82	25	8	0.10	21	1.36	3	0.41	12.50
PRP 266365.6	100	62	3	3	67	27	8	0.07	31	1.66	4	0.61	15.63
PRP 226567.1	90	77	3	3	67	2	8	0.07	26	1.55	6	1.03	17.70
PRP 296667.2	95	87	3	3	77	2	24	0.27	30	1.36	7	0.81	16.33
PRP 016567.2	95	70	3	2	80	30	13	0.18	29	1.40	0	0.00	10.57
PRP 146267.11	100	82	3	3	77	5	11	0.18	20	1.07	11	1.29	16.97
PRP 16267.9	90	72	3	3	77	32	23	0.28	33	1.44	8	0.90	17.47
PRP 016567.12	80	75	2	3	60	0	10	0.12	19	0.93	8	0.99	13.67
PRP 016567.10	70	27	4	2	47	17	19	0.13	17	0.57	2	0.17	5.90
PRP 016567.6	95	95	3	3	55	5	13	0.14	27	1.57	8	1.12	18.93
PRP 016367.7	100	85	3	3	67	7	14	0.14	20	1.3	6	1.26	18.00
PRP 01658.3	90	57	3	2	75	55	16	0.17	27	1.51	7	0.93	17.43
Rosita	100	85	3	3	87	2	16	0.16	30	1.48	9	1.09	18.20
CIP 391058.175	85	77	2	3	80	12	6	0.07	21	0.98	7	0.84	12.60
PRP 226267.1	75	50	3	3	57	7	8	0.12	28	1.47	3	0.40	13.30
PRP 226265.1	100	62	3	2	65	10	5	0.37	24	1.27	3	0.55	14.63
K.Jyoti	65	57	2	2	67	60	11	0.21	21	0.91	2	0.25	9.17

3.1.2 Develop low cost PBS production technologies under in vitro and glass house conditions

Since the establishment of tissue culture laboratory and the glasshouse in 1989, National Potato Research Program (NPRP) has been producing certain amount of disease free potato seed as pre-basic seed (PBS) annually. For this, efficient production of *in vitro* plantlets is the most important works. In this regard, selection of appropriate and efficient methods for *in vitro* rapid multiplication of plantlets and microtuber production under *in vitro* conditions and sustainable and economic production PBS under glasshouse are main focus of the program. To overcome this, NPRP has already completed some studies and published results on the use of natural light for *in vitro* plantlets under laboratory conditions, protocol for microtuber production and PBS production by hydroponic cultivation system.

Utilization of PBS is another the most important part in seed production program and in other hand it is also necessary to explore the important of quality source seed through farmer participation. The overall reduction in the cost of *in vitro* plantlets and maximum production of medium to large size PBS under glasshouse are prime importance in reducing cost per unit PBS. The objectives of these studies were to efficient and rapid multiplication of plantlets under *in vitro* conditions, efficient production of minituber in a sustainable way and to know about the virus status of the succeeding generation of PBS under on-farm as well as on-station.

3.1.2.1 Long term preservation of potato germplasm under in vitro conditions

Plant growth regulators are organic compounds, other than nutrients, that modify plant physiological processes. They act inside plant cells to stimulate or inhibit specific enzyme or enzyme systems and help regulate plant metabolism. Among different uses of PGR, the main objective in this experiment is hastening the maturity to decrease turn over in *in vitro* plantlets of potato. The experiment was conducted under in vitro conditions since 2012/13 and this is the third year. Ten single nodes were sub-cultured on each test tube with 20 test tubes per replication and repeated three times. Potato cultivars Janak Dev and Desiree were used in the study. After one month of sub-cultured, necessary parameters were taken every month interval till the plantlets are of one year old or more. Result indicated that all tested plant growth regulators showed some effects on most of the parameters as compared to control or standard checked. Among the MH (20 ppm) showed better effect by showing slow growth pattern with complete plant (leaf, node and root) of the incubated plantlets under in vitro condition followed by ABA (30 ppm) until 7 months. Maleic Hydrazide (30 ppm) showed good response till 360 days of

sub-cultured. Chlorocholine Chloride and control treatment showed overgrowth in around 90 days of sub-cultured (Table3.1.2.1, 3.1.2.2, 3.1.2.3, 3.1.2.4 and 3.1.2.5). And the experiment is continued with the objective of finding the proper concentration of PGR for long term preservation of potato germplasm under in vitro condition without regular sub culture.

Table 3.1.2.1 Effect of different chemicals on height of leaf per plant under in vitro condition on potato varieties Janak Dev and Desiree

Treatments	30 DASC		60 DASC		90 DASC		120 DASC		150 DASC		180 DASC		210 DASC		240 DASC		270 DASC		300 DASC		330 DASC		360 DASC	
	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2
ABA 10 ppm	0.5	0.5	0.8	0.9	1.1	1.0	1.1	1.1	1.6	1.2	1.8	1.3	1.8	1.3	1.8	1.4	1.8	1.7	1.8	1.7	1.8	1.7	1.8	1.7
ABA 20 ppm	0.7	0.8	0.7	1.4	1.1	2.1	1.4	2.0	1.4	2.1	1.7	2.2	1.7	2.4	1.7	2.6	1.7	3.3	1.8	3.3	1.8	3.3	1.8	3.3
ABA 30 ppm	0.8	0.5	0.8	1.2	0.9	1.7	0.9	1.7	0.9	1.7	0.9	1.7	1.1	1.7	1.1	1.7	1.1	1.7	1.1	1.7	1.1	1.7	1.1	1.7
MH 10 ppm	2.8	2.0	4.0	3.4	4.3	3.5	4.4	3.7	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
MH 20 ppm	3.1	4.3	5.2	5.0	5.3	5.3	5.3	5.3	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
MH 30 ppm	1.3	1.9	2.2	2.0	2.3	2.1	2.3	2.1	2.4	2.1	2.4	2.1	2.4	2.1	2.4	2.1	2.4	2.1	2.4	2.1	2.4	2.1	2.4	2.1
CCC 5 ppm	6.5	7.0	11.5	12.2	12.2	12.9	12.6	13.5	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
CCC 10 ppm	7.0	6.8	11.6	11.0	13.0	11.8	14.0	12.4	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
CCC 20 ppm	5.8	6.9	10.1	11.7	10.6	12.3	10.6	12.3	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
Control (MS)	6.7	7.4	11.8	12.4	11.8	12.6	12.4	12.9	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
V1= JanakDev ; V2=Desiree																								

Table 3.1.2.2 Effect of different chemicals on number of nodes per plant under in vitro condition on potato varieties Janak Dev and Desiree

Treatments	30 DASC		60 DASC		90 DASC		120 DASC		150 DASC		180 DASC		210 DASC		240 DASC		270 DASC		300 DASC		330 DASC		360 DASC	
	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2
ABA 10 ppm	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
ABA 20 ppm	0.0	1.0	1.0	3.0	1.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
ABA 30 ppm	0.0	1.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0
MH 10 ppm	0.0	1.0	1.0	6.0	1.0	7.0	1.0	7.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
MH 20 ppm	3.0	2.0	5.0	7.0	4.0	8.0	6.0	8.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
MH 30 ppm	4.0	5.0	7.0	5.0	6.0	7.0	8.0	7.0	9.0	8.0	10	10	11	13	11	13	11	13	11	13	11	13	11	13
CCC 5 ppm	6.0	3.0	8.0	12.0	7.0	14.0	13.0	14.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
CCC 10 ppm	7.0	9.0	9.0	12.0	8.0	14.0	12.0	14.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
CCC 20 ppm	6.0	8.0	7.0	14.0	10.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
Control (MS)	8.0	9.0	10.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
V1= JanakDev ; V2=Desiree																								

Table 3.1.2.3 Effect of different chemicals on number of leaf per plant under in vitro condition on potato varieties JanakDev and Desiree (DASC = Days after subculture)

Treatments	30 DASC		60 DASC		90 DASC		120 DASC		150 DASC		180 DASC		210 DASC		240 DASC		270 DASC		300 DASC		330 DASC		360 DASC	
	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2
ABA 10 ppm	2.5	2.2	2.7	2.9	3.0	2.6	4.0	5.0	6.0	8.0	9.0	12.0	9.0	12.0	9.0	12.0	9.0	12.0	9.0	12.0	9.0	12.0	9.0	12.0
ABA 20 ppm	3.1	2.8	3.5	3.5	3.6	3.4	6.0	6.0	6.0	7.0	6.0	7.0	6.0	7.0	6.0	7.0	6.0	7.0	6.0	7.0	6.0	7.0	6.0	7.0
ABA 30 ppm	2.1	1.8	2.8	2.5	2.6	2.4	5.0	5.0	7.0	8.0	7.0	8.0	7.0	8.0	7.0	8.0	7.0	8.0	7.0	8.0	7.0	8.0	7.0	8.0
MH 10 ppm	7.7	7.4	7.9	8.1	8.2	8.0	12.0	11.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
MH 20 ppm	6.2	5.9	6.4	6.6	6.7	6.5	10.0	9.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
MH 30 ppm	2.9	2.6	3.1	3.3	3.4	3.2	5.0	5.0	7.0	8.0	9.0	10.0	12.0	15.0	12.0	15.0	12.0	15.0	12.0	15.0	12.0	15.0	12.0	15.0
CCC 5 ppm	7.9	7.0	7.5	7.7	7.8	7.6	10.0	14.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
CCC 10 ppm	15.0	12.7	15.2	OG	15.5	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
CCC 20 ppm	8.0	7.7	8.2	8.4	8.5	8.3	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
Control (MS)	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG

V1= JanakDev ; V2=Desiree

able 3.1.2.4 Effect of different chemicals on branch per plant under invitro condition on potato varieties Janak Dev and Desiree (DASC = Days after subculture)

Treatments	30 DASC		60 DASC		90 DASC		120 DASC		150 DASC		180 DASC		210 DASC		240 DASC		270 DASC		300 DASC		330 DASC		360 DASC	
	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2
ABA 10 ppm	1.0	2.0	1.0	3.0	2.0	5.0	2.0	7.0	2.0	7.0	3.0	7.0	5.0	7.0	5.0	7.0	5.0	7.0	5.0	7.0	5.0	7.0	5.0	7.0
ABA 20 ppm	1.0	1.0	2.0	2.0	2.0	4.0	2.0	4.0	3.0	4.0	3.0	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0	4.0
ABA 30 ppm	1.0	1.0	2.0	3.0	2.0	6.0	2.0	6.0	3.0	6.0	3.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0
MH 10 ppm	1.0	1.0	1.0	3.0	2.0	7.0	2.0	7.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
MH 20 ppm	1.0	1.0	1.0	2.0	1.0	3.0	2.0	3.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
MH 30 ppm	1.0	2.0	1.0	3.0	2.0	4.0	2.0	4.0	3.0	4.0	3.0	4.0	4.0	5.0	5.0	6.0	7.0	8.0	8.0	8.0	8.0	8.0	8.0	11.0
CCC 5 ppm	1.0	1.0	2.0	3.0	2.0	5.0	2.0	5.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
CCC 10 ppm	1.0	1.0	2.0	3.0	1.0	5.0	2.0	5.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
CCC 20 ppm	1.0	1.0	1.0	2.0	2.0	4.0	2.0	4.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG
Control (MS)	1.0	2.0	1.0	3.0	2.0	5.0	2.0	5.0	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG	OG

V= JanakDev ; V2=Desiree

Table 3.1.2.5 Effect of different chemicals on root length per plant under invitro condition on potato varieties Janak dev and Desiree (DASC = Days after subculture)

Treatments	30 DASC		60 DASC		90 DASC		120 DASC		150 DASC		180 DASC		210 DASC		240 DASC		270 DASC		300 DASC		330 DASC		360 DASC	
	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2
ABA 10 ppm	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
ABA 20 ppm	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
ABA 30 ppm	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
MH 10 ppm	No	No	Vvs	No	Vvs	No	No	Vvs	Vvs	S	VS	M	S	L	L	L	L	L	L	L	L	L	L	L
MH 20 ppm	No	No	Vvs	No	Vvs	No	No	Vvs	Vvs	S	VS	M	S	L	L	L	L	L	L	L	L	L	L	L
MH 30 ppm	No	No	Vvs	Vvs	VS	S	VS	S	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CCC 5 ppm	No	Vvs	No	S	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CCC 10 ppm	S	Vs	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CCC 20 ppm	S	Vs	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Control (MS)	S	Vs	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

V= JanakDev ; V2=Desiree

Root length : No= No root, Vvs=<1cm, VS=1 to 3 cm, S=3 to 5 cm, M=5 to 7 cm, L=7cm

3.1.2.2 Degeneration studies of PBS under different agro-ecological zones at field conditions

In potato crop, degeneration is mostly due to infection with one or more viruses which reduce potato yield by 10-60 %. When go in specific viruses the yield reduction is varied with individual virus, yield reduced by 50-95% with PLRV infection, PVX cause 5-70% yield loses, PVM yield loss of about 10%, 11-38% by PVS and yield losses up to 60 % by combined effect of PVS and PVA and up to 95 % by PVY. In this way yield reduction by virus infection depends on percentage of infected plants and the type of virus(s) infecting the plant. The study was done only by comparing rouged and none rouged of virus infected plants. But because of the change of seed lots during the study period, the infected plants appeared occasionally and so significant yield differences were recorded between the compared treatments, and hence, yielded no output. The experiment was started from the fiscal year 2069/70 and conducted at two locations, RARS, Parwanipur, Bara to represent the tropical region and NPRP, Khumaltar, Lalitpur to represent the sub-tropical region of Nepal. From the year (2070/71) one more location; Nigale was included to represent the tropical region of the country. Treatment combination, seed source and cultural activities were similar in all locations.

A) Hattiban

Field experiments were conducted in the experimental field of National Potato Research Program (NPRP), Kumaltar. The objective of study was to evaluate the rate of degeneration due to viral diseases in Janak Dev and Kufri Jyoti. The experimental plot design was Randomized Complete Block Design with 3 replication and 5 treatments considering each farmer as a replication. There were 10 treatment combinations consisting 2 varieties.

