ANNUAL REPORT

2004/05 (2061/62)

NEPAL AGRICULTURAL RESEARCH COUNCIL

NATIONAL POTATO RESEARCH PROGRAMME

Khumaltar, Lalitpur, Nepal

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Cover page photographs :

First row left to right : Office building, Glasshouse
Second row left to right : Potato plantlets growing on glasshouse bench, pre-basic seeds of pipeline potato varieties

Contents

Acknowledgments

The National Potato Research Programme (NPRP) gratefully acknowledges for contributions on potato research from NARC disciplinary Divisions and Agriculture Research Stations. Thanks are due to District Agriculture Development Offices and National Potato Development Programme, Khumaltar for their remarkable cooperation.

We appreciate the collaboration rendered by McKnight foundation through Idaho University USA for the identification of PTM resistant potato varieties during the last two years. NPRP is thankful to Dr Jim Lorenzen for supporting entomological research programme through PTM project. NPRP is also thankful to CIP Lima, Peru and its Regional Office Delhi for providing potato clones as per demand and supporting TPS research and development in Nepal. Thanks are due to farmers who participated in the On Farm research, seed distribution among the farmers and assisted in promoting new varieties and technologies.

Mr. B.M. Sakha, Senior Scientist, is highly acknowledged for his hard effort in compiling this report. I would also like to thank other scientists Mr. B.P. Sharma, Dr. S. P. Dhital, Mr. R.C. Adhikari, and Mr. B.P. Luintel for bringing this Annual Report to the present shape.

Mr. G. P. Rai
Coordinator
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Acronyms

ADO	=	Agriculture Development Office
AESA	=	Agri-ecosystem analysis
BS	=	Basic seed
CFFT	=	Coordinated Farmers' Field Trial
CIP	=	International Potato Center
CVT	=	Coordinated Varietal Trial
DAP	=	Days after planting
DAS-ELISA	=	Double Antibody Sandwitched - Enzyme Linked Immuno Sorbant Assay
F_1	=	First generation
F_1C_1	=	First clonal generation of TPS
FFS	=	Farmers' field school
FFT	=	Farmers Field Trial
FYM	=	Farm yard manure
GC	=	Ground coverage
HPS	=	Hybrid Potato Seed
HYV	=	High yielding variety
IDM		Integrated disease management
IET	=	Initial Evaluation Trial
LB	=	Late blight
LSD	=	Least significant difference
MoU		Memorandum of understanding
NPDP	=	National Potato Development Programme
NPRP	=	National Potato Research Programme
NS	=	Not significant
OM	=	Organic matter
OS	=	Over size
PARC	=	Pakhribas Agricultural Research Center
PBS	=	Pre-basic seed
PDA	=	Potato dextrose agar (medium)
PLRV	=	Potato Leaf Roll Virus
PRA	=	Participatory rural appraisal
PTM	=	Potato tuber moth
PVA	=	Potato Virus A
PVM	=	Potato Virus M
PVS	=	Potato Virus S
PVX	=	Potato Virus X
PVY	=	Potato Virus Y
RARS	=	Regional Agriculture Research Station
RCBD	=	Randomized Complete Block Design
RGL	=	Remained green leaves
RRA	=	Rapid rural appraisal
SDC	=	Swiss Agency for Development and Cooperation
SS	=	Seed size
SWZ	=	Switzerland
TPS	=	True Potato Seed
US	=	Under size
VDC	=	Village Development Committee
vs.	=	Versus

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important food crops in Nepal. Area under potato is about 1,46,789 ha and total production 17,38,840 mt with an average productivity of 11.85 t/ha (Table 1). It occupies the **fifth** position in area coverage and **second** in total production and **first** in productivity among the food crops grown in Nepal. 'Statistical Information on Nepalese Agriculture' published by Agri-business and Promotion Division, Ministry of Agriculture and Cooperatives has put potato as one of the cash crops. However, potato serves as staple food in the high hills and plays a vital role in the food security in the country. Therefore, potato could be compared with other cereal crops. Out of the total area under potato, 18 % is in the high hills and mountains, 42% in the mid-hills and 40 % in terai (ABPS, 2005).