Treatment combination

Treatments	Variety	Combination
Covered by insect proof net	V1: Kufri Jyoti	T1V1
	V2: Janak Dev	T1V2
Only spraying of appropriate insecticides when aphid population reaches critical	V1: Kufri Jyoti	T2V1
	V2: Janak Dev	T2V2
Only roughing of infected plant (negative selection)	V1: Kufri Jyoti	T3V1
	V2: Janak Dev	T3V2
Spraying of appropriate insecticides and roughing of infected plant (2+3)	V1: Kufri Jyoti	T4V1
	V2: Janak Dev	T4V2
Control	V1: Kufri Jyoti	T5V1
	V2: Janak Dev	T5V2

The data were collected with following observations:

a. Emergence at 30 and 60 days after sowing
b. Number of stems per plant
c. Plant Height (cm)
d. Tuber yield per plot: For this data the total yield from a single plot was divided to three grades as under seed size; Seed size and Over seed size and the weight and number of each grade were recorded.
e. The samples were collected after 45 days of emergence for performing virus test and DAS-ELISA test was done. Virus incidences in the potato foliage from different treatments were detected through ELISA and presented in Table No. 3.1.2.6

Table 3.1.2.6 Virus test of Degeneration trial of Hattiban 2072/73 through ELISA

Sample	PVM	PVX	PLRV	PVA	PVY	PVS
R1V1T1	0.064	0.056	0.051	0.048	0.058	0.065
R1V1T2	0.053	0.048	0.045	0.043	0.057	0.057
R1V1T3	0.048	0.051	0.049	0.051	0.05	0.051
R1V1T4	0.066	0.055	0.046	0.052	0.06	0.051
R1V1T5	0.06	0.055	0.051	0.047	0.061	0.058
R1V2T1	0.054	0.049	0.043	0.044	0.047	0.05
R1V2T2	0.059	0.049	0.046	0.043	0.05	0.057
R1V2T3	0.052	0.045	0.05	0.052	0.057	0.055
R1V2T4	0.054	0.054	0.056	0.048	0.046	0.057
R1V2T5	0.056	0.153	0.051	0.051	0.061	0.053
R2V1T1	0.053	0.052	0.053	0.05	0.053	0.052
R2V1T2	0.047	0.051	0.05	0.046	0.046	0.051
R2V1T3	0.053	0.057	0.05	0.048	0.049	0.058
R2V1T4	0.093	0.052	0.049	0.042	0.046	0.05
R2V1T5	0.052	0.05	0.052	0.043	0.048	0.052
R2V2T1	0.054	0.05	0.054	0.045	0.052	0.05
R2V2T2	0.054	0.053	0.048	0.059	0.057	0.053
R2V2T3	0.057	0.05	0.051	0.049	0.056	0.059
R2V2T4	0.069	0.056	0.052	0.056	0.06	0.059
R2V2T5	0.063	0.052	0.051	0.052	0.108	0.053
R3V1T1	0.056	0.058	0.054	0.051	0.059	0.05
R3V1T2	0.058	0.058	0.051	0.048	0.055	0.055
R3V1T3	0.059	0.055	0.05	0.046	0.054	0.057
R3V1T4	0.059	0.059	0.051	0.045	0.056	0.054
R3V1T5	0.109	0.063	0.052	0.049	0.055	0.061
R3V2T1	0.069	0.058	0.052	0.051	0.062	0.059
R3V2T2	0.063	0.058	0.05	0.051	0.064	0.055
R3V2T3	0.062	0.053	0.055	0.049	0.06	0.057
R3V2T4	0.062	0.055	0.053	0.049	0.059	0.055
R3V2T5	0.057	0.052	0.058	0.052	0.067	0.067
Negative	0.053	0.045	0.045	0.042	0.049	0.052
Negative	0.053	0.048	0.044	0.042	0.049	0.053

Note: if the result is more than twice the average of negative, then it is considered as infected

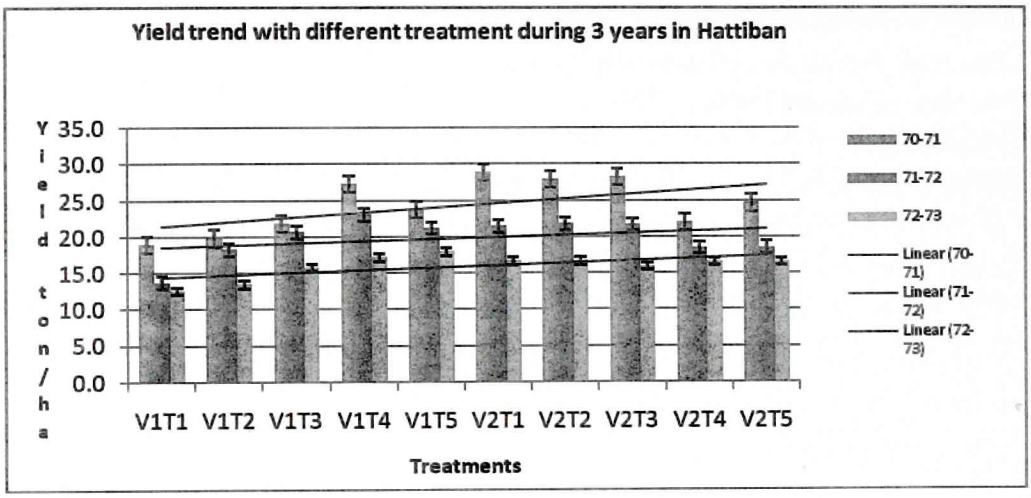


Figure 3: Yield trend with different treatment during 3 years in Hattiban

The result shows that there is in the year 2070/71, V1T1 showed the highest (27.2 ton/ha) and V2T4 the lowest (12.7 ton/ha). The result in the year 2071/72 yield was highest (29.18 ton/ha) in V2T3 and lowest in V1T1 (16.55 ton/ha) and the yield was highest and lowest 17.1 ton/ha and 4.165 ton/ha in V1T2 and V2T1 respectively.

B) Parwanipur

Field experiments were conducted in the experimental field of Regional Agriculture Research Station (RARS), Parwanipur, Bara, Nepal. The objective of study was to evaluate the rate of degeneration due to viral diseases in Cardinal and Kufri Jyoti. The experimental plot design was Randomized Complete Block Design with 3 replication and 5 treatments considering each farmer as a replication. There were 10 treatment combinations consisting 2 varieties.

Treatment combination

Treatments	Variety	Combination
Covered by insect proof net	V1: Kufri Jyoti V2: Cardinal	T1V1 T1V2
Only spraying of appropriate insecticides when aphid population reaches critical	V1: Kufri Jyoti V2: Cardinal	T2V1 T2V2
Only roughing of infected plant (negative selection)	V1: Kufri Jyoti V2: Cardinal	T3V1 T3V2
Spraying of appropriate insecticides and roughing of infected plant (2+3)	V1: Kufri Jyoti V2: Cardinal	T4V1 T4V2
Control	V1: Kufri Jyoti V2: Cardinal	T5V1 T5V5

The data were collected with following observation:

a. Emergence at 30 and 60 days after sowing
b. No. of stem per plant
c. Plant Height
d. Tuber yield per plot: For this data the total yield from a single plot was divided to three grades as under seed size; Seed size and Over seed size and the weight and number of each grade were recorded.

The samples were collected after 45 days of emergence for performing virus test and DAS-ELISA test was done.Virus incidences in the potato foliage from different treatments were detected through ELISA and presented in Table No. 3.1.2.7.

Table 3.1.2.7a Virus test of Degeneration trial of Parwanipur 2072/73 through ELISA

Sample	PVM	PVX	PLRV	PVA	PVY	PVS
R1V1T1	0.062	0.054	0.048	0.047	0.053	0.056
R1V1T2	0.05	0.046	0.049	0.042	0.055	0.055
R1V1T3	0.047	0.055	0.044	0.049	0.053	0.052
R1V1T4	0.068	0.057	0.042	0.059	0.064	0.048
R1V1T5	0.05	0.053	0.055	0.049	0.059	0.052
R1V2T1	0.057	0.046	0.041	0.048	0.049	0.053
R1V2T2	0.043	0.049	0.047	0.045	0.051	0.052
R1V2T3	0.055	0.043	0.053	0.055	0.055	0.054
R1V2T4	0.053	0.051	0.057	0.049	0.046	0.055
R1V2T5	0.045	0.055	0.053	0.053	0.059	0.048
R2V1T1	0.05	0.055	0.051	0.053	0.051	0.048
R2V1T2	0.048	0.054	0.051	0.043	0.049	0.05
R2V1T3	0.051	0.058	0.051	0.043	0.043	0.061
R2V1T4	0.05	0.051	0.047	0.043	0.049	0.049
R2V1T5	0.053	0.049	0.055	0.045	0.049	0.057
R2V2T1	0.052	0.053	0.058	0.044	0.052	0.052
R2V2T2	0.052	0.049	0.047	0.061	0.059	0.048
R2V2T3	0.056	0.052	0.053	0.051	0.053	0.054
R2V2T4	0.071	0.051	0.052	0.054	0.062	0.05
R2V2T5	0.065	0.053	0.053	0.054	0.059	0.051
R3V1T1	0.065	0.057	0.048	0.055	0.054	0.057
R3V1T2	0.056	0.058	0.052	0.045	0.052	0.053
R3V1T3	0.057	0.055	0.053	0.047	0.05	0.055
R3V1T4	0.058	0.053	0.059	0.046	0.055	0.059
R3V1T5	0.068	0.06	0.058	0.049	0.059	0.063
R3V2T1	0.051	0.055	0.058	0.055	0.06	0.059
R3V2T2	0.069	0.053	0.049	0.053	0.059	0.053
R3V2T3	0.059	0.05	0.057	0.051	0.065	0.047
R3V2T4	0.061	0.056	0.055	0.047	0.057	0.052
R3V2T5	0.058	0.052	0.053	0.057	0.069	0.059
Negative	0.043	0.047	0.042	0.045	0.043	0.048
Negative	0.041	0.043	0.043	0.041	0.041	0.042

Note: if the result is more than twice the average of negative, then it is considered as infected

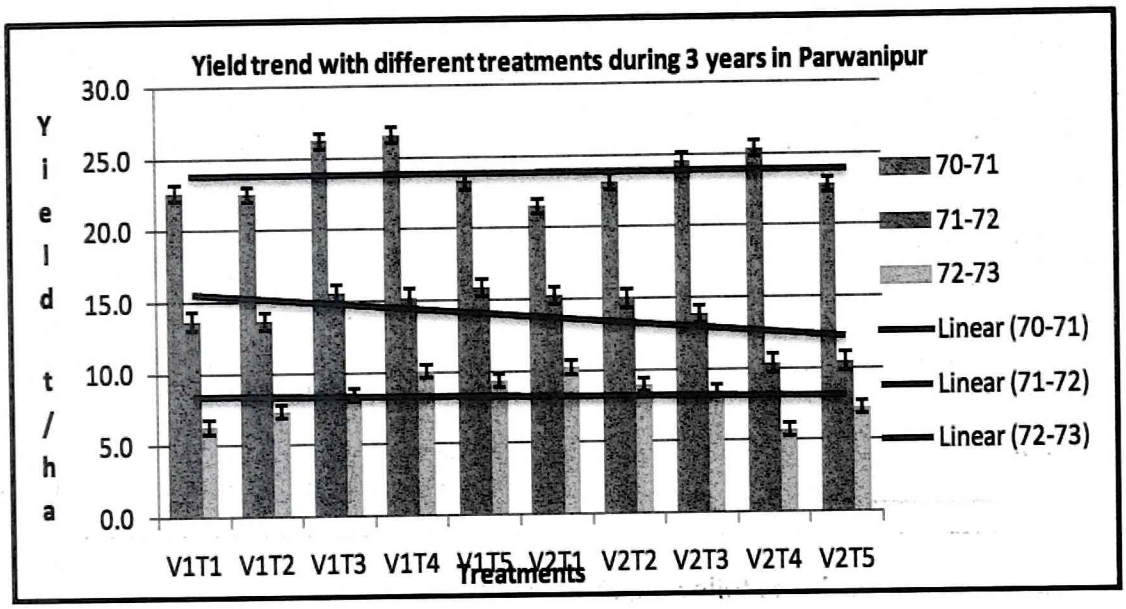


Figure 4: Yield trend with different treatment during 3 years in Parwanipur

Crop yield was higher in treated plot compared to control in both variety giving the highest yield by Kufri Jyoti 16.6 t/ha under T4 and 13.1 t/ha under T2 in 2071/72 and 2072/73 respectively. In case of Cardinal yield was higher in 20.2 under T4 and 13.1 under T2 in 2071/72 and 2072/73 respectively.

C) Nigale

Field experiments were conducted in Nigale. The objective of study was to evaluate the rate of degeneration due to viral diseases in Cardinal (V1) and Khumal seto (V2). The experimental plot design was Randomized Complete Block Design with 3 replication and 5 treatments considering each farmer as a replication. There were 10 treatment combinations consisting 2 varieties.

Treatment combination

Treatments	Variety	Combination
Covered by insect proof net	V1: Cardinal V2: Khumal Seto-1	T1V1 T1V2
Only spraying of appropriate insecticides when aphid population reaches critical	V1: Cardinal V2: Khumal Seto-1	T2V1 T2V2
Only roughing of infected plant (negative selection)	V1: Cardinal V2: Khumal Seto-1	T3V1 T3V2
Spraying of appropriate insecticides and roughing of infected plant (2+3)	V1: Cardinal V2: Khumal Seto-1	T4V1 T4V2
Control	V1: Cardinal V2: Khumal Seto-1	T5V1 T5V5

The data were collected with following observation:

a. Emergence at 30 and 60 days after sowing
b. No. of stem per plant
c. Plant Height
d. Tuber yield per plot: For this data the total yield from a single plot was divided to three grades as under seed size; Seed size and Over seed size and the weight and number of each grade were recorded.

The samples were collected after 45 days of emergence for performing virus test and DAS-ELISA test was done.Virus incidences in the potato foliage from different treatments were detected through ELISA and presented in Table No. 3.1.2.8.

Table 3.1.2.7b Virus test of Degeneration trial of Nigale 2072/73 through ELISA

Sample	PVM	PVX	PLRV	PVA	PVY	PVS
R1V1T1	0.065	0.07	0.074	0.066	0.053	0.067
R1V1T2	0.056	0.062	0.072	0.069	0.059	0.064
R1V1T3	0.057	0.066	0.050	0.054	0.047	0.072
R1V1T4	0.057	0.059	0.048	0.057	0.054	0.064
R1V1T5	0.560	0.112	0.048	0.087	0.049	0.058
R1V2T1	0.093	0.069	0.053	0.058	0.048	0.073
R1V2T2	0.094	0.074	0.050	0.055	0.046	0.088
R1V2T3	0.093	0.047	0.047	0.053	0.052	0.090
R1V2T4	0.097	0.051	0.041	0.057	0.043	0.088
R1V2T5	0.085	0.044	0.039	0.050	0.042	0.060
R2V1T1	0.134	0.042	0.042	0.061	0.050	0.070
R2V1T2	0.118	0.035	0.040	0.060	0.042	0.079
R2V1T3	0.095	0.113	0.071	0.113	0.059	0.126
R2V1T4	0.059	0.055	0.066	0.059	0.055	0.065
R2V1T5	0.053	0.063	0.070	0.054	0.050	0.082
R2V2T1	0.053	0.058	0.050	0.062	0.043	0.057
R2V2T2	0.083	0.062	0.06	0.115	0.053	0.086
R2V2T3	0.077	0.067	0.048	0.051	0.046	0.064
R2V2T4	0.067	0.049	0.044	0.051	0.041	0.070
R2V2T5	0.091	0.053	0.044	0.060	0.043	0.069
R3V1T1	0.119	0.048	0.046	0.059	0.040	0.070
R3V1T2	0.106	0.043	0.042	0.046	0.032	0.065
R3V1T3	0.123	0.039	0.040	0.051	0.036	0.080
R3V1T4	0.118	0.045	0.040	0.050	0.049	0.086
R3V1T5	0.064	0.078	0.064	0.069	0.056	0.077
R3V2T1	0.053	0.073	0.053	0.059	0.052	0.076
R3V2T2	0.056	0.053	0.056	0.056	0.047	0.075
R3V2T3	0.050	0.072	0.050	0.056	0.047	0.082
R3V2T4	0.054	0.06	0.054	0.081	0.047	0.057
R3V2T5	0.047	0.062	0.047	0.058	0.045	0.058
Negative	0.062	0.460	0.043	0.042	0.031	0.068
Negative	0.077	0.041	0.041	0.047	0.036	0.050

Note: if the result is more than twice the average of negative, then it is considered as infected

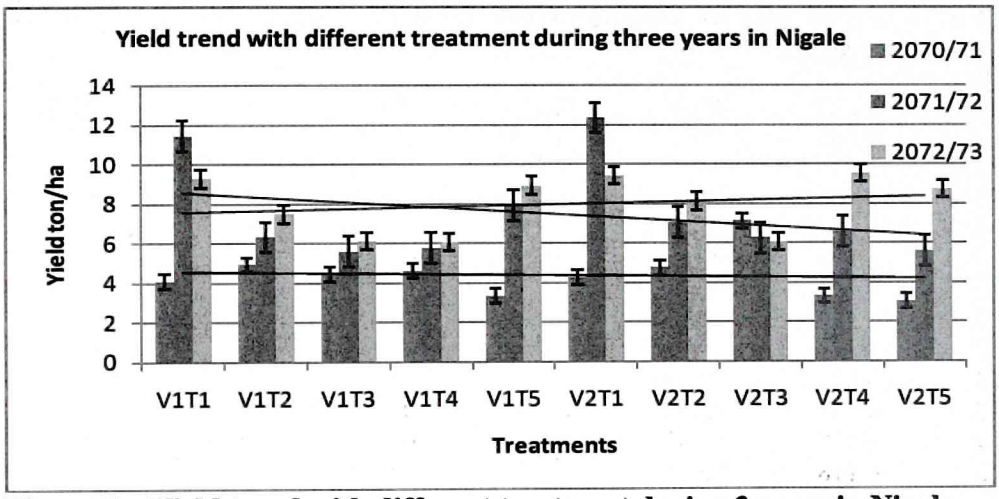


Figure 5: Yield trend with different treatment during 3 years in Nigale

The result shows that there is in the year 2070/71, V2T3 showed the highest (7.12 ton/ha) and the lowest in V1T5 (3.03 ton/ha). The result in the year 2071/72 yield was highest (12.35 ton/ha) in V2T2 and lowest in V1T3 (5.58 ton/ha). And the yield was highest and lowest 9.54 ton/ha and 6.07 ton/ha in V2T3 and V2T4 respectively.

3.1.2.3 Virus elimination of promising clones and farmers most preferred cultivars Virus elimination

During fiscal year 2072/73, virus cleaning of Jumli Local, Khumal Rato, Khumal Laxmi and Rosita was done with meristem culture and the variety 393073.179 and PRP 25861.1 was also successfully cleaned according to the target.

3.1.2.4 Survey and surveillance of virus on different seed standard at different research station and farms

Seed producer groups, farmers or stations situated under different agro-ecological zones should know how long (number of generations) can be multiplied PBS as quality source seeds for ware potato production for their respective zones/areas. Similarly, in the case of seed production at Farm/Station also should know the quality of seed stock. Such type of survey activity may help for the optimum utilization of valuable pre-basic as well as basic seeds for seed production purpose and also ensures the availability of quality seeds for ware potato producers.

Immediately after establishment of the laboratory and production of the PBS, most of the RARS and ARS had started to use the high quality seed for the production of the quality basic seed for their own seed production program and or for distribution to the respective regions. Since long, there is lack of systematic seed quality maintenance program and

supervision program. Keeping this in mind, NPRP is started to train the staffs and observed the field where basic seed is producing. During surveying period, total two research stations were visited and collected some basic information. In the first stage, mainly diseases and pests were recorded under field condition and in the second stage the collected sample seed were bought to NPRP for serological test of potato viruses. The field observation result is presented in table 3.1.2.8

Table 3.1.2.8 Virus test result of potato from RARS and ARS in 2072/73

Sample	PVM	PVX	PLRV	PVA	PVY	PVS
Cardinal PBS Khajura	0.044	0.072	0.054	0.051	0.051	0.053
Cardinal PBS Khajura	0.063	0.088	0.059	0.054	0.072	0.056
K Ujjwal PBS khajura	0.058	0.101	0.076	0.060	0.087	0.054
K Ujjwal PBS khajura	0.048	0.084	0.059	0.058	0.079	0.051
K. jyoti PBS Khjura	0.045	0.079	0.045	0.054	0.050	0.046
CIP 377957.5 BS3 Dailekh	0.059	0.080	0.069	0.067	0.072	0.061
CIP 388676.1 BS3 Dailekh	0.048	0.091	0.071	0.070	0.068	0.053
CIP 395195.7 BS3 Dailekh	0.056	0.088	0.050	0.063	0.064	0.062
Desiree BS3 Dailekh	0.046	0.068	0.033	0.053	0.050	0.047
CIP 384321.15 BS3 Dailekh	0.054	0.069	0.051	0.046	0.049	0.052
PRP 35861.18 BS3 Dailekh	0.055	0.043	0.074	0.051	0.067	0.068
K. Jyoti BS3 Dailekh	0.045	0.073	0.046	0.042	0.053	0.045
K. Jyoti PBS Kajura	0.078	0.102	0.066	0.066	0.130	0.081
K. Jyoti PBS Kajura	0.046	0.056	0.046	0.054	0.054	0.046
K. Sinduri BS1 Parwanipur	0.064	0.100	0.073	0.076	0.108	0.081
K. Upahar BS3 Parwanipur	0.053	0.092	0.073	0.065	0.081	0.063
K. Seto BS3 Parwanipur	0.068	0.090	0.069	0.071	0.105	0.083
k. Ujjwal BS3 Parwanipur	0.060	0.075	0.052	0.059	0.085	0.061
PRP 25861.1 BS3 Parwanipur	0.052	0.086	0.069	0.070	0.091	0.072
Desiree PBS Parwanipur	0.056	0.083	0.060	0.068	0.110	0.313
K. Rato PBS Parwanipur	0.072	0.079	0.039	0.068	0.115	0.070
K. Rato BS3 Parwanipur	0.051	0.085	0.073	0.066	0.128	0.070
K. Jyoti BS3 Parwanipur	0.058	0.044	0.075	0.068	0.063	0.073
IPY 8 PBS Parwanipur	0.072	0.073	0.074	0.068	0.089	0.081
Cardinal PBS Parwanipur	0.065	0.088	0.061	0.065	0.065	0.071
Car BS3 Parwanipur	0.059	0.099	0.062	0.065	0.072	0.072
K. Rato invitro	0.043	0.053	0.048	0.047	0.051	0.047
Desiree invitro	0.044	0.064	0.047	0.046	0.048	0.480
Negative	0.043	0.032	0.043	0.045	0.045	0.031
Negative	0.038	0.040	0.042	0.030	0.048	0.047

Maintaining the generation of the seed is the most important and difficult too. At present, this is lacking in most of the seed producer partners. Mainly, local cultivars were found high percentage of virus infection in most of the served locations.

3.1.3 Improving food security and nutrition of rural people in Nepal and Bhutan through collaborative potato breeding for yield stability and micronutrient density

3.1.3.1 Introduction, multiplication of potato germplasm

NPRP Khumaltar introduced 19 different CIP clones as minitubers from CIP through Indian Technitubers Company, Chandigadh, India, (Table 3.1.3.1) and were multiplied at Hattiban Farm, Khumaltar, Lalitpur in last two seasons and the harvest was stored at cold store Balaju, Kathmandu. After bulking to the required number, they were planted in Nigaley farm at the Nucleus Seed Potato Center (NSPC) as a mother trial with 3 replications and remaining tubers were kept under multiplication for further use in next season. Due to the budget constraint and unavailability of sufficient amount of seed tubers during planting season, baby trial planting was not possible. All the cultural practices were followed as per the NPRP recommendations.

Table 3.1.3.1 : Technitubers introduced from India, 2015

SN	TECH Code #	Product type	Total Quantity	Weight (kgs)	Size Grade or Range
1	TECH 7001-301024.14	G0	155	0.42	12-15mm
2	TECH 7003-302498.7	G0	1000	1.66	12-15mm
3	TECH 7004-303381.3	G0	1000	1.56	12-15mm
4	TECH 7005-304347.6	G0	500	0.91	12-15mm
5	TECH 7006-304350.1	G0	420	0.79	12-15mm
6	TECH 7007-304350.118	G0	1071	1.76	12-15mm
7	TECH 7008-304351.109	G0	351	0.68	12-15mm
8	TECH 7009-304366.46	G0	460	0.85	12-15mm
9	TECH 7010-304368.46	G0	1013	1.66	12-15mm
10	TECH 7011-304387.17	G0	3704	5.66	12-15mm
11	TECH 7012-391058.175	G0	421	0.79	12-15mm
12	TECH 7014-393371.58	G0	205	0.46	12-15mm
13	TECH 7015-396311.1	G0	198	0.45	12-15mm
14	TECH 7016-397029.21	G0	379	0.73	12-15mm

SN	TECH Code #	Product type	Total Quantity	Weight (kgs)	Size Grade or Range
15	TECH 7017-397079.6	G0	1513	2.36	12-15mm
16	TECH 7018-304394.56	G0	2686	4.16	12-15mm
17	TECH 7019-388972.22	G0	371	0.71	12-15mm
18	TECH 7020-304371.2	G0	169	0.41	12-15mm
19	TECH 7021-304405.47	G0	901	1.46	12-15mm

3.1.3.2 PVS training

Participatory Variety Selection (PVS) training on potato was conducted in 4 different exercises on July 26-27 (Table 3.1.3.2) at Nucleus Seed Potato Centre (NSPC), Nigaley Sindhupalchowk at the time of harvest. The training was intended to assess the best performing clones involving NARC researchers, extension workers and potato farmers.

The most important characteristics participants listed were tuber yield, disease resistance, marketable, taste, color and shape of the tuber. "Yield" came in first priority among both women and men and "Disease resistance" in second position. However, women ranked "Taste" in third position whereas men ranked "Marketable" as their third preference and "Color" and "Shape" were also listed as preferred criteria but less important that the previous (Table 3.1.3.2)

Table 3.1.3.2: Ranking of selection criteria gender-wise, 2016 at harvest

Selection criteria	Women		Men		Total	
	Number	%	Number	%	Number	%
Yield	26	31	41	36	67	34
Disease resistance	20	24	32	28	52	26
Taste	19	22.5	16	14	35	18
Marketable	12	14	22	19	34	17
Color	4	5	1	1	5	2.5
Shape	3	3.5	2	2	5	2.5
Total	84	100	114	100	198	100

The table (3.1.3.3) below shows the description of each clone: shape, size, skin color, flesh color and eyes. Highlighted ones are the clones that obtained the highest scores during the ranking session.

Table 3.1.3.3: Description of each clone of the trial (Nigaley, 2016)

Clones	Shape	Size	Skin color	Flesh color	Eye
Tech 7021- 304405.47	round to oval	Medium	White	yellow	Red
Tech 7006- 304350.1	oval	small to medium	light red	White	Shallow
Tech 7016- 397029.21	round	Medium	White	White	Shallow
Tech 7007-304350.118	round to oval	medium to big	Red	Yellow	medium deep
Tech 7008-304351.109	oblong	Medium	Red	White	Shallow
Tech 7015-396311.1	round to oval	medium to big	Red	Yellow	Shallow
Tech 7003-302498.7	oval	Medium	White	White	Shallow
Tech 7012-391058.175	oval	medium to large	White	Yellow	Shallow
Tech 7004-303381.3	round	Medium	Red	Yellow	Deep
Rosita (ch)	round	medium to big	Red	Yellow	medium deep
Tech 7009-304366.46	oval to oblong	Medium	Red	Yellow	Shallow
Tech 7005-304347.6	round	Medium	Red	Yellow	Deep
Tech 7019-388972.22	round	Medium	White	White	Shallow
Tech 7010-304368.46	oval	Medium	White	Yellow	Red
Tech 7014-393371.58	oval	Medium	White	White	Red
Tech 7017-397079.6	oval	Medium	White	White	Shallow
Tech 7020-304371.2	oblong	small to medium	White	White	Shallow
Tech 7018-304394.56	oblong	Medium	White	White	Shallow
Tech 7011-304387.17	oblong	Small	White	Yellow	Shallow

To evaluate and select Technituber materials received from CIP India, a mother trial with 3 replications and 16 tubers per clone was undertaken at Nigaley, Sindhupalchok. The planting was done on 20th February 2016 and harvest on 26th July 2016.The very popular variety in the locality named "Rosita" was used as the check. The clones with highest emergence percentage were Tech 7005-304347.6, Tech 7007-304350.118, Tech 7008-304351.109 and Tech 7009-304366.46 while the clone Tech 7016-397029.21 (88.3%) had the highest ground coverage. The most uniform plants were observed in clone Tech 7021-304405.47 (5). The clone Tech 7016-397029.21 had the most vigorous (4) plants with vigor scale in range of 1-5.

The most tolerant clone to hailstone was found to be the variety Rosita (10%) and the clone Tech 7011-304387.17 was found to be most susceptible one (73.3%). The clones Tech 7020-304371.2 and Tech 7015-396311.1 were highly affected by late blight disease (90%) and the clone Tech 7012-391058.175 comparatively less (45%). The plants of Rosita (62 cm) were comparatively taller and the highest main stem bearing clone was Tech 7009-304366.46 (3) in the trial (Table 3.1.3.4). The result obtained from the trial are as following:

Table 3.1.3.4: Vegetative characteristics of the clones tested at NSPF, Nigaley, 2016

Clones	Emergence at 45DAP (#)	Ground cover (%)	Uniformity	Plant vigour (1-5)	Hailstone damage (%)	LB (%)	Plant height (cm)	No of stems/plant
Tech 7003-302498.7	31	65	3	3	25	86.7	37.8	2
Tech 7004-303381.3	31	63	3	3	25	73.3	43.1	2
Tech 7005-304347.6	32	68	3	3	17	78.3	42.1	1
Tech 7007-304350.118	32	50	3	2	52	81.7	32.6	1
Tech 7006-304350.1	30	42	3	2	60	86.7	31.4	1
Tech 7008-304351.109	32	52	2	2	63	83.3	41.1	2
Tech 7009-304366.46	32	75	3	3	18	86.7	49.5	3
Tech 7010-304368.46	31	77	4	4	18	76.7	41.9	3
Tech 7020-304371.2	29	40	3	2	58	90.0	30.3	2
Tech 7011-304387.17	30	37	2	2	73	78.3	23.7	2
Tech 7018-304394.56	30	42	2	2	68	83.3	27.8	1
Tech 7021-304405.47	32	78	5	4	17	83.3	57.2	3
Tech 7019-388972.22	32	67	3	3	32	88.3	36.1	2
Tech 7012-391058.175	32	72	3	3	48	45.0	45.4	2
Tech 7014-393371.58	31	70	3	3	30	60.0	44.6	2
Tech 7015-396311.1	31	48	3	2	48	90.0	28.6	2
Tech 7016-397029.21	31	88	4	4	13	86.7	55.7	3
Tech 7017-397079.6	30	72	4	4	12	88.3	55.1	2
Rosita	31	82	4.3	4	10	78.3	62.0	2
Mean	30.98	62.4	3.21	2.9	36.2	80.26	41.4	2.1
F-Test	**	**	**	**	**	**	**	**
LSD (0.05)	1.92	17.76	0.87	0.66	37.65	14.44	11.4	0.98

Regarding tuber yield and its attributes, the highest number of tubers per hectare was counted in the clones Tech 7010-304368.46 (540972) followed by Tech 7016-397029.21(509722) (Table 3.1.3.5). The clone Tech 7016-397029.21 was found highest yielder (22.94 t/ha) among all the tested clones compared. The most marketable tuber yielding clone was Tech 7016-397029.21 (178) followed by Tech 7010-304368.46 (148), whereas the highest non-marketable tubers were counted in the clone Tech 7011-304387.17 (118). The highest yield per plot was obtained from Tech 7016-397029.21 (11.03 kg) which corresponds to 22.94 mt/ha yield and the least yield per plot was obtained from the clone Tech 7018-304394.56 (3.17 kg) which corresponds to 6.66 mt/ha only.

Table 3.1.3.5: Yield and gender wise ranking of each clone (Nigaley, 2016)

Clone	Marketable tubers/ plot	Non-marketable tubers/ plot	Total tubers /ha	Total tubers' weight t/ha	Women votes	Men votes	Total votes
Tech 7003-302498.7	100	48	307638	14.95	7	1	8
Tech 7004-303381.3	10	81	380555	12.47	14	3	17
Tech 7005-304347.6	72	44	242361	15.88	55	68	123- I
Tech 7007-304350.118	46	19	136111	8.52	16	15	31
Tech 7006-304350.1	56	36	193055	7.83	0	0	0
Tech 7008-304351.109	108	47	323611	12.85	15	19	34
Tech 7009-304366.46	86	77	340277	10.87	4	0	4
Tech 7010-304368.46	148	111	540972	18.07	27	16	43
Tech 7020-304371.2	50	67	244444	6.77	1	0	1
Tech 7011-304387.17	81	118	413888	7.75	0	1	1
Tech 7018-304394.56	61	56	243055	6.60	0	1	1
Tech 7021-304405.47	87	49	284027	14.02	10	6	16
Tech 7019-388972.22	10	65	352083	11.52	16	5	21
Tech 7012-391058.175	53	33	179166	12.89	0	0	0
Tech 7014-393371.58	86	34	249305	15.43	21	12	23
Tech 7015-396311.1	58	29	183333	8.79	19	24	43
Tech 7016-397029.21	178	66	509722	22.94	33	35	68-III
Tech 7017-397079.6	83	24	222916	10.19	1	2	3
Rosita (ch)	84	69	318750	14.60	55	20	75-II
Mean	86	56.	298172	12.26			
F-Test	**	**	**	**			
LSD (0.05)	36.36	38.54	117706.8	4.57			

In gender wise ranking of the clones, women and men participants' first preference was on the clone Tech 7005-304347.6 scoring 55 and 68 (Table 3), whereas second priority of women was to the variety Rosita and men's to Tech 7016-397029.21 indicating that the choices relied on particular clone. Overall ranking was also highest on clone Tech 7005-304347.6 scoring 123 followed by Rosita (75) and Tech 7016-397029.21 (68), respectively. Interestingly, the preferences of female participants differed from preferences of male participants in attributes of variety Rosita.