Table1. Area, production and productivity comparison of food crops

Food crops	Area (ha)	Rank	Production (MT)	Rank	Productivity (t/ha)	Rank
Paddy	15,41,729	I	42,89,827	I	2.782	II
Maize	8,49,892	II	17,16,042	III	2.019	IV
Wheat	6,75,807	III	2,89,838	V	1.120	V
Millet	2,58,839	IV	14,42,442	IV	2.134	III
Barley	26,428	VI	29,341	VI	1.110	VI
Potato	1,46,789	**V**	17,38,840	**II**	11.846	**I**

Source: Statistical Information on Nepalese Agriculture published by Agri-business and Promotion Division, Ministry of Agriculture and Cooperatives (2004/05 (2061/62)

Potato gained as an important food crop in Nepal only from the middle of the 19th century. The first official attempt to improve potato production was initiated in 1962 under a joint programme 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 Programme (NPDP) was incepted in 1972 at Kirtipur with a nationwide mandate to conduct potato research and development. Two potato farms, one at Jaubari, Ilam and other at Nigale, Sindhupalchok, were also established during 1980s. In 1974, NPDP was relocated to Khumaltar. Linkages were established with International Potato Center (CIP) in Lima, Peru, led to appointment of a CIP Country Research Scientist in 1976.

In 1977, a five-year bilateral agreement (1978-1983) was signed between Government of Nepal (HMG) and the government of Switzerland to further strengthen R & D activities of NPDP. CIP's regional programme was relocated to New Delhi, India in 1980. In 1983, the bilateral agreement between Nepal and Switzerland was further extended for a period of 1983-1987. During the early phase, major focus was on seed potato production through contract system. Later in 1989, a tissue culture laboratory was established 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, NPDP was separated into two programmes, Potato Research Programme (PRP) and Potato Development Program (PDP) with specific mandates on research and development respectively. PRP is under the Nepal Agricultural Research Council (NARC) and PDP under the Department of Agriculture (DOA). As a national commodity research programme, PRP is responsible for appropriate research on potato throughout the country to improve the livelihoods of Nepalese farmers.

Potato is a cool season crop. In general, a minimum of 70 days of cool weather is required to obtain an economic yield. However, substantially higher yields can be obtained with a longer growing season (up to 160 days).

In Nepal, potatoes are grown in two main seasons - during winter under short day conditions in the terai and during summer under long day conditions in the hills. Besides these, potatoes are also cultivated at other times of the year in areas where growing conditions are favorable, such as monsoon planting in the dry high hills and autumn planting in Kathmandu valley.

Scenario of area and productivity of potato

Potato is grown in quite diversified climatic conditions under rain fed, partially irrigated and full irrigated conditions. With the support of irrigation projects and accessibility of inputs during the last decades (1995/96-2004/05) area of potato cultivation has been increased by 38.5 percent (Figure 1). With the little improvement on the management of disease and insect pest and supply of quality potato seed in the farmer's field level, productivity of potato increased by 39.78 % in the fiscal year 2004/05 as compared to 1995/96 (Figure 2).

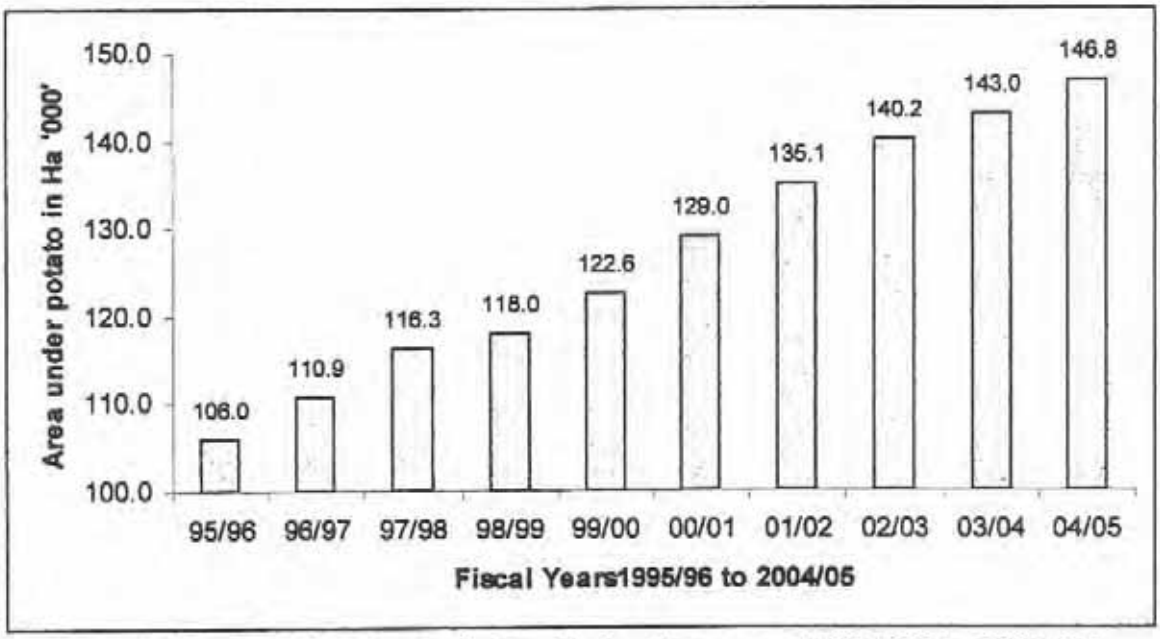

Figure 1. Area under potato during the last ten years (1995/96 to 2004/05)