Promising clones are maintained and multiplied at field level (Nigaley farm) to secure the stock for on-station and on-farm trials to be conducted by NPRP. This stock is used for the trial sets for high hill stations such as Jumla, Nigaley and their command areas. The stock of reporting period is in Table 3.1.3.4.6.

Table 3.1.3.6: Seed stock of Technitubers at Khumaltar and Nigale, 2016

	Khumaltar	Nigaley	
Potato clones	**Weight of tubers (Kg) at Cold store (spring 2016 harvest)**	**No. of Tubers**	**Weight of tubers (Kg)**
Tech 7003-302498.7	13	240	11.30
Tech 7004-303381.3	11	242	8.52
Tech 7005-304347.6	11	245	11.10
Tech 7007-304350.118	10	110	6.64
Tech 7006-304350.1	6	152	4.90
Tech 7008-304351.109	19	260	8.36
Tech 7009-304366.46	8	255	9.60
Tech 7010-304368.46	16	370	13.48
Tech 7020-304371.2	13	205	6.18
Tech 7011-304387.17	14	255	5.80
Tech 7018-304394.56	13	250	7.35
Tech 7021-304405.47	11	215	14.6
Tech 7019-388972.22	12	215	10.00
Tech 7012-391058.175	3	170	10.54
Tech 7014-393371.58	4	205	12.34
Tech 7015-396311.1	7	152	8.40
Tech 7016-397029.21	11	344	20.2
Tech 7017-397079.6	9	170	10.00
Total	**191**	**4055**	**179.31**

Sensory evaluation was organized at Nigale farm on 27th of July in 2016 to determine the end-user's preferences on organoleptic attributes of potatoes (Table 3.1.3.7, Table 3.1.3.8. and Table 3.1.3.9). Thirty six participants representing from farmers, extension workers and researchers took participation in this evaluation. Among the participants, the number of male and female was almost equal. Eighteen technotuber clones were compared for their organoleptic attributes to the local popular variety Rosita. About 1 kg of representative tubers of each clone was boiled, served on a plate, cut into small pieces and given a number to hide its original name. Thereafter, evaluation forms were distributed to each participant for independent evaluation. They were expected to evaluate the clones based on four criteria: appearance, taste, texture and overall impression. The results showed that men and women preferred the clone Tech 7020-

304371.2 for its attractiveness and the clone Tech 7017-397079.6 for its waxy texture while their preferrence for taste differed slightly as men mostly preferred Tech 7009-304366.46 while most women preferred Tech 7021-304405.47 . The overall ranking of men and women was silimilar that they selected 304405.47 as the excellent clone.

After analysis of aggregated preference of men and women, it was found that the clone Tech 7020-304371.2 was the most attractive followed by Tech 7021-304405.47 and Tech 7005-304347.6 respectively, whereas in the texture clone Tech 7017-397079.6 was found the most waxy. For the taste, clone Tech 7021-304405.47 was excellent, clone Tech 7017-397079.6 was moderate and Tech 7016-397029.21 was poor. Overall rating of clone Tech 7021-304405.47 was the highest, Tech 7017-397079.6 was moderate and Tech 7016-397029.21 was poor in participatory varietal selection by the participants.

A strong correlation was observed between taste and overall evaluation of the potato clones. This means that most of the participants prioritized taste for the selection of clones.

Table 3.1.3.7 Ranking of clones by men during organoleptic test (Attr. = Attractive, Mod. = Moderate, Excel. = Excellent)

Clone	Appearance			Texture			Taste			Overall			
	Attr.	Mod.	Poor	Waxy	Floury	Soggy	Excel	Mod.	Poor	Bitter	Excel	Mod.	Poor
Tech 7019-388972.22	3	10-IV	5	11-II	4	3	4	9-V	4-V	1-III	2	10-V	6-V
Tech 7005-304347.6	14-II*	3	1	11-II	5	2	5-V	8	4-V	1-III	6-III	10-V	2
Tech 7010-304368.46	4	12-II	2	5	6-V	7-II	2	9-V	7-II	0	1	10-V	7-IV
Tech 7018-304394.56	5-V	8	5	8-V	4	6-III	2	7	7-II	2-II	1	8	9-II
Tech 7004-303381.3	5-V	8	5	8-V	4	6-III	2	7	7-II	2-II	1	8	9-II
Tech 7014-393371.58	1	10-IV	7-IV	10-III	6-V	2	1	11-III	6-III	0	0	14-I	4
Tech 7017-397079.6	2	13-I	3	12-I	2	4-V	1	14-I	2	1-III	1	14-I	3
Tech 7020-304371.2	15-I	3	0	9-IV	3	6-III	2	11-III	4	1-III	3-V	12-III	3
Tech 7011-304387.17	1	11-III	6-V	9-IV	6-V	3	3	8	5-IV	2-II	3-V	8	7-IV
Tech 7003-302498.7	3	3	12-I	10-III	6-V	2	3	10-IV	5-IV	0	2	10	6-V
Tech 7008-304351.109	8-IV	9-V	1	7	7-IV	4-V	2	11-III	5-IV	0	1	13-II	4
Tech 7021-304405.47	14-II	3	1	7	7-IV	4-V	11-II	6	0	1-III	10-I	7	1
Tech 7016-397029.21	8-IV	8	2	3	15-I	0	0	5	9-I	4-I	0	5	13-I
Tech 7007-304350.118	3	7	8-III	5	3	10-I	1	9-V	7-II	1-III	0	9	9-II
Tech 7006-304350.1	9-III	9-V	0	8-V	7-IV	3	8-III	6	4-V	0	8-II	9	1
Tech 7012-391058.175	4	11-III	3	5	13-II	0	8-III	9-V	0	1-III	6-III	11-IV	1
Tech 7015-396311.1	4	11-III	3	7	9-III	2	4	12-II	1	1-III	4-IV	13-II	1
Tech 7009-304366.46	4	10-IV	4	10-III	6-V	2	12-I	3	3	0	8-II	8	2
Rosita	2	6	10-II	7	6-V	5-IV	6-IV	11-III	1	0	3-V	12-III	3

**The Romanized numbers behind the number of votes indicate the final rank of the clones after totaling the results*

Table 3.1.3.8 Ranking of potato clones by women during the organoleptic test (Attr. = Attractive, Mod. = Moderate, Excel. = Excellent)

Clone	Appearance			Texture			Taste				Overall		
	Attr.	Mod.	Poor	Waxy	Floury	Soggy	Excel	Mod.	Poor	Bitter	Excel	Mod.	Poor
Tech 7019-388972.22	5	25-I	6	18-V	12	6	7	16	11-III	2-III	5	22	9
Tech 7005-304347.6	25-III	9	2	20-III	7	9	9	14	11-III	2-III	7	22	7
Tech 7010-304368.46	9	21-IV	6	7	12	17-II	6	19-IV	11-III	0	3	24-IV	9
Tech 7018-304394.56	7	17	12-V	18-V	7	11-V	9	13	12-II	2-III	6	19	11-IV
Tech 7004-303381.3	7	17	12-V	18-V	7	11-V	9	13	12-II	2-III	6	19	11-IV
Tech 7014-393371.58	5	22-III	9	17	12	7	6	22-II	8-V	0	3	28-II	5
Tech 7017-397079.6	7	25-I	4	23-I	4	9	3	26-I	6	1-IV	2	29-I	5
Tech 7020-304371.2	30-I	5	1	17	4	15-III	9	19-III	7	1-IV	10-V	20	6
Tech 7011-304387.17	4	18	14-III	20-III	8	8	7	15	12-II	2-III	6	20	10-V
Tech 7003-302498.7	7	8	21-I	19-IV	11	6	5	20	11-III	0	4	20	12-III
Tech 7008-304351.109	11-V	18	7	13	11	12-IV	2	21-III	12-II	1-IV	1	25-III	10-V
Tech 7021-304405.47	27-II	8	1	18-V	10	8	24-I	11	0	1-IV	23-I	12	1
Tech 7016-397029.21	11-V	18	7	9	25-II	2	1	15	15-I	5-I	1	12	23-I
Tech 7007-304350.118	3	14	19-II	11	7	18-I	2	15	15-I	4-II	0	14	22-II
Tech 7006-304350.1	19-IV	15	2	13	15-IV	8	11-V	16	9-IV	0	10	21	5
Tech 7012-391058.175	10	23-II	3	9	27-I	0	18-III	16	1	1-IV	13-III	20	3
Tech 7015-396311.1	10	20-V	6	16	14-V	6	13-IV	19-IV	3	1-IV	12-IV	22-V	2
Tech 7009-304366.46	11-V	18	7	22-II	8	6	23-II	9	4	0	18-II	15	3
Rosita	6	17	13-IV	13	17-III	6	18-III	17-V	1	0	9	24-IV	3

**The Romanized numbers behind the number of votes indicate the final rank of the clones after totaling the results*

Table 3.1.3.9 Ranking of potato clones by total participants during the organoleptic test (Nigaley, 2016)

	Appearance			Texture			Taste				Overall		
Clones	**Attr.**	**Mod.**	**Poor**	**Waxy**	**Floury**	**Soggy**	**Excel**	**Mod.**	**Poor**	**Bitter**	**Excel**	**Mod.**	**Poor**
Tech 7019-388972.22	5	25-I	6	18	12	6	7	16	11-III	2	5	22	9
Tech 7005-304347.6	25-III	9	2	20-III	7	9	9	14	11-III	2	7	22	7
Tech 7010-304368.46	9	21	6	7	12	17-II	6	19	11-III	0	3	24-III	9
Tech 7018-304394.56	7	17	12	18	7	11	9	13	12-II	2	6	19	11
Tech 7004-303381.3	7	17	12	18	7	11	9	13	12-II	2	6	19	11
Tech 7014-393371.58	5	22-III	9	17	12	7	6	22-II	8	0	3	28	5
Tech 7017-397079.6	7	25-I	4	23-I	4	9	3	26-I	6	1	2	29-I	5
Tech 7020-304371.2	30-I	5	1	17	4	15-III	9	19	7	1	10	20	6
Tech 7011-304387.17	4	18	14-III	20-III	8	8	7	15	12-II	2	6	20	10
Tech 7003-302498.7	7	8	21-I	19	11	6	5	20	11-III	0	4	20	12-III
Tech 7008-304351.109	11	18	7	13	11	12	2	21-III	12-II	1	1	25-II	10
Tech 7021-304405.47	27-II	8	1	18	10	8	24-I	11	0	1	23-I	12	1
Tech 7016-397029.21	11	18	7	9	25-II	2	1	15	15-I	5-I	1	12	23-I
Tech 7007-304350.118	3	14	19-II	11	7	18-I	2	15	15-I	4-II	0	14	22-II
Tech 7006-304350.1	19	15	2	13	15	8	11	16	9	0	10	21	5
Tech 7012-391058.175	10	23-II	3	9	27-I	0	18-III	16	1	1	13-III	20	3
Tech 7015-396311.1	10	20	6	16	14	6	13	19	3	1	12	22	2
Tech 7009-304366.46	11	18	7	22-II	8	6	23-II	9	4	0	18-II	15	3
Rosita	6	17	13	13	17-III	6	18-III	17	1	0	9	24-III	3

**The Romanized numbers behind the number of votes indicate the final rank of the clones after totaling the resul*

Other comments

Some of the clones of the trial were promising for their field and organoleptic observations done by the participants. Based on their overall performance, the seeds of clones Tech 7016-397029.21, Tech 7010-304368.46, Tech 7005-304347.6, Tech 7014-393371.58, Tech 7003-302498.7, Tech 7021-304405.47, Tech 7009-304366.46, Tech 7015-396311.1, Tech 7017-397079.6, Tech 7014-393371.58 and Tech 7005-304347.6 are recommended to multiply further and plan for next year's mother and baby trials in the project sites.

3.2 Sweet Potato

3.2.1 Sweet potato Variety Improvement

Under sweet potato variety improvement program, NPRP is trying to follow similar varietal evaluation scheme as followed in potato varietal improvement scheme. Collected germplasm were multiplied under *in vitro* and/or screen house conditions, followed by preliminary evaluation in observation trials under field conditions at Khumaltar and/or appropriate locations. The best performing materials are further tested as Initial Evaluation Trial (IET), and later as Coordinated Varietal Trial (CVT) in different collaborative farms and stations. Promising lines from CVT are further promoted to Coordinated Farmers' Field Trial (CFFT) carried out at out-reach research sites of different stations and further one time under farmers' acceptance test (FAT) and the most performing clone are recommended for commercial cultivation in respective locations.

3.2.1.1 Germplasm collection, maintenance and evaluation

Germplasm collection, maintenance and evaluation are major research activities of NPRP. International Potato Centre (CIP), Lima, Peru is one of the major germplasm sources. Till 2011/12, 21 exotic clones received from CIP and six local collections were been maintained under field conditions. In 2012/13, one exotic genotype, Kentucky Red, and other 15 local genotypes had been collected from different parts of the country, as either stem cuttings or roots (Table 3.2.1.1). Out of them, three genotypes (Kentucky Red, Panchkhal Red and Shantipur Red) did not emerge, and cuttings of Tarkutar White and Chipleti White did not survive. Till 2012/13, 21 exotic clones received from CIP and 22 local collections were been maintained under field conditions (Table 7.1). During 2013/14, additional 44 sweet potato genotypes had been collected from different parts of the country (Table 7.1). Out of them Fistar White and Bhantabari Red did not emerge. During 2014/15, 8 sweet potato genotypes had been collected from different part of country. And altogether 77 different sweet potato genotypes have been planted under

field conditions in NPRP, Khumaltar in 2015/16. Collection and maintenance of local as well as exotic germplasm of sweet potato will be continued over times in the programme.

In addition, 20 different sweet potato genotypes had been maintained under field conditions in HRS, Dailekh and Malepatan, Pokhara.

Table 3.2.1.1: List of *in vivo* sweet potato germplasm maintained in NPRP, 2015/16

CIP Number	Code	Variety	Origin	Received Date	Source
400039	CIP-10-01	10-C-1	DOM	Feb. 6, 2010	CIP, Peru
400917	CIP-10-02	Comal	ECU	Feb. 6, 2010	CIP, Peru
440001	CIP-10-03	Resisto	USA	Feb. 6, 2010	CIP, Peru
440007	CIP-10-04	W-208	USA	Feb. 6, 2010	CIP, Peru
440008	CIP-10-05	W-213	USA	Feb. 6, 2010	CIP, Peru
440012	CIP-10-06	W-217	USA	Feb. 6, 2010	CIP, Peru
440014	CIP-10-07	W-219	USA	Feb. 6, 2010	CIP, Peru
440015	CIP-10-08	W-220	USA	Feb. 6, 2010	CIP, Peru
440020	CIP-10-09	W-225	USA	Feb. 6, 2010	CIP, Peru
440021	CIP-10-10	W-226	USA	Feb. 6, 2010	CIP, Peru
440047	CIP-10-11	Bugsbunny	PRI	Feb. 6, 2010	CIP, Peru
440099	CIP-10-12	TIS 9101	NGA	Feb. 6, 2010	CIP, Peru
440112	CIP-10-13	Centennial	USA	Feb. 6, 2010	CIP, Peru
440135	CIP-10-14	Travis	USA	Feb. 6, 2010	CIP, Peru
440185	CIP-10-15	L 0-323	USA	Feb. 6, 2010	CIP, Peru
440267	CIP-10-16	Hung Loc 4	VNM	Feb. 6, 2010	CIP, Peru
440287	CIP-10-17	VSP 3	PHL	Feb. 6, 2010	CIP, Peru
440328	CIP-10-18	AVRDC-CN 1840-284	TWN	Feb. 6, 2010	CIP, Peru
440513	CIP-10-19	Koganesengan	JPN	Feb. 6, 2010	CIP, Peru
441538	CIP-10-20	Tenian	USA	Feb. 6, 2010	CIP, Peru
441624	CIP-10-21	L 4-13	USA	Feb. 6, 2010	CIP, Peru
Japanese Red	HRD-10-01	-	JPN	2010	HRD, Nepal
Dhankuta Red-1	KCU-10-01	-	Dhankuta	2010	Farmer
Dhankuta Red-2	KCU-10-02	-	Dhankuta	2010	Farmer
Sunsari Red-1	KCU-10-03	-	Sunsari	2010	Farmer
Helen	BMS-12-01	-	-	June 2012	Helen Keller
Bengali Red	KCU-12-01	-	India	June 2012	Market
Sangachowk White	KCU-12-02	-	Sindhupalchowk	Nov. 22, 2012	Market
Lamatar White	TPG-12-01	-	Lalitpur	Nov. 22, 2012	Farmer
Batakeshwor White	DC-12-01	-	Dhanusa	Dec. 13, 2012	Farmer
Barhathwa White	KCU-12-03	-	Sarlahi	Dec. 14, 2012	Farmer
Hansposa White	KCU-13-01	-	Sunsari	Jan. 19, 2013	Farmer
Haibung White	BMS-13-01	-	Sindhupalchowk	Mar. 18, 2013	Farmer
Haibung Red	BMS-13-02	-	Sindhupalc	M ar. 18, 2013	Farmer

			howk		
Fendikuna White	BMS-13-03	-	Lamjung	Jul. 5, 2013	Farmer
Paundi White	BMS-13-05	-	Lamjung	Jul. 5, 2013	Farmer
Majhigaun White	BMS-13-06	-	Lamjung	Jul. 5, 2013	Farmer
Bensisahar Red	BMS-13-07	-	Lamjung	Jul. 5, 2013	DADO
Parewatar White	BT-13-02	-	Dhading	Jul. 23, 2013	Farmer
Kalidaha White	BT-13-03	-	Dhading	Jul. 23, 2013	Farmer
Salang White	BT-13-04	-	Dhading	Jul. 23, 2013	Farmer
	BMS-13-10	-	Japan		Food Re.
Japanese Purple				Aug. 21, 2013	Div