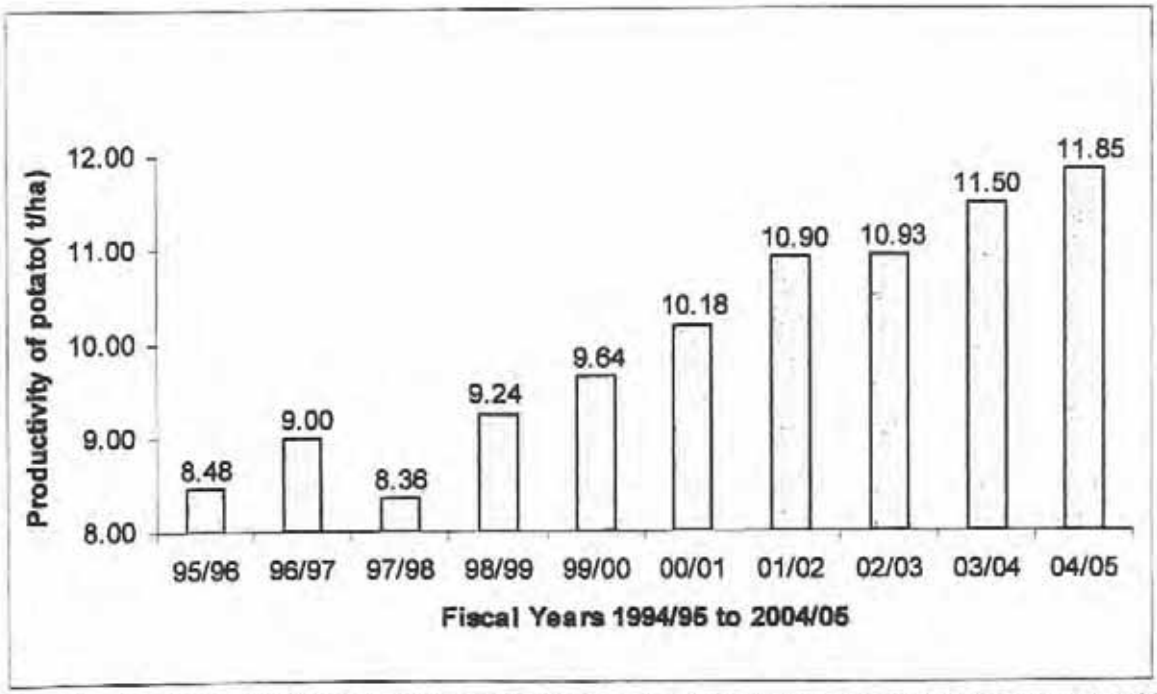

Figure 2. Average productivity of potato during the last ten years (1995/96 to 2004/05)

The goal, purpose, expected outputs and activities to be carried out to address the National goal of farmer's livelihoods improvement through this National Potato Research Programme is summarized in the **Log frame** (Appendix VII).

Goal: To improve the livelihoods of Nepalese farmers through potato cultivation.

Objectives:

1. Develop appropriate technologies to increase the production and productivity of potatoes for different agro- ecological zones of the country.
2. Identify and solve production constraints to seed and ware potatoes through on station and farmer's participatory multi location field research.
3. Produce high quality healthy source seed of released/recommended potato varieties.
4. Establish coordination with potato stake holders in the country.
5. Develop and strengthen linkages between National and International potato R & D related organizations.

Of the total activities outlined in the Log frame, the following research activities were performed during the fiscal year 2004/05 (2061/62).

1. Develop high yielding varieties with resistance to major diseases conducting experiment in the research stations representing mountain, hills and terai agro climatic conditions. The sub activities carried were CVT and IET
   Mountain (2000-2500 m a s l): ARS Pakhribas, ARS Lumle, ARS Jumla
   Mid hills (1000-1500 m a s l): PRP Khumaltar and ARS Malepatan Pokhara
   Terai (100-500 m a s l): RARS Tarahara, RARS Parawanipur and RARS Nepalganj

   1.1 Variety improvement on potato for high tuber yield and late blight disease resistance in hills and terai of Nepal.

2. For the Identification of high yielding TPS families and to develop appropriate agronomic practices experiments were conducted in PRP Khumaltar (Mid hills) and RARS Tarahara (terai).

   2.1 Evaluation of TPS families in the nursery and field conditions of Nepal.

3. Research on Disease and Pest Management
   3.1 Studies on *Phytophthora infestans* mating types and cost effective management of Late Blight.
   3.2 Survey and management of Black scurf disease (*Rhizoctonia solani*) of potato
   3.3 Investigation on Potato Tuber Moth (PTM) in Collaboration with Idaho University of USA and Entomology Division Khumaltar

4. Studies on soil fertility and nutrients management in potato

5. Quality and disease-free seed production

   5.1 Low cost technology development for potato production through ICM approach for the hills of Nepal.
   5.2 Sustainability studies for basic seed production
   5.3 Pre basic and basic seed production

6. Farmer's participatory research was conducted in collaboration with ORD and respective OR sites of concern ARS and RARS located in terai, mid hills and mountain.

Promising potato clones selected from the CVT were further evaluated as CFFT with the participation of farmers in the potato growing pockets. Location specific research project 'Survey and Management of Black scurf Disease of Potato' was conducted at Mainapokhar Bardiya with farmers' participation in their disease infested sick plot.

NPRP also manages a full fledge tissue culture laboratory for the PBS production. About 200,000 tuber lets of different varieties are produced each year under quarantine glasshouse conditions at Khumaltar. PBS is sold to farmer groups through National Potato Development Programme under DOA. PBS is further multiplied in Horticulture Farms under and NARC and DOA for basic seed-1 to meet the farmer's demand of their respective OR sites.

CIP Peru and its Regional office Delhi are supporting for potato research in Nepal in the field of technology development and supply of potato clones on request. Farmer's participatory researches on adaptation of TPS families have been implemented in collaboration with Regional office Delhi.

1.0 GERMPLASM EVALUATION

1.1 VARIETAL IMPROVEMENT

As a national commodity programme, National Potato Research Programme is responsible for conducting appropriate research throughout the country on several disciplines, among which varietal valuation is one of them. Potato germplasms are evaluated in Potato Research Farm at Hattiban, Khumaltar and at different Agriculture Research Stations and Farms to identify suitable varieties for the diverse agro-ecological zones of the country with due consideration of both farmers and consumers preference.

Several years of efforts has resulted into release of six potato varieties namely, Kufri Sindhuri, Desiree, Kufri Jyoti, Janak Dev, Khumal Seto-1 and Khumal Rato-2 for different agro-ecological zones of the country. Other clones such as Perricholi and NPI-T/0012 are under the process of release. Besides these, NPI - 106, Cardinal, I - 1124 and local cultivars named Jumli Local, Kathmandu Local and Sarkari Seto are recommended as the varieties. Clones 386201.3LB, 388572.1K, 388572.4K, 388580.6D, 388576.3D and 388764.26LB are the promising ones in varietal evaluation scheme at present. CIP clones 388572.1K, 388572.4K and 388574.6D have already cleaned and these clones are under the seed multiplication phase.

The results of several on-station and on-farm varietal trials conducted during 2004/2005 at Khumaltar and in different research stations are presented below:

1.1.1 INITIAL EVALUATION TRIAL (IET)

Introduction

NPRP receives pathogen tested exotic genetic materials mostly from International Potato Centre (CIP) and from its local sources. These materials are initially multiplied under screen-house conditions, followed by preliminary evaluation in observation nurseries (PON) under field conditions in Khumaltar. The best materials are bulked and further tested as initial evaluation trials (IET) at Hattiban Research Farm, Khumaltar and RARS Parwanipur as the representative sites of hills and terai, respectively.

IET is the initial testing of new clones for yield potentiality, adaptability and disease response. The lines promoted from this stage are further tested as coordinated varietal trials (CVT) in different collaborative farms and stations throughout the country. Promising lines from CVT are further promoted to coordinated farmers' field trials (CFFTs) at out-reach research sites of different farms and research stations. The performance of the tested clones and farmer's preferences are recorded and evaluated. After two years of farmers' acceptance test (FAT) the most preferred clones are recommended for commercial production in respective ecological domain and then a proposal is submitted for releasing as a variety.