CIP Number	Code	Origin	Received Date	Source
Bhantabari Red	BMS-13-11	Sunsari	Aug. 24, 2013	Famer
Bhantabari White	BMS-13-12	Sunsari	Aug. 24, 2013	Famer
Tareni White	BMS-13-13	Rupandehi	Sep. 11, 2013	Famer
Balewa White	BMS-13-14	Baglung	Nov. 22, 2013	Famer
Balewa Red	BMS-13-15	Baglung	Nov. 22, 2013	Famer
Chyanglitar White	BMS-13-16	Gorkha	Nov. 25, 2013	Famer
Chyanglitar Red	BMS-13-17	Gorkha	Nov. 25, 2013	Famer
Jorsal White	YKS-13-01	Panchthar	Dec. 9, 2013	Famer
Pallotar Red	YKS-13-02	Panchthat	Dec. 9, 2013	Famer
Limba White	YKS-13-03	Panchthat	Dec. 9, 2013	Famer
Chomagu White	YKS-13-04	Panchthar	Dec. 9, 2013	Famer
Mangalbare Red	YKS-13-05	Ilam	Dec. 11, 2013	Famer
Barbote Red	YKS-13-06	Ilam	Dec. 11, 2013	Famer
Bodhe White	YKS-13-07	Ilam	Dec. 11, 2013	Famer
Dhukurpani White	YKS-13-08	Jhapa	Dec. 12, 2013	Famer
Tarabari White	YKS-13-09	Jhapa	Dec. 12, 2013	Famer
Bhangbari White	YKS-13-10	Jhapa	Dec. 12, 2013	Famer
Fadani White	YKS-13-11	Morang	Dec. 13, 2013	Famer
Lamatar Red	YKS-13-12	Morang	Dec. 13, 2013	Famer
Kheruwa White	YKS-13-13	Morang	Dec. 13, 2013	Famer
Bensisahar White	BMS-13-09	Lamjung	Jul. 15, 2014	Famer
Hybrid White	BMS-14-01	Kapilvastu	Jan. 11, 2014	Famer
Motipur White	BMS-14-02	Kapilvastu	Jan. 11, 2014	Famer
Motipur Red	BMS-14-03	Kapilvastu	Jan. 11, 2014	Famer
Gajrahiya Orange	BMS-14-04	Kapilvastu	Jan. 11, 2014	Famer
Thutobari White	BMS-14-05	Nawalparasi	Jan. 13, 2014	Market
Tribeni White	BMS-14-06	Nawalparasi	Jan. 13, 2014	Market
Tribeni Red	BMS-14-07	Nawalparasi	Jan. 13, 2014	Market
Bijuwar White	BMS-14-08	Pyuthan	Mar. 3, 2014	Famer
Dhanwang Red	KCU-14-01	Salyan	Dec. 8, 2014	Farmer
Kavra White	KCU-14-02	Salyan	Dec. 8, 2014	Farmer
Syuja White	KCU-14-03	Dang	Dec. 8, 2014	Farmer
Kimchaur White	KCU-14-04	Salyan	Dec. 8, 2014	Farmer
Satbariya Red	PB-15-01	Dang	Jan. 3, 2015	Farmer
Satbariya White	PB-15-02	Dang	Jan. 3, 2015	Farmer

3.2.1.2 Initial evaluation trial (IET)

Introduction

IET is the initial testing of new clones for yield potentiality, adoptability in different agro-climatic zones and major diseases and pest response. During the year 2072/73, one set of IET materials was planted at RARS, Tarahara, Sunsari and one set at NSRP, Jitpur, Bara as the representative sites of terai.

Materials and Methods

Total of 23 genotypes of sweet potatoes collected from different part of country and selected from initial evaluation trial were assessed for their vegetative and yield characteristics. Trials were laid out in RCBD with two replications. The 3.6 m^2 sized plots were fertilized @ 30:30:50 kg NPK together with 20 tons of compost per hectare as basal dose. Planting was done at 60 x 30 cm row to row and plant to plant spacing.

Results and Discussion

At NSRP, Jitpur, 14 genotypes of sweet potato showed extremely spreading type of plant vine while remaining eight genotypes have spreading nature (Table 3.2.1.2). Semi-compact nature of plant vine was found only in genotype Japanese Purple. Regarding the roots yield, Benshisahar White produced the highest yield (34.6 t/ha) followed by Thutabari White (20.7 t/ha). The top five promising lines were Benshisahar White, Thutabari White, Parewatar White, Sangachok Red, Salang White and Motipur White with the average yield ranging from 10.9 to 34.6 t/ha. At RARS, Tarahara, one set of IET was planted but satisfactory data not received.

Based on the performance of the tested clones on IET, elite clones will be selected for coordinated varietal trials (CVTs) to be conducted next year.

Table 3.2.1.2: Plant and yield characteristics of sweet potato clones under Initial Evaluation Trial (IET) at NSRP, Jitpur, Bara, 2015/16

Clones	Plant type	Roots/plot (No)	Wt. of roots/plot (kg)	Yield (t/ha)
Barbote White	Ex. spreading	42.5	3.0	8.3
Benshisahar White	Ex. spreading	71.0	12.45	34.6
Parewatar White	Spreading	44.5	5.11	14.2
Kalidah White	Ext. spreading	42.0	2.83	7.9
Salang White	Ext. spreading	62.5	3.92	10.9
Thutabari White	Ext. spreading	43.5	7.45	20.7
Phadani White	Spreading	47.5	3.01	8.4
Motipur White	Spreading	43.5	3.93	10.9
Kheruwa White	Spreading	34.0	1.89	5.3
Bhangbari White	Ext. spreading	34.0	1.82	5.1
Lamatar Red	Ext. spreading	31.5	1.56	4.3
Motipur Red	Spreading	18.5	0.83	2.3
Bhantabari White	Ext. spreading	43.5	3.70	10.3
Limba White	Ext. spreading	45.5	2.45	6.8
Fedikunwa Red	Ext. spreading	52.5	3.30	9.2
Sangachok Red	Spreading	41.5	5.06	14.1
Chyanglitar White	Ext. spreading	55.5	3.55	9.9
Mangalbare Red	Ext. spreading	31.5	0.95	2.7
Haibung red	Ext. spreading	33.0	1.27	3.5
Barhathawa White	Ext. spreading	34.5	1.73	4.8
Japanese Purple	Semi compact	10.0	1.13	3.1
Bengali Red	Spreading	15.0	1.65	4.6
Japanese Red	Spreading	25.0	2.44	6.8
Grand Mean		39.2	3.26	9.1
F value		0.121	0.112	0.112
LSD(0.05)		32.60	5.742	15.95
CV%		40.1	84.9	84.9

3.2.1.3 Coordinated farmers field trials (CFFTs)

Introduction

This is the on -farm evaluation of the promising clones in on station trials where clones selected from CVTs were tested in different outreach sites of respective research stations. In CFFTs, researchers, farmers and extension workers are involved to test and select the desired variety.

Materials and Methods

Five outstanding orange-fleshed sweet potato genotypes, namely CIP 440267, CIP 440328, CIP 440021, CIP 440012 and CIP 440015, had been identified from two years CVT evaluation. These five genotypes were planted in the farmers' fields of Shantijhoda, Itahari-2 Sunsari, Chyanglitar-3 of Gorkha and Kusadevi-3 of Kabhrepalanchok districts. Japanese Red variety and local genotype of sweet potato was used as the standard and farmer's check respectively. Three farmers namely Mr. Krishna Regmi, Mr. Khagendra Bhujel and Mr. Khagendra Parajuli in Sunsari, Mr. Buddhi Bahadur Pariyar, Mr. Gyanendra Kumal, and Mr. Arjun Kumar Shrestha in Gorkha and Mr. Sasi Adhikary, Mr. Rajendra Thapa and Mr. Dipendra Thapa in Kabhrepalanchok were selected for experiment. Based on the on-station performance, selected genotypes tested in farmer's field condition. Trials were laid out in RCBD with three replications. The 3.6 m^2 sized plots were fertilized @ 30:30:50 kg NPK together with 20 tons of compost per hectare as basal dose. Two-to-three nodal stem cuttings were planted at 60 x 30 cm row to row and plant to plant spacing. Plant characteristics and yield and yield attributing parameters were recorded during study.

Results and Discussion

At the outreach research site of RARS Tarahara, Sunsari the ground cover was recorded the highest (88.33%) in local genotype and lowest (78.33%) in CIP 440012 and CIP 440328. CIP 440015 yielded the highest (7.45 t/ha) followed by CIP 440021 (7.13 t/ha) (Table 3.2.1.3). Other promising clone was CIP 440267 (6.16 t/ha).Root yield (t/ha) among the tested clones were not significant different. Roots of Japanese Red and local genotype were damaged low by rats.

At the outreach site (Gorkha) of RARS, Lumle, CIP 440328 produced the highest yield (13.98 t/ha) followed by CIP 440015 (13.96 t/ha) and CIP 440012 (11.62 t/ha) (Table 3.2.1.4).CIP 440328 and CIP 440015 both were statistically at par. Roots of clones CIP 440021, CIP 440012 and Japanese Red were damaged low to moderately by rats.

At Kusadevi VDC of Kabhrepalanchok district, CIP 440267 produced the highest yield (17.13 t/ha) followed by CIP 440328 (15.08 t/ha) and Japanese Red (14.59 t/ha) (Table 3.2.1.5). Other promising clone was CIP 440015 (13.56 t/ha). Roots of clone CIP 440012 were damaged low by rats.

Table 3.2.1.3: Plant characteristics and yield of sweet potato clones under coordinated farmers field trial (CFFT) at RARS, Tarahara Sunsari, 2015/16

Clones	Ground cover (%)	Tuber (roots) /plot (No)	Plant Type	Yield (t/ha)	Pest damage*
CIP 440015	83.33	90.0	Semi-erect	7.45	0
CIP 440021	80.00	104.0	semi -compact	7.13	0
CIP 440012	78.33	72.0	semi -compact	5.42	0
CIP 440267	81.67	85.7	Spreading	6.16	0
CIP 440328	78.33	38.3	Spreading	3.93	0
Japanese Red	80.00	33.3	Spreading	4.26	3
Farmer's check	88.33	54.0	Spreading	4.31	1
F- test	*	*		Ns	
LSD(0.05)	5.930	46.95		3.129	
CV%	4.1	38.7		31.8	

*:0=No damage, 3=low damage, 5=moderately damage, 7= highly damage, 9=totallydamage

Table 3.2.1.4: Plant characteristics and yield of sweet potato clones under coordinated farmers field trial (CFFT) at Chyanglitar Gorkha, 2015/16

Clones	Ground cover (%)	Tuber (roots) /plot (No)	Plant Type	Yield (t/ha)	Pest damage*
CIP 440015	86.7	85.3	Semi-erect	13.96	0
CIP 440021	80.0	73.7	semi –compact	7.96	1
CIP 440012	88.3	50.3	semi –compact	11.62	1
CIP 440328	85.0	81.0	Spreading	13.98	0
CIP 440267	93.3	53.3	Spreading	8.24	0
Japanese Red	73.3	53.7	Spreading	10.93	3
Farmer's check	66.7	40.3	Spreading	3.93	1
F- test	**	**		**	
LSD(0.05)	11.09	22.38		4.830	
CV%	7.6	20.1		26.9	

*:0=No damage, 3=low damage, 5=moderately damage, 7= highly damage, 9=totally damage

Table 3.2.1.5: Plant characteristics and yield of sweet potato clones under coordinated farmers field trial (CFFT) at Kusadevi, Kabhrepalanchok, 2015/16

Clones	Ground cover (%)	Tuber (roots) /plot (No)	Plant Type	Yield (t/ha)	Pest damage*
CIP 440015	78.3	82.0	Semi-erect	13.56	0
CIP 440021	46.7	50.7	semi -compact	5.61	0
CIP 440012	51.7	59.3	semi -compact	8.56	1
CIP 440328	63.3	96.3	Spreading	15.08	0
CIP 440267	73.3	104.0	Spreading	17.13	0
Japanese Red	83.3	84.3	Spreading	14.59	0
Farmer's check	100.0	45.0	Spreading	4.07	0
F- test	**	**		**	
LSD(0.05)	19.64	30.65		7.088	
CV%	15.6	23.1		35.5	

*:0=No damage, 3=low damage, 5=moderately damage, 7= highly damage, 9=totally damage

4. Source seed potato production

4.1 In vitro maintenance of recommended and released potato varieties and Production of 40 thousand in vitro plantlets

Activities under tissue culture laboratory

Since the establishment of tissue culture laboratory and glasshouse facility in 1989, National Potato Research Program has been producing disease-free pre-basic seed potatoes each year during autumn and spring seasons. For pre-basic seed potato production, disease-free *in vitro* plantlets are produced in the tissue culture laboratory and transplanted under aphid-proof glasshouse and screen house under sterile conditions. Following activities were carried out during 2015/16 (2072/73).

Germplasm maintenance

A total of 58 potato germplasm has been maintained in this year 2015/16 and maintained under i*n vitro* condition in the laboratory (Annex 4.1). Out of them 11 cultivars had been used for PBS production purpose.

Rapid propagation

Virus-free mother plantlets are propagated by subcultures using single nodal cutting technique and grown in a growth chamber under 2000 Lux light intensity, 25±2°C temperatures and 16 hr photoperiod. Depending on the cultivar, fully grown plantlets is obtained after three to six weeks of culture. Five to ten single nodal segments are harvested from each plantlet in the laminar flow cabinet under sterile condition. This process is continued until sufficient plantlets are produced for transplanting in the glasshouse and screen house. A total of 30,400 *in vitro* plantlets of 15 cultivars were produced in autumn season (August, 2015) and total 28,985*in vitro* plantlets of 17 cultivars were produced in spring season (Jan., 2015) (Table 4.1).

Table 4.1 *In vitro* plantlets produced under laboratory condition for plantation in the glass/screen houses, 2015/16(2072/73)

Varieties	Spring Season	Autumn Season
Cardinal	3800	3800
Desiree	3800	3800
Janak Dev	2900	2900
K. Jyoti	3800	3800
K.Seto	2100	2100
K. Upahar	1900	1900
K. Ujjwal	3200	3200
IPY 8	3800	3800
K. Rato	400	400
K. Laxmi	400	400
K. Sindhuri	400	400
MS 42-3	400	400
TPS 7	400	400
TPS 67	400	400
MF II	400	400
Rosita	400	400
Jumli Local	400	400
PRP 25861.1	1100	-
CIP .179	1100	-
CIP.32	1100	-
	32200	28900

4.2 Production of 200 thousands PBS under glass/screen house conditions

4.2.1 Glasshouse activities for pre-basic seed (PBS) production

Soil mix preparation

About one month before the initiation of transplanting in each season, the sand soil mixture of each bench in the glasshouse and screen house were mixed thoroughly and drenched uniformly with water until the benches were well drained. The soil surface was then gently raked and partitions of one meter were marked along the benches.

Soil sterilization

Formaldehyde solution (1%) was drenched thoroughly over the partitioned area to treat the sand soil mixture thoroughly. Immediately after the chemical application, each bench

was covered with polythene sheets. Polythene sheets were removed after one week and the sand soil mixture was turned over several times with the help of clean spades to get rid of the volatile chemical residues, which otherwise are phyto-toxic to *in vitro* plantlets.

Transplanting

In August 2016, a total of 30,400 plantlets of 18 cultivars were transplanted in the glasshouse/screenhouse for autumn season for pre-basic seed production. Similarly, 2,27169 plantlets of 17 cultivars were transplanted in the glasshouse/screenhouse for spring season pre-basic seed production. The total 59,385 in vitro plantlets were produced during the F.Y. 2015/16 (2072/73) (Table 4.1).

Pre-basic seed (PBS) production

PBSs were produced during two seasons, the first one during autumn 2014 and the second one during spring 2015. During autumn 2014, total of 1,56,688 PBS comprising seventeen cultivars were produced in glass/screenhouse. The cultivars were Cardinal, Desiree, Janak Dev, Khumal Seto-1, Kufri Jyoti, Kufri Sindhuri, Khumal Laxmi, Khumal Rato-2, IPY-8, Khumal Ujawal, MS 42.3, TPS-7, TPS-67, Rosita, MF-II, Jumli Local and Khumal Upahar. In spring 2015, total 2,95,426 pre-basic seed potatoes comprising 17 cultivars were produced in glass/screen house. So, altogether 4,52,114 pre-basic seed potatoes were produced during 2014/15 (2071/72) (Table 4.2).

Table 4.2 PBS production in the glasshouse/screenhouse during 2014/15 (2071/72)

Cultivars	Autumn 2015	Spring 2016	Total
Cardinal	23384	20265	43649
Desiree	18964	16635	35599
IPY-8	4479	18305	22784
Janakdev	21018	20162	41180
Jumlilocal	1314	463	1777
Khumal Laxmi	116	-	116
Khumal Seto-1	10043	13815	23858
Kufri Jyoti	5364	12212	17576
Kufri Sindhuri	2457	1765	4222
Khumal Ujawal	4520	18200	22720
Khumal Upahar	427	-	427
MF-II	379	225	604
MS 42.3	1122	6773	7895
Rosita	346	920	1266
TPS-7	614	1642	22569
TPS-67	244	860	1104
Khumal Rato-2	-	136	136

4.2.2 Cold storage

PBSs were graded into five categories, viz. <0.25 g, <0.5 g, 0.5-1.0 g, 1.0-5.0 g, and >5.0 g size. After grading, the PBS were packed in nylon net bags with proper labeling and then stored in Kohinoor Cold store, Balaju. PBS harvested in winter has to be stored for about nine months, whereas those harvested in summer have to be stored for about five months. These pre-basic seeds are distributed to the seed growers and other agencies during the succeeding fiscal year 2015/16 (2072/73). About more than 59 per cent of the PBS potatoes produced in autumn 2014 were larger than one gram sized. In case of spring 2015 production, only about 18.6 per cent tubers were larger or more than one gram sized (Tables 4.3 and 4.4). The total production of 227,169 pre-basic seed potatoes this year (Table 4.5).

Table 4.3: Pre-basic seed produced during autumn (August - November), 2015/16 (2072/73) 1st lot) (To be distributed during terai season, 2016/17 (2073/74)

Varieties	> 5 gm	1 - <5 gm	0.5 - < 1 gm	0.25 - <0.5 gm	< 0.25 gm	Total No.
Cardinal	3752	9260	6566	2588	1218	23384
Desiree	2132	5539	6330	2123	2840	18964
IPY-8	923	1666	1130	485	275	4479
Janakdev	2150	7212	7850	2463	1343	21018
Jumlilocal	114	535	420	140	105	1314
Khumal Laxmi	40	53	0	23	0	116
Khumal Seto-1	353	2500	4010	1430	1750	10043
Kufri Jyoti	1607	1857	1235	450	215	5364
Kufri Sindhuri	200	1000	1000	137	120	2457
Khumal Ujawal	165	1400	2130	450	375	4520
Khumal Upahar	80	160	67	80	40	427
MF-II	116	113	70	60	20	379
MS 42.3	37	225	385	250	225	1122
Rosita	61	105	109	48	23	346
TPS-7	152	220	152	70	20	614
TPS-67	10	55	84	60	35	244
Total	11,892	31,900	31,538	10,857	8,604	94,791
%	12.55	33.65	33.27	11.45	9.08	100.00

Table 4.4: Pre-basic seed produced during spring (January–May), 2015/16 (2072/73), 2nd lot (To be distributed during hill season)

Varieties	> 5 gm	1 - <5 gm	0.5 - < 1 gm	0.25 - <0.5 gm	< 0.25 gm	Total No.
Cardinal	1080	5275	7300	4295	2315	20265
Desiree	0	835	7240	4080	4480	16635
IPY-8	295	3930	8940	2860	2280	18305
Janakdev	0	1213	7534	5715	5700	20162
Jumlilocal	0	43	130	145	145	463
Khumal Rato-2	0	0	21	40	75	136
Khumal Seto-1	0	570	4980	3765	4500	13815
Kufri Jyoti	180	1017	4960	2910	3145	12212
Kufri Sindhuri	0	65	225	475	1000	1765
Khumal Ujawal	0	570	7730	4000	5900	18200
MF-II	0	0	35	50	140	225
MS 42.3	30	533	3210	1800	1200	6773
Rosita	0	165	500	135	120	920
TPS-7	0	89	458	315	780	1642
TPS-67	0	105	215	140	400	860
Total	1,585	14,410	53,478	30,725	32,180	132,378
%	1.20	10.89	40.40	23.21	24.31	100.00

Table 4.5: Total pre-basic seed production during 2015/16(2072/73)

Varieties	> 5 gm	1 - <5 gm	0.5 - < 1 gm	0.25 - <0.5 gm	< 0.25 gm	Total No.
Cardinal	4832	14535	13866	6883	3533	43649
Desiree	2132	6374	13570	6203	7320	35599
IPY-8	1218	5596	10070	3345	2555	22784
Janakdev	2150	8425	15384	8178	7043	41180
Jumlilocal	114	578	550	285	250	1777
Khumal Laxmi	40	53	0	23	0	116
Khumal Rato-2	0	0	21	40	75	136
Khumal Seto-1	353	3070	8990	5195	6250	23858
Kufri Jyoti	1787	2874	6195	3360	3360	17576
Kufri Sindhuri	200	1065	1225	612	1120	4222
Khumal Ujawal	165	1970	9860	4450	6275	22720

Source seed potato production

Khumal Upahar	80	160	67	80	40	427
MF-II	116	113	105	110	160	604
MS 42.3	67	758	3595	2050	1425	7895
Rosita	61	270	609	183	143	1266
TPS-7	152	309	610	385	800	2256
TPS-67	10	160	299	200	435	1104
Total	13477	46,310	85,016	41,582	40,784	227,169
%	5.93	20.39	37.42	18.30	17.95	100.00

4.3 Production of 3000 kg basic seed of different varieties at Hattiban farm using PBS

Total 3,393 kg basic seeds of different varieties have been produced at Hattiban Farm for further seed multiplication for the next year plantation (Table 4.6).

Table 4.6: Basic seed produced at Hattiban Farm during F.Y. 2015/16 (2072/73)

Variety	BS 1		BS2		BS3		Total		Total (Kg)
White	bag	kg	bag	kg	bag	kg	Bag	kg	
K.Jyoti	-		8	-	9	-	17	-	850
Khumal Seto-1		26	7	-	2	40	9	66	516
NPI-106	-	-	-	-	3	-	3	-	150
Khumal Ujawal	-	65	10	-	3	-	13	65	715
Khumal Upahar	-	20	1	40	1	-	2	60	160
Red									
Cardinal	-	9	-	-	3	-	3	9	159
Janakdev	-	10	1	-	5	-	6	10	310
IPY 8	-	20	2	-	-	-	2	20	120
Khumal Rato-2		13	2	32	-	-	2	45	145
Desiree		3	6	-	7	-	13	3	253
Kufrisinduri	-	10	-	5	-	-	-	15	15
Total	**-**	**176**	**37**	**77**	**33**	**40**	**70**	**293**	**3393**

Note: 1 bag = 50 kg

4.4 Pricing and distribution of PBS

The per unit price of the pre-basic seed potatoes fixed for the fiscal year 2015/16 was Rs. 13.00 for larger than five gram sized minituber, Rs. 11.00 for 1-5 g sized, Rs. 9.00 for 0.5-1 g sized, Rs. 1.50 for 0.25 -0.50 g and Rs. 0.75 for smaller than 0.25 g sized mini tubers (same as last year) (Table 4.7).

Source seed potato production

During 2015/16 all PBS produced in 2013/14 were distributed to seed potato growers through District Agriculture Development Offices, Horticulture Farms/Agriculture Research Stations, NGOs and others agencies throughout the country in coordination with the National Potato Development Program (Department of Agriculture), Khumaltar.

Table 4.7: Pre-basic seed potato pricing of the last few years

PBS Grade (size)	Per unit PBS price (Rs.)						
	1996/97 (2053/54)	1997/98 (2054/55)	2010/11 (2067/68)	2011/12 (2069/70)	2012/13 (2069/70)	2014/15 (2071/72)	2015/16 (2072/73)
>5 g	-	-	5.50	6.00	10.0	10.0	13.00
>1 g	1.00	1.00	5.00	5.50	8.00	8.00	11.00
0.5-1 g	0.25	0.50	2.50	3.00	6.00	6.00	9.00
0.25-0.5 g	0.00	0.00	0.7	0.75	2.00	2.00	1.50
<0.25 g	-	-	0.25	0.25	1.00	1.00	0.75

4.5 Production of 1000 kg foundation seed (FS) of rice variety(s) at Hattiban farm using breeder's seed (2)

To improve the soil health of the Hattiban Farm, rice cultivation with flooding was practiced in rotation. This year, 3205 kg of rice foundation seed was produced, from Khumal-4

5. RESPONSE OF POTATO GENOTYPES TO DIFFERENT MOISTURE CONDITION AND MULCHES TO COPE THE EFFECT OF CLIMATE CHANGE IN MID HILL CONDITION KHUMALTAR

The experiment was conducted at Hattiban Research Farm (1340 masl). Six potato clones were tested in the experiments were Cardinal, Desiree, Kufri Jyoti, Khumal Seto-1, Janakdev and Khumal Upahar. Three management/ moisture condition namely; irrigated, rain-fed and black plastic mulch were used in this study. The uniform tuber size ranged from 25-50 g were used and the trial was planted on 25th January 2016, in split- plot design with three replications where management conditions were placed in main plot and variety treatments placed at sub-plot treatments. The spacing was maintained at 60 x 25 cm with three rows per treatment, and plot size was 4.5 m^2. Well sprouted tubers were chosen and 30 tubers, 10 tubers per row were planted at each treatment, and all other cultural practices were followed as per the recommendations of NPRP.

The plant characters ground cover, plant height, tuber yield, tuber size distribution (undersize, seed size, and oversize, wt.). The data were analyzed using GENSTAT package and main factor, sub-plot factor and interaction mean are presented in the results.

The management effect on potato varieties on plant height, total yield and tuber size distribution are given in Table 5.1. The varieties had significant effect on ground cover (%), plant height (cm) and yield .The management condition had significant effect on plant height and yield (t/ha). But the interaction effect of management condition and varieties on plant height was significant while on ground cover and yield(t/ha) was non-significant

Table 5.1 Effect of moisture condition and mulch on growth and yield of potato genotypes, 2072/73

Source of variation	Ground cover (%)	Plant height (cm)	Total yield (t/ha)	Tuber size distribution (wt. kg /plot)		
				< 25g	25-50g	>50g
Management (M)						
Irrigated condition	74.44	48.78	28.28	1.272	7.82	3.64
Rain-fed condition	72.50	41.88	26.04	1.094	7.13	3.49
Drought(Plastic mulch)	81.39	64.87	35.36	0.778	7.72	7.41
F-value	0.025	<.001	<.001	0.019	0.327	0.001
$LSD_{0.05}$	5.614	4.095	1.081	0.278	1.198	1.196

			Varieties (V)			
Cardinal	48.89	33.69	18.40	1.211	5.60	1.47
Desiree	67.78	42.48	30.54	1.078	8.91	3.76
Kufri Jyoti	83.89	43.40	34.67	0.011	6.86	7.73
Khumal Seto-1	72.22	50.64	31.73	1.400	9.91	2.97
Janakdev	90.00	76.60	23.95	0.800	6.84	3.13
Khumal Upahar	93.89	64.24	40.08	0.789	7.21	10.03
F-value	<.001	<.001	<.001	<.001	<.001	<.001
LSD $_{0.05}$	5.946	3.555	3.075	0.285	1.005	0.953
			Interaction			
M	*	***	***	*	NS	**
V	***	***	***	***	***	***
M X V	NS	*	NS	NS	**	NS

NS=not significantly different,* significant at <0.05, ** highly significant at <0.01 and *** highly significant at <0.001 levels respectively.

Table 5.2: Interaction effect of management condition and varieties on yield and dry matter of potato, 2072/73

Management condition	Varieties	Yield (t/ha)	Dry Matter (%)
Irrigated condition	Cardinal	16.30	22.81
	Desiree	29.92	21.18
	Kufri Jyoti	33.18	22.16
	Khumal Seto-1	29.56	23.30
	Janakdev	22.00	20.54
	Khumal Upahar	38.74	22.59
Rain-fed condition	Cardinal	14.44	25.35
	Desiree	25.85	22.66
	Kufri Jyoti	32.66	23.45
	Khumal Seto-1	24.96	21.01
	Janakdev	23.41	24.71
	Khumal Upahar	34.89	23.56
Drought (Black plastic mulch)	Cardinal	24.45	20.75
	Desiree	35.85	20.25
	Kufri Jyoti	38.15	19.29
	Khumal Seto-1	40.67	21.27
	Janakdev	26.44	22.34
	Khumal Upahar	46.59	23.18
	Grand Mean	**29.89**	**22.47**

The interaction mean of management condition and varieties on tuber yield and dry matter are given in Table 5.2. The use of black plastic mulch gave the highest yield (46.59 t/ha) in Khumal Upahar followed by Khumal seto-1 (40.67 t/ha). But in Cardinal, lowest yield (24.45 t/ha) was recorded with this management condition. Khumal Upahar and Kufri jyoti varieties were found better under rain-fed condition in Khumaltar conditions. Likewise Khumal Upahar (38.74 t/ha) and Kufri jyoti (33.18 t/ha) produced highest tuber yield in irrigated conditions. Variety cardinal gave the lowest yield in all three management condition. The maximum dry matter content 23.30 % in Khumal seto-1 in case of irrigated condition while 25.35% was observed in cultivar Cardinal under rainfed condition. Late cultivar Khumal Upahar gave the highest dry matter content under provision of black plastic mulch.

6. TECHNOLOGY TRANSFER AND SERVICES

6.1 Training/Workshops

The workshop on "Strengthening Impact assessment in the CGIAR(SIAC) Experts elicitation workshop on Tracking Potato and Sweet potato improved cultivars adoption in Nepal" was organized by International Potato centre(CIP) Lima, Peru and National Potato Research Programme(NPRP) at Khumaltar, Lalitpur on March 17 and 18 2016.
The inception workshop was also held on "Biodiverse and nutritious potato improvement across Peru, Nepal and Bhutan" from 2072-12-30 to 2073-01-01 at Hotel Himalaya Kupandol.

6.2 Services

Giving training to technical officers from RARS, ARS and ADOs.