Materials and Methods

Three different sets of trials were planted at Hattiban farm Khumaltar, Regional Agricultural Research Station Parwanipur and Agricultural Research Station (Hort.) Jumla. In all the locations, the trial was laid down in randomized complete block design (RCBD) with three replications.

The plots were fertilized at the rate of 100:100:60 kg NPK together with 20 t compost per hectare. Well-sprouted tubers were planted in a single row with 60 x 25 cm spacing. The seed size ranged from 25-50 g.

Following data were recorded:

Growth parameters

1. Emergence (%) at 15 and 30 days after planting
2. Plant height (average of 5 plants)

3. Plant uniformity (after 6 weeks of planting at 1-5 scale)
4. Number of main stem per plant (average of 5 plants)
6. Late blight rating (using 1-9 scale)

Yield and Yield parameters
1. Number of plants harvested
2. Total number and wt. of tubers/plot
3. Number and weight fraction of the tubers
4. Yield ton per hectare
5. Tuber color, shapes and eye depth of the tubers

The clones included in the trials were as following:

S.N.	RARS Parwanipur (TERAI)	PRP Khumaltar (MID HILL)	ARS (Hort.) Jumla (HIGH HILL)
1	396082.16	392657.8	385556.4
2	I-1035	393280.64	393382.44
3	392247.19	396010.42	393339.242
4	392287.48	392271.58	393280.64
5	392661.18	391617.54	396082.7
6	385556.4	393077.159	393077.159
7	392657.8	393637.10	396009.16
8	393280.64	389746.2	395014.53
9	392617.54	393339.242	393280.57
10	392637.10	393385.39	393233.38
11	393077.159	392228.66	392657.8
12	393385.39	393280.57	392637.10
13	393339.242	393382.44	392661.18
14	394005.115	391396.96	393077.54
15	393619.8	393077.54	391002.6
16	394051.4	K. Chipsona 1	391396.96
17	394050.11	K. Chipsona 2	393385.39
18	393574.61	K. Kanchan	391617.18
19	392244.3	391002.6	Desiree (ch)
20	394007.55	395014.97	Jumla Local (ch)
21	394036.103	394005.115	Kufri Jyoti (ch)
22	393574.72B	391061.73	
23	384003.161	394007.55	
24	K. Chipsona 1	391058.38	
25	K. Chipsona 2	394003.161	
26	NY123	391046.2	
27	P 161-3	394036.103	
28	Q 132-53	393574.72B	
29	L 235-4	394051.4	
30	Desiree (ch)	P 161-3	
31	Kufri Sindhuri (ch)	Q 132-53	
32		NY 123	
33		L 235 -4	
34		Kufri Jyoti (ch)	
35		Desiree (ch)	

Results and Discussion

Terai

At RARS Parwanipur, twenty-nine different clones were evaluated and compared with Desiree, Kufri Sindhuri. Among twenty-nine different clones, twenty-five clones were received from CIP, Lima Peru and four potato tuber moth resistant clone (NY123, P161-3, Q132-53 and L235-4) from Idaho University, America. Highest (100) emergence was recorded in Kufri Chipsona –2 and lowest (13) in clone 394050.110 (Table 1.1a). Highest (5) plant uniformity was observed in clone 392287.48, 392657.8, 392617.54, 393339.242, 394005.115, Kufri Chipsona-2, NY 123, P161-3 and L 235-4 in 1 to 5 scales. Highest percent of ground cover was observed in clone 393280.64 (90) followed by clone 392661.18 (87) and 394005.115 (87). Ground covers in rest of the clones were ranged from 22 to 82 %. Plant vigor was obtained highest (5) in clone 392637.10. Except the vigor of clone 394050.110 (2), the vigor of all the tested clones were ranged from 3 to 4 in 1 to 5 scales. Average number of main stems per plant were counted highest (4) in clone 393339.242 followed by clone 392617.54 (3), 393385.39 (3), 394036.103 (3) and Kufri Chipsona-1 (3). Tallest plant was measured in clone 392617.54 (65cm) and the most dwarfest in 394036.103 (17cm).

Clone 392247.19, 394005.115, 393619.8, 384003.161 and Q 132-53 were found susceptible to late blight disease whereas clone 385556.4, 392617.54, 393077.159, 393358.39 and Kufri Chipsona-2 were found resistant to late blight disease. All the tested clones were found almost similar trends in early blight disease. Clones like 392247.19, 392661.18, 392657.8, 393280.64, 393077.159, 394005.115, 393619.8, 394051.4, 394050.110, 392244.3, 384003.161 and Q 132-53 were found highly resistant to early blight.