6.3 Publications

Overall 5 publications, viz. 3 booklets, 1 folder and one book was published by NPRP this year (Annex 5.1)

6.4 Information through media

Short interview was given by concerned scientists on potato production constraints and research outputs for solution, late blight management options for controlling disease, and potato production through hydroponic technique. (Annex 5.2)

6.5 Visits

Several potato farmers, researchers, extensionists and students visited NPRP laboratory and fields in this year. Their major interest was seen on value addition, disease management, tissue culture technology and variety improvement. CTEVT's JTA trainers also visited NPRP and acquainted with potato cultivation. (Annex 5.3)

6.6 Awards (received by staff/office)

Best employee award received by Mr. Tej Prasad Ghimire for his hard work and dedication to research on pre basic seeds of potato on the occasion of 25th NARC day, 2073.

7. BUDGET AND EXPENDITURE

The approved regular annual budget for the F.Y. 2015/16 was NRs. 2,17,74,000.00 out of which NRs. 1,78,05,942.09 was released with overall expenditure of NRs. 1,78,05,942.09(Annex 7.1).

During this year, a sum of NRs. 807154.61 was collected as revenue through source seed potato, research potato, rice seed and others (Annex 7.2).

8. KEY PROBLEMS

8.1 Problems Encountered.

- Lack of supporting scientists to carry potato breeding activities and conduct diseases related research activities
- Insufficient mid-level technical manpower to carry out potato/sweet potato research
- Unavailability of quality water at laboratory and glass house
- Load shedding for longer period 80 hr/week
- Lack of irrigation facilities at Hattiban Research Farm
- No cold storage facilities for storing high quality seed

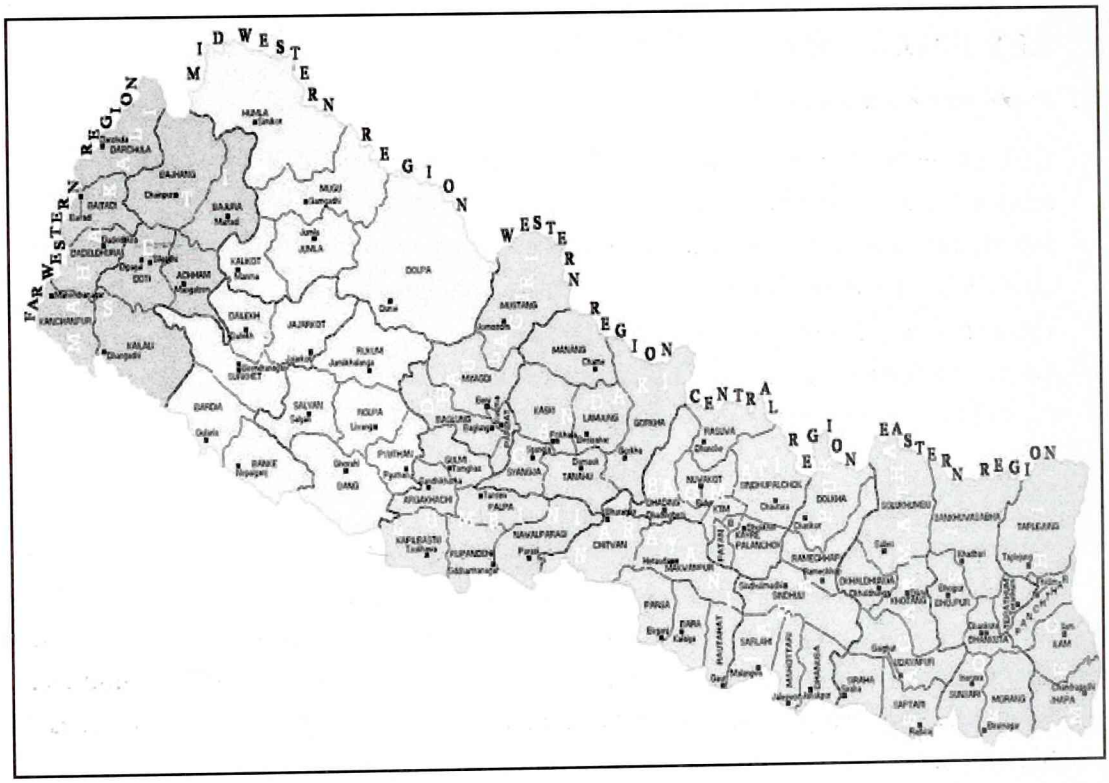
9. WAY FORWARD

- Variety development (high yielding and tolerant to major biotic and abiotic stresses)
- Development of varieties for processing and value addition
- Utilization of biotechnological methods for crop improvement e.g. molecular characterization, DNA finger printing, soma clonal variation, haploid breeding etc.
- High yielding, early maturing, disease resistant and drought tolerant varieties for high hills,
- High quality nutritious varieties for mid and high hill areas
- Development of late blights resistant varieties as well as management technologies for late blight (disease forecasting etc.) black scurf, powdery scab and wart.
- Red ant management for rain fed hill conditions
- Mechanization for planting, spraying, earthing up, harvesting and grading
- Appropriate storage for seed and processing potato using cold and rustic storage
- Studies on adoption of released varieties and recommended technologies

Annexes

Annex 1.1

Map of command area



Note: The darker area in the map is the command area of NPRP

Annex 1.2 Area, Production and Productivity of Potato in Nepal, 2014/15 (E. = Eastern, C. = central, W. = western, M.W. = Mid-western, F.W.= Far western)

District/Region	Area (ha)	Production (tons)	Productivity (kg/ha)
E. Mountain	15075	211544	14033
E. Hills	27265	330116	12108
E. Terai	30833	403650	13091
E. Region	73173	945310	12919
C. Mountain	10600	136888	12914
C. Hills	31641	475110	15016
C. Terai	19798	282287	14258
C. Region	62039	894285	14415
W. Mountain	932	11125	11937
W. Hills	14571	162440	11148
W. Terai	7615	88995	11687
W. Region	23118	262560	11357
M.W. Mountain	5984	59678.3	9973
M.W. Hills	8832	110892	12556
M.W. Terai	9295	124328	13376
MW. Region	24111	294898	12231
F.W. Mountain	2359	26717	11326
F.W. Hills	4517	64132	14198
F.W. Terai	7720	98385	12744
FW. Region	14596	189234	12965
NEPAL	197037	2586287	13126

Annex 2.1

List of Laboratory Facilities

Laboratory	Major instruments	Manpower in laboratory	Facilities
Tissue culture	Autoclave Laminar bench ELISA reader Hot air oven Water bath Distillation units Air conditioners	S-4 = 1, S-3=1 T6 = 1 T-3 = 2 Labors on daily wage basis = 2	Major six potato viruses (PVA, PVM, PVS, PVX, PVY and PLRV) testing Potato viruses elimination Potato germplasm conservation *In vitro* potato plants production
Potato Pathology	BOD Incubator Seed germinator Laminar flow Oven Refrigerator Autoclave Micro digital balance Microscope Stereo microscope	S-4 = 1 T-6 = 1 Labor on daily wages = 1	Pathogen conservation Pathogen storage Pathogen inoculation Disease culture Microscopic observations
Post Harvest	Digital balance Frying pan Chip cuter machine	S-4 = 1 T-3 = 1	Dry matter and specific gravity determination, of potato Chip making
Potato breeding/Plant Physiology	Refrigerator Microscope Specific gravity measuring instrument	S-4 = 1 S-3 = 1 T-6 = 1 T-5=2 T-3 = 1	Specific gravity Microscopic observations

Annex 2.2

Human Resource in 2072/73 (2015/16)

S. N	Name	Design-ation	Qualification	Specialization/ Working area	Remarks
1	Dr. Bhim B. Khatri	S-4	Ph. D. (Hort.)	Varietal evaluation/Potato physiology	Coordinator
2	Dr. Binod P. Luintel	S-3	Ph. D. (Hort.)	Varietal evaluation/Potato breeding	On study leave
3	Mr. Prakash Bhattarai	S-3	M.Sc.Ag. (Hort.)	PBS & Sweet potato	On deputation from RARS Tarahara
4	Dr. Kalika Pd. Upadhyay	S-3	Ph.D (Hort.)	Varietal improvement on potato	
5	Mr. Sanjiv Gautam	S-1	M.Sc.Ag.(Hort.)	Processing of potato	
6	Mr. Birendra B. Rana	T-6	B. Sc. Ag	Pathology	On study leave
7	Mr. Duryodhan Chaudhary	T-6	I.Sc.Ag.	Varietal development of potato	On study leave
8	Mrs. Shantwana Ghimire	T-6	M.Sc (BEM)	Tissue culture/PBS	
9	Mr. Prakash Shrestha	A-6	B.Com.	Finance	
10	Mrs. Anjali Bajracharya	A-6	B.Com.	Administration	On deputation from RARS, Tarahara
13	Mr. Mukunda Bhattarai	T-6			On study leave
14	Ms.Suprabha Pandey	T-6	BSc Ag	Potato	On deputation from RARS Tarahara
15	Mr. Ratna Prasad Upreti	T-5	S.L.C	Glasshouse	
16	Mrs. Bhawani Thapaliya	TH-3	I.A.	Tissue culture lab.	
17	Mr. Tej Prasad Ghimire	TH-3	S.L.C.	Glasshouse	
18	Mrs. Sharada Thapamagar	TH-3	7 Class	Tissue culture lab.	
19	Mr. Shiva Bdr. Sapkota	AH-3	Literate	Administration	
20	Mr. Bidur Pokharel	AH-3	Literate	Glasshouse	
21	Mr. Ramesh C. Khatiwada	TH-3	7 Class	Cold store	
22	Mr. Rameshwor Karki	TH-		Hattiban Farm	
23	Mr.Sarad Kumar Thapa			Administration	

Annex 3.1

Summary Progress of NPRP Research Projects and Activities in 2072/73 (2015/16)

Name of project/Activities	Project/Activity Leader	End Year	Budget allowed in "000	Major Progress/Achievements
Source seed production of potato and rice at glasshouse and Hattiban	Dr.B.B Khatri		2285	
In vitro maintenance of recommended and released potato varieties(3)		Core		Germplasm are maintained and continue multiplication under in vitro condition
Production of 30 thousand *in vitro* plantlets (3)		Core		Mother plants are maintained and plantlets are multiplied for second season plantation of 2072/73
Production of 175 thousands PBS under glass/screen house conditions (3)		Core		Second season harvesting is done with 132,378 PBS
Production of 2.5 ton basic seed of different varieties at Hattiban farm using breeders seed (3)		Core		Harvesting is completed
Production of 1 ton foundation seed (FS) of rice variety (s) at Hattiban Fram using breeders seed.				Harvesting completed
Develop low cost PBS production technologies under in vitro and glass house condition	Mrs. Santwona Ghimire		855	
Long term preservation of potato germplasms under in vitro conditions (3)		2016		Data recording and observation is complete

Annexes

Name of project/Activities	Project/Activity Leader	End Year	Budget allowed in "000	Major Progress/Achievements
Somatic hybridizatipon of potato protoplast as a tool for new variety development				Could not ne carried out due to unavailability of chemicak in time in the local market
Degeneration studies of PBS under different agro-ecological zones at field conditions				Data recording and harvesting of trial is completed in Parwanipur and khumaltar. Trial of nigale farm is yet to be harvested
Survey and surveillance of virus on different seed standard at different research station and farms				
Virus cleaning of promising clones and farmers most preferred cultivars				Successfully cleaned the virus of in vitro plantlets of potato vars. CIP 393073.179, 395112.32 and PRP 25861.1
Development of sustainable and efficient PBS strategies for commercial and prebasic seed potato production	Mr. Prakash Bhattarai		300	
Response of different moisture condition and mulches on potato production to cope the effect of climate change				Harvesting work is completed

Annexes

Name of project/Activities	Project/Activity Leader	End Year	Budget allowed in "000	Major Progress/Achievements
Use of diferent planting materials for efficient PBS production under glasshouse/screen house condition				Data compilation is ongoing
Integrated nutrinet management practices to increase productivity of PBS under glasshouse condition				Harvesting work is completed
Sweet potato variety development for food and nutrition security	Mr. Prakash Bhattarai		385	
Collection, conservation and multiplication of sweet potato genotypes from different parts of country and abroad				Planted roots of local and OSP genotypes of sweet potato are under growing stage at GH Khumaltar. Twenty genotypes have been planted at HRS Pokhara and Dailekh for next year experiment
Preliminary evaluation of sweet potato landraces				Planted tubers/roots are under growing stage
Initial evaluation trial (IET)				Harvesting of IET is completed and data compilation /analysis is running
Participatory sweet potato varietal screening (CFFT)				Harvesting of FFT Trial is completed and data compilation / analysis is runnung
Variety development on potato	Dr. Kalika Prasad		1105	

Annexes

Name of project/Activities	Project/Activity Leader	End Year	Budget allowed in "000	Major Progress/Achievements
	Upadhyay			
Introduction, collection, characterization, maintenance and multiplication of potato clones				In vitro plantlets transplanted at main office screen house are being observed. Some of the plantlets are performing well.
Potato breedeing at NPRP Hattiban Farm, Khumaltar				In crossing block of screen house at main office, initiation of flowering has been observed. So continuous light has been provided.
Germplasm screening against late blight and wart at hills of Nepal				Late blight screening trial is ongoing at nigale.
Initial evaluation trial (IET)				IET set of Khumaltar is harvested
Coordinated Varietal Trial (CVT)				CVT set of Khumaltar has been harvested
Coordinated Farmers Field Trial (CFFT)				The data entry and analysis is in progress of CFFT set of stations.
Evaluation of potato clones for abiotic stress tolerance (heat, drought and frost etc)				The trial set of Hattiban has been harvested.

Annex 4.1 List of potato germplasms maintained at NPRP, Tissue Culture Laboratory during F.Y. 2015/16(2072/73)

S.N.	CIP #	Origin	Clones	Received Date	Source
1	800258	India	Kufri Jyoti		CIP, Peru
2	-	-	Cardinal	Nov. 26, 2004	SASA, UK
3	800048	-	Desiree	Oct. 27, 2004	CIP, Peru
4	720123	-	Janak Dev	Feb. 12,1998	CIP, Peru
5	800265	India	Kufri Sindhuri	Mar. 28, 1990	CIP, Peru
6	388572.4	-	IPY-8	-	Cleaned in NPRP
7	388572.1	-	Khumal Laxmi	-	Cleaned in NPRP
8	676008	-	Khumal Rato-2	Feb.12,1998	CIP, Peru
9	720088	-	Khumal Seto-1	Feb.12,1998	CIP, Peru
10	-	-	L-235.4	-	CIP, Peru

Annex 4.2 List of potato germplasm maintained at NPRP's Tissue Culture Laboratory during 2015/16(2072/73)

CIP #	Breeder code	Pedigree		Received Date	Source	Source
		Female	Male			
306514.64	MN-10.64	303887.17(1)	303887.17(1)	13-Aug-14	In-vitro	CIP, Peru
306087.132	MN-132	303887.6(1)	303828.20(1)	13-Aug-14	In-vitro	CIP, Peru
306087.56	MN-14.56	303887.6(1)	303828.20(1)	13-Aug-14	In-vitro	CIP, Peru
306087.72	MN-14.72	303887.6(1)	303828.20(1)	13-Aug-14	In-vitro	CIP, Peru
306418.1	MN-15.1	303887.6(1)	303888.4(1)	13-Aug-14	In-vitro	CIP, Peru
306018.4	MN-16.4	303887.6(1)	303803.16(1)	13-Aug-14	In-vitro	CIP, Peru
306018.66	MN-16.66	303887.6(1)	303803.16(1)	13-Aug-14	In-vitro	CIP, Peru
306154.126	MN-17.126	303826.2(1)	303835.19(1)	13-Aug-14	In-vitro	CIP, Peru
306143.65	MN-13.65	303887.6(1)	303835.11(1)	13-Aug-14	In-vitro	CIP, Peru
306418.53	MN-15.53	303887.6(1)	303835.19(1)	13-Aug-14	In-vitro	CIP, Peru
306416.68	MN-3.68	303887.10(1)	303888.4(1)	13-Aug-14	In-vitro	CIP, Peru
306513.57	MN-9.57	303887.17(1)	303835.11(1)	13-Aug-14	In-vitro	CIP, Peru
306143.62				14-Aug-14	In-vitro	CIP, Peru
304394.56		Shepody	391207=(LR93.050)	15-Aug-14	In-vitro	CIP, Peru
381381.9	Rukinzo	378493.915	PRECOZ BULK			
395017.242		393085.13	392639.8			