In respect to yield and yield parameters, L 235-4 produced highest (96) numbers of seed size tubers. Clone 393280.64 gave highest (89%) weight of seed size tubers. Highest number (13) of oversize seed tubers were obtained from clone 392661.18 and highest (69%) weight in 392657.8 (Table 1.1b). Total numbers of tubers per plot was harvested highest (172) in L 235-4 and the lowest (15) in 394050.110. Highest (5.45 kg/plot) weight per plot was harvested in clone 392661.18 and the lowest (0.46 kg) in 394050.110.

Tuber yields among the tested clones were statistically significant (Table 1.1b). Clone 385556.4 gave highest yield (32.13 t/ha) followed by 392657.8 (30.75 t/ha), 393077.159 (25.16 t/ha) and 392617.54 (25.10 t/ha). Clones 392661.18, 393280.64, 393385.39, 393339.242, 394005.115, 393619.8, 394051.4, 393574.61, 392244.3, 394007.55, 394036.103, 393574.61.72B were found red skinned type. Majorities of the tested clones were observed either round, round flat or long tuber shaped. Clones 392287.48, 392657.8, 393385.39, 393619.8, 394050.110, 394077.55 and 384003.161 were found deep eye and remaining clones were either medium or shallow eye depth.

Based on various agronomic and yield data evaluated in the trial, clones 385556.4, 392657.8, 393280.64, 392617.54, 392637.10, 393385.39, 393077.159 and 393339.242 are promoted to Coordinated Varietal Trials (CVTs). Clones 396082.16, 392247.19 and 392287.48 are discarded from the evaluation trial and rests are recommended for further testing in Parwanipur condition.

Table 1.1a. Vegetative characteristics of IET at RARS Parwanipur, 2004/2005

Clones	Number of tuber planted	Emergence (%)	Plant uniformity (1-5)	Ground cover (%)	Plant vigor (1-5)	Stem/ plant	plant height (cm)	Late blight (1-9)	Early blight (1-9)
396082.16	16	69	3	63	4	2	45	5	3
I-1035	16	40	3	52	3	2	36	4	3
392247.19	16	71	4	63	4	1	30	7	1
392287.48	16	77	5	70	4	2	48	6	2
392661.18	16	96	4	87	4	2	62	3	1
385556.4	16	54	3	60	4	2	45	2	2
392657.8	16	27	5	33	3	2	54	2	1
393280.64	16	94	4	90	4	2	61	5	1
392617.54	16	77	5	67	4	3	65	2	3
392637.10	16	88	3	82	5	2	60	3	2
393077.159	16	54	3	60	4	2	48	2	1
393385.39	16	60	4	70	4	3	50	2	3
393339.242	16	94	5	75	3	4	58	3	3
394005.115	16	77	5	87	4	2	48	7	1
393619.8	16	90	3	78	4	2	45	7	1
394051.4	16	50	2	52	3	2	41	6	1
394050.110	16	13	4	22	2	1	28	3	1
393574.61	16	96	3	75	4	2	46	6	3
392244.3	16	58	4	57	3	2	41	6	1
394007.55	16	81	4	77	4	1	47	6	2
394036.103	16	92	4	73	3	3	17	6	2
393574.72B	16	83	4	82	4	2	39	6	2
384003.161	16	75	4	62	3	1	39	7	1
K. Chipsona 1	16	98	4	70	3	2	55	4	2
K. Chipsona 2	16	100	5	75	4	2	40	2	2
NY123	16	88	5	63	3	1	40	4	3
P 161-3	16	96	5	82	4	3	37	5	3
Q 132-53	16	96	5	75	3	2	48	7	1
L 235-4	16	92	4	80	4	1	36	4	2
Desiree (ch)	16	61	4	63	3	2	45	6	3
K. Sindhuri (ch)	16	47	3	65	4	2	57	5	1

Table 1.1b Yield characteristics of IET at RARS Parwanipur, 2004/05

Clones	No. of pts hvtd	Tuber grading (# & % wt)						Yield / plot		Adjusted yield (t/ha)	Tuber characteristics			Pt type
		US		SS		OS					Color	Shape	Eye	
		#	wt	#	wt	#	wt	#	kg					
396082.16	11	12	8	26	85	1	7	39	1.36	8.21 gh	W	R	M	E
I-1035	7	7	5	13	67	3	28	22	1.19	12.20 efgh	W	RC	M	E
392247.19	12	14	9	21	74	2	17	37	1.32	7.41 h	W	O	M	S
392287.48	12	20	11	36	78	3	11	60	1.83	9.90 fgh	W	Ob	S	S
392661.18	15	34	6	53	63	13	31	100	5.45	23.93 bc	LR	R	M	E
385556.4	9	13	2	42	56	9	41	64	3.97	32.13 a	W	R	S	S
392657.8	4	6	4	10	28	7	69	23	1.98	30.75ab	W	RF	D	S
393280.64	15	19	3	82	89	3	9	104	4.53	20.17cde	R	RC	M	S
392617.54	12	12	2	44	51	12	47	68	4.54	25.10abc	W	RCo	S	E
392637.10	14	36	5	56	60	10	35	102	4.21	20.11 cde	W	O	M	S
393077.159	9	7	2	26	39	11	59	44	3.25	25.16 abc	W	O	S	S
393385.39	10	22	4	45	61	7	35	73	2.91	22.40 cd	R	RF	D	S
393339.242	15	52	11	72	78	3	11	127	3.43	15.33 defgh	Lpp	RF	M	S
394005.115	12	30	6	57	80	4	14	91	3.13	17.69 cdef	R	L	S	S
393619.8	14	19	5	68	88	2	7	90	3.02	13.89 efgh	R	L	D	S
394051.4	8	6	4	20	79	3	17	29	1.35	10.7fgh	LR	L	M	E
394050.11	2	5	6	9	60	0	0	15	0.46	9.72 fgh	W	RF	D	S
393574.61	15	20	5	65	88	2	7	86	2.80	12.16 efgh	LR	L	M	S
392244.3	9	22	11	29	82	1	7	53	1.58	20.18 cde	R	R	S	S
394007.55	13	18	7	33	59	6	34	57	2.23	11.44 fgh	R	L	V	S
394036.103	15	58	15	60	81	1	4	119	1.95	8.84 gh	R	R	S	E
393574.72B	13	18	8	47	78	3	15	68	2.42	12.20 efgh	R	L	S	S
384003.161	12	20	9	39	83	3	8	63	1.61	8.8 hg	R	RF	D	S
K. Chipsona 1	16	13	7	41	77	2	16	56	1.80	7.68 gh	W	O	S	S
K. Chipsona 2	16	40	9	88	72	6	27	134	4.11	17.15 cdef	W	R	S	E
NY123	14	19	4	42	69	6	12	67	2.83	13.73 efgh	W	R	S	S
P 161-3	15	39	4	79	83	3	16	113	3.58	15.48 defg	W	R	M	S
Q 132-53	15	23	9	49	76	4	13	76	2.51	10.8 fgh	W	R	S	S
L 235-4	15	69	15	96	61	5	24	172	3.26	14.76 defgh	W	R	S	S
Desiree (ch)	13	15	2	48	53	4	13	66	2.26	11.36 fgh	R	L	S	S
K. Sindhuri (ch)	11	39	9	57	58	2	0.16	98	1.90	11.82 fgh	R	R	S	S
CV (%)										31.75				
F-Test										**				
LSD (0.05)										8.06				

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test.
W=white, R=red, LR=Light red, RF=round flat, R= Round, RC = Rround compressed, Lpp= Light purple, L=Long, S=Shallow eye depth, M=Medium eye depth, D=Deep eye

Hills

At NPRP, thirty-three different clones were evaluated and compared with check variety Desiree and Kufri Jyoti (Table 1.2a). Among thirty-three different clones, twenty-seven clones were received from CIP, Lime Peru and four different potato tuber moth resistant clone (P161-3, Q132-53, NY123 and L235-4) from Idaho University, America. Highest (100%) plant emergence was recorded in Desiree and lowest (48%) in NY 123. Plant uniformity was found highest (5) in 393077.159, 389746.2, 394005.115, 394051.4 and L235-4 whereas the lowest (1) in Q 132-53. Ground cover percent was ranged from 18 to 98 among the clones. Clone 394005.115 produced highest (98%) ground cover where lowest (18%) in NY 123. Average plant height was measured

highest (93.6cm) in 391396.96 followed by 395014.97 (71.66cm), 393280.64 (69.46cm), 391617.54 (67.33cm), 393339.242 (61.53cm) and 393382.44 (64.2cm). Clones 396010.42, 393077.159, 389746.2, 393339.242, 394005.115, 394051.4, L 235-4, Kufri Jyoti and Desiree were found highest (5) plant vigor in the trial. Highest (5) number of main stems per plant was counted in Kufri Jyoti check variety. With respect to plant maturity, numbers of early, medium and late maturing clones were 8, 14 and 11, respectively (Table 1.2a). Late blight disease did not occur in this year. The disease rating score was 1 in all the clones in 1 to 9 CIP scales. However, the conclusion of disease resistance cannot be made based on this result. Early blight disease did not appear among the clones. Early blight disease score was remaining same in all the clones.