703312			
703825			
396012.266		391004.1	393280.58
392025.7		Linea 21	386614.16=(XY.16)
395445.16			
392797.22			
393382.44			
395112.32			
397079.26			
395017.229			
392637.229			
392637.10		387143.22	387170.9
399078.11		391686.5	393079.4
391058.175			
393613.2			
392759.1			
399067.22			
393536.13			
394611.112			
701165			
39400.52			
393381.106		388611.22	676008=(I-1039)
703287	Azul		
393371.159		387170.16	389746.2
395443.103		BWH-87.289	385280.1=(XY.13)
397067.2			
396033.102		392639.53	393382.64
399706.27			
392633.54		387132.2	387334.5
391002.6		386209.1	386206.4
392973.48		KRASA	385280.1=(XY.13)
393083.2		387315.27	390357.4
399079.22		395274.1	395257.6
393371.164		387170.16	389746.2
395111.13			
391930.13			

391930.1		BWH-87.338	SELF
396287.5			
391046.14		386209.1	387338.3
393073.179			
306022.69	MN-20.69	303816.2(1)	303803.18(1)
304369.22		Mariela	676008=
			(I-1039)

Annex 4.3

Production of Source Seed in FY 2072/73

Commodity	Variety	Type	Unit	Target (Kg)	Production (Kg)
Potato	17 varieties	PBS	No.	2,00,000	2,27,169
Potato	11 varieties	BS	Kg	3000	3,393
Rice	Khumal 4	Foundation	Kg	1500	3270

Annex 4.4

Distribution of Source Seed in FY 2072/73

Commodity	Type	Quantity (Kg)	Major stakeholder(s)	Distributed districts
Potato	PBS	2,27,169	ADO and seed growers, research farm	Different ADOs
Potato	Basic	3,393	ADO and seed growers, research farm	Different ADOs
Rice	Foundation	3270	Local Farmers	Lalitpur

Annex 4.5 The harvest of Techni tubers, 2015/16 at Hattiban Research Farm, Khumaltar, Lalitpur, Nepal (LB = Late blight, Color W, R = White, Red; Shape O, R, L = Oval, Round, Long; Eye depth S, M = Shallow, Medium; Maturity E, M, L = Early, Medium, Late)

Clones	Plant unif. (1-5)	Plant vigor (1-5)	LB (1-9)	Tuber characters			Total #	Total wt. (kg)	Maturity
				Color	Shape	Eye depth			
Tech 7016-397029.21	3	3	3	W	O	M	1823	27	E
Tech 7020-304371.2	3	2	5	W	O	S	781	12.5	E
Tech 7019-388972.22	2	2	6	W	O	S	980	15	E
Tech 7014-393371.58	4	5	1	W	R	M	631	10	L
Tech 7015-396311.1	3	3	3	R	R	S	651	6	M
Tech 7012-391058.175	4	5	1	W	R	M	424	5	L
Tech 7008-304351.109	5	5	3	R	O	S	1722	338	M
Tech 7005-304347.6	4	4	3	R	R	S	1901	32	M
Tech 7004-303381.3	4	4	2	R	R	M	3671	49	M
Tech 7009-304366.46	4	4	4	R	O	M	1692	24	E
Tech 7001-301024.14	5	5	1	W	R	M	197	2	L
Tech 7006-304350.1	3	3	6	R	O	S	738	10	E
Tech 7003-302498.7	3	3	5	W	O	S	2287	40	E
Tech 7011-304387.17	2	2	5	W	O	M	2112	44	E
Tech 7021-304405.47	4	4	3	w	R	M	3395	57.5	M

Annexes

Clones	Plant unif. (1-5)	Plant vigor (1-5)	LB (1-9)	Tuber characters			Total #	Total wt. (kg)	Maturity
				Color	Shape	Eye depth			
Tech 7018-304394.56	2	2	5	W	L	S	1805	26	Early
Tech 7010-304368.46	3	4	3	W	R	M	1548	19.5	Early
Tech 7007-304350.118	2	2	5	R	O	M	625	8.5	Early
Tech 7017-397079.6	3	3	5	w	O	S	814	14	Early
TOTAL								**440.0**	

Annex 5.1 Training/Workshop/Seminar Organized in FY 2072/73(2014/15)

SN	Name of Training/ Workshop/ Seminar	Duration	Target group	Location
1	"Strengthening Impact assessment in the CGIAR(SIAC) Experts elicitation workshop on Tracking Potato and Sweet potato improved cultivars adoption in Nepal"	March 17 and 18 2016.	Technical officers	NPRP, Khumaltar
2	"Biodiverse and nutritious potato improvement across Peru, Nepal and Bhutan"	2072-12-30 to 2073-01-01	Scientists	Hotel Himalaya Kupandol
3	International Training Programme on "DNA based GMO detection for seed testing and certification"	Nov.30-Dec.12 2015	Scientists	ICAR, NBPGR, New Delhi.
4	Agromet-Advisory Bulletin study trip	Asar 2073 (July 2016)	Scientist	Pune, India

Annex 5.2 Information Disseminated Through Media, 2072/73

SN	Information disseminated/Media coverage	Type*	Name/ Type of media	Date/Time
1	Potato and Sweet potato Variety development and releasing status	Short interview	Karobar Daily News	Ashad 2073

Annex 6.1 Papers Published in FY 2072/73 (2015/16)

Title of the paper	Authors	Name of proceedings, journals etc.
Seedling tubers evaluation of true potato seed families for commercial potato production in Nepal	P. Bhattarai and I.P. Gautam	Nepalese Journal of Agricultural Sciences, Vol. 13, 1 Sept. 2015
Sweet potato research for enhancing food and nutrition security in Nepal	Prakash Bhattarai	Journal of Horticulture, Forestry and Biotechnology, Vol. 19(4),62-70, 2015
आलु उत्पादन तथा उत्पादनोपरान्त वार्षिक कार्य तालिका	डा. भीमबहादुर खत्री र सञ्जीब गौतम	Booklet
उन्नत आलुखेतीका लागि सिफारिस प्रविधि	डा. भीमबहादुर खत्री र सञ्जीब गौतम	Booklet
उन्नत सखरखण्ड खेती प्रविधी	प्रकाश भट्टराई, भीम बहादुर खत्री	Booklets
सखरखण्डका उन्मोचन उन्मुख जातहरू: एक छोटो परिचय	प्रकाश भट्टराई र	Booklet
डा. भीमबहादुर खत्री		Book
जलवायु परिवर्तन र आलुवाली	डा. कालिकाप्रसाद उपाध्याय, सञ्जीब गौतम र सुप्रभा पाण्डे	Folder

Annex 7.1

Regular Annual Budget and Expenditure Record of FY 2072/73 (2015/16)

(in NRs.)

वार्षिक बजेट	रकमान्तर वा थप	खुद वार्षिक बजेट	ले.को.नं.	लेखा शीर्षक	बजेट निकासा	खर्च	निकासा बांकी
१७५२४०००।००	०	१७५२४०००।००		चालु खर्च	१४८६६५०१।५८	१४८६६५०१।५८	२६५७४९८।४२
७७६५०००।००		७७६५०००।००	२१११११	तलब	७४३३५८८।४७	७४३३५८८।४७	३३१४११।५३
२६९०००।००		२६९०००।००	२१११३	महंगी भत्ता	२६९०००।००	२६९०००।००	०।००
१६५०००।००		१६५०००।००	२११२१	पोशाक	१६५०००।००	१६५०००।००	०।००
८४८०००।००		८४८०००।००	२२१११	पानी तथा बिजूली महशूल	२८७५१५।९६	२८७५१५।९६	५६०४८४।०४
१२५०००।००		१२५०००।००	२२११२	संचार महशूल	१२३८७२।००	१२३८७२।००	११२८।००
५४०००।००		५४०००।००	२२२११	ईन्धन	२८४०७।५०	२८४०७।५०	२५५९२८।५०
८००००।००		८००००।००	२२२१२	सञ्चालन तथा मर्मत संभार	८००००।००	८००००।००	०।००
५६०००।००		५६०००।००	२२२१३	बीमा	५६०००।००	५६०००।००	०।००
७००००।००		७००००।००	२२३११	कार्यालय सम्बन्धी खर्च	६३०४८६।०६	६३०४८६।०६	६९५१३।९४
११०००।००		११०००।००	२२३१३	पुस्तक	११०००।००	११०००।००	०।००
११६०००।००		११६०००।००	२२३१४	ईन्धन अन्य प्रयोजन	६१३०१।००	६१३०१।००	५४६९।००
५२५५०००।००		५२५५०००।००	२२५२१	उत्पादन सामग्रीरसेवा खर्च	३९८९८९५।५९	३९८९८९५।५९	१२६५१०४।४१
८१४०००।००		८१४०००।००	२२६१२	भ्रमण खर्च	६९४७८३।००	६९४७८३।००	११९२१७००
६०००।००		६०००।००	२२७११	विविध खर्च	५९९८८।००	५९९८८।००	१२।००
४२५०००।००	०	४२५०००।००	ले.शी.नं.	पुंजीगत खर्च	२९३९४४०।५१	२९३९४४०।५१	१३१०५५९।४९
०।००		०।००	२९२२१	भवन निर्माण	०।००	०।००	०।००
७५०००।००		७५०००।००	२९२३१	पुंजीगत सुधार खर्च (भवन	४५४८१७३१	४५४८१७३१	२९५१८२।६९
२००००।००		२००००।००	२९३११	फर्निचर तथा फिक्चर्स	१८८६६९।०२	१८८६६९।०२	११३३०।९८
१३५०००।००		१३५०००।००	२९५११	मेशिनरी औजार	९४४६८०।००	९४४६८०।००	४०५३२०।००
१९०००००।००		१९०००००।००	२९६११	सार्वजनिक निर्माण	१३५१२७४।१८	१३५१२७४।१८	५४८७२५।८२
		०।००	२९६२१	पुंजीगत सुधार खर्च	०।००	०।००	०।००
५०००।००		५०००।००	२९७१२	सफ्टवेयर निर्माण र खरिद खर्च	०।००	०।००	५०००।००
२१७७४०००।००	०।००	२१७७४०००।००		जम्मा	१७८०५९४२।०९	१७८०५९४२।०९	३९६८०५७९१

Annex 7.2

Out of Sync of expenditure (Beruju) Status of FY 2072/73 (2015/16)

	फछ्र्यौट मै बाकी रहेको बेरुजु					
विवरण	नियमित	असूली	पेश्की	जम्मा बेरुजु	फ्च्योट	जम्मा बांकी बेरुजु
२०४८।५	०।००	०।००	०	०।००	०।००	०।००
२०४९।५०	०।००	०।००	०	०।००	०।००	०।००
२०५०।५	०।००	०।००	०	०।००	०।००	०।००
२०५१।५	०।००	०।००	०	०।००	०।००	०।००
२०५२।५	३९५४५।००	०।००	०	३९५४५।००	३७०४५।००	२५००।००
२०५३।५	०।००	०।००	०	०।००	०।००	०।००
२०५४।६	०।००	०।००	०	०।००	०।००	०।००
२०५५।६	०।००	०।००	०	०।००	०।००	०।००
२०५६।६	०।००	३४६६।२५	०	३४६६।२५	०।००	३४६६।२५
२०५७।६	०।००	०।००	०	०।००	०।००	०।००
२०५८।६	३७००।००	०।००	०	३७००।००	३७००।००	०।००
२०५९।६०	९०३३।००	०।००	०	९०३३।००	५०००।००	४०३३।००
जम्मा	५२२७८।००	३४६६।२५	०	५५७४४।२५	४५७४५।००	९९९९।२५
२०६०।६	५९८६६।५६	०।००	०	५९८६६।५६	९७६९।७१	५००९६।८५
२०६१।६	०।००	०।००	०।००	०।००	०।००	०।००
२०६२।६	०।००	२९५१३।७५	०।००	२९५१३।७५	०।००	२९५१३।७५
२०६३।६	०।००	११८५।००		११८५।००		११८५।००
२०६४।७	०।००	१२४९।००	०।००	१२४९।००	१२४९।००	०।००
२०६५।७	०।००	०।००	०।००	०।००	०।००	०।००
२०६६।७	०।००	०।००	०।००	०।००	०।००	०।००
२०६७।७	०।००	२०२५।००	०।००	२०२५।००	०।००	२०२५।००
जम्मा	५९८६६।५६	३३९७२।७५	०।००	९३८३९।३१	११०१८।७१	८२८२०।६०
२०६८।७	०।००	०।००	०।००	०।००	०।००	०।००
२०६९।७०	०।००	२०७३१।६०		२०७३१।६०	१७४८८।००	३२४३।६०
२०७०।७	०।००	४४००।००	४४०००।००	४८४००।००	५०००।००	४३४००।००
२०७१।७		३९४९।००		३९४९।००		३९४९।००
जम्मा	०।००	२९०८०।६०	४४०००।००	६९१३१।६०	२२४८८।००	४६६४३।६०
कुल जम्मा	११२१४४।५६	६६५१९।६०	४४०००।००	२१८७१५।१६	७९२५१।७१	१३९४६३।४५

Annex 7.3

Revenue Status of FY 2072/73(2015/16)

Budget code	Income source	1st Trimester	2nd Trimester	3rd Trimester	Total
5292	Potato	5,94,788.00	2,17,512.00	15,28,113.00	23,44,313.00
5900	Other income	1,500.00	-	4,56,621.71	4,58,121.71
	Total	5,96,288.00	2,17,512.00	23,05,234.71	31,22,934.71

Log Frame of National Potato Research Program, Khumaltar, 2015/16

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS (OVI)	MEANS OF VERIFICATION (MOV)	IMPORTANT ASSUMPTION
GOAL: To improve the food security and livelihoods of Nepalese farmers	• Health and living standard upgraded and measured	Economic status report	Government realizes important role in food security
PURPOSE: To increase the productivity of potato and sweet potato and farmers income	• Productivity increased by 25% with the adoption of ICM by the end of 2017	Agriculture statistics report from MoAD	All the stake holders of potato production jointly work
OUTPUTS: 1. High yielding and economically important diseases and insect pest resistant potato and sweet potato varieties developed for major agro climatic conditions. 2. Losses caused by diseases and insect pest minimized. 3. Package of practices for higher yield, safe storage & processing technology developed for potato and sweet potato. 4. Appropriate seed production technology developed and high quality potato seed produced. 5. NPRP efficiently managed, National and International linkages strengthened for potato R & D.	1. At least two late blight resistant varieties and one of sweet potato variety released for commercial production by the end of 2017 2. Low cost and environment friendly management technology developed for economically important diseases, weeds and insect pests of potato by the end 2017 3. Package of practices developed for post harvest losses minimized by 15 percent. 4. Low cost PBS production technology developed and hand over to private sector to fulfill the demand of high quality seeds by 2017. 5. Programme implemented to achieve the expected out puts by strengthening national and international linkages	1. Report of variety release committee 2. PRP Annual reports/ Project completion report 3. PRP Annual reports/ Project completion report 4. PRP Annual reports/ Project completion report 5. Germplasms and Scientist visit exchanged	Resource allocation for potato research improved as per its importance to address the food security climatic and edaphic factors remain congenial.
ACTIVITIES: 1.1 Variety improvement on potato for higher tuber		Project monitoring and evaluation report	Project leader get empowered to perform their

yield 1.2 Sweet potato variety development for food and nutrition security 2.1 Studies on economically important potato diseases (late blight, scab, wart, viruses and bacterial wilt) 2.2 Studies on economically important insect pests (PTM, leaf minor fly, white grub and red ants) 3.1 Soil fertility management 3.2 Studies on minimization of post harvest losses and value addition 3.3 Development of appropriate package of practices for potato and sweet potato as per climatic conditions 4.1 Sustainability studies for pre-basic seed production 4.2 Pre basic and source seed production on potato 5.2 Publication of research findings (Annual reports, booklets, leaflets). 5.3 Technology dissemination through radio, TV and print media. 5.4 Coordinate National and International collaborative research projects.	**Project wise budget for 2072/73** Project # — Rs. '000 Variety development on potato — 1105 Develop low cost technology — 855 Source seed production — 2285 Sweet potato variety develop. — 385 Dev. Sustainable PBS prod. — 300 FMP — 1139 **Total — 6059.00**		research projects effectively.

Making chips of potatoes

Sweet potato research in farmers field

Sprouting pattern of Potato