In yield and yield attributes, L235-4 produced highest (192) numbers of seed size tubers (Table 1.2b). Highest (90.17 %) weight of seed size tubers was harvested from 391046.2. Highest (26) numbers and weight (50.16%) over size tubers were harvested from 393077.54. Total number of tubers per plot was counted highest (491) in L235-4 and weight (kg) harvested from 393077.159 (7.16kg) followed by L235-4 (7.10 kg).

Tuber yield variation was highly significant among the clones (Table 1.2b). Among the tested clones, L235-4 was the highest (31.74 t/ha) yielder followed by 393077.159 (31.14 t/ha), 393382.44 (29.77 t/ha), 393077.54 (29.42 t/ha), Kufri Chipsona –2 (29.32 t/ha), 394036.103 (26.14 t/ha), Kufri Chipsona –1 (23.87 t/ha), 389746.2 (23.72 t/ha), 393280.64 (23.62 t/ha), 394005.115 (23.36 t/ha) 391396.96 (22.56 t/ha) and 394051.4 (22.38 t/ha). Almost all the tested clones were found round in tuber shape and few of them are oval type. Clones 393280.64, 396010.42, 389746.2, 393339.242, 393385.39, 392228.66, 393280.57, 393382.44, 391396.96, Kufri Kanchan, 395014.97, 394005.115, 394007.55, 394003.161, 394036.103, 393574.72B and 394051.4 were found red skinned type and remaining clones were white to creamy white skinned type. Most of the tested clones were either medium or shallow eye depth and few of them were deep eyes.

Based on the various agronomic and yield data obtained from last two years, clones 392228.66 393280.64, 396010.42, 393077.159, 389746.2, 393385.39, 393280.57, 393382.44, 391396.96, 393077.54 and Kufri Chipsona –2 are promoted to Coordinated Varietal Trial (CVTs). Clones 392657.8, 391617.54, 392637.10, 393339.242, K. Kanchan, 391002.6, 395014.97 and 392271.58 are discarded from the evaluation scheme and rests of the clones are recommending for retest one year more under Khumaltar condition.

Table 1.2a Vegetative characteristics of IET at NPRP Khumaltar, 2004/05

Clones	Emerg-ence %	Unifmty (1-5)	Ground cover (%)	Plant height (cm)	Plant vigor (1-5)	No. of stems/pt	Maturity	Late blight (1-9)	Early blight (1-9)
392657.8	98	4	80	57.73	4	3	L	1	1
393280.64	65	3	68	69.46	3	3	M	1	1
396010.42	94	4	87	50.73	5	4	L	1	1
392271.58	98	3	77	45.73	4	3	M	1	1
391617.54	94	3	57	67.33	3	3	M	1	1
393077.159	90	5	87	57.93	5	4	M	1	1
392637.10	81	3	73	61.2	4	3	M	1	1
389746.2	96	5	80	51.33	5	2	M	1	1
393339.242	96	4	65	61.53	5	4	M	1	1
393385.39	90	3	72	58.6	3	4	E	1	1
392228.66	98	3	68	38.46	4	3	E	1	1
393280.57	90	3	70	43.06	3	3	L	1	1
393382.44	96	4	82	64.2	4	3	E	1	1
391396.96	96	4	72	93.6	4	4	M	1	1
393077.54	94	4	87	57.66	4	3	L	1	1
Kufri Chipsona- 1	96	4	78	54.33	4	3	M	1	1
Kufri Chipsona -2	94	4	78	57.26	4	4	L	1	1
Kufri Kanchan	98	4	68	44.93	4	4	E	1	1
391002.6	75	4	50	58.4	4	3	M	1	1
395014.97	94	3	72	71.66	4	3	L	1	1
394005.115	98	5	98	45.73	5	4	M	1	1
391061.73	73	3	68	59.33	3	3	M	1	1
394007.55	88	3	80	54.46	3	2	L	1	1
391058.38	92	4	80	46	4	3	E	1	1
394003.161	79	3	80	43.13	4	3	E	1	1
391046.2	83	3	57	45.73	3	4	M	1	1
394036.103	94	4	87	57.33	4	4	L	1	1
393574.72B	96	4	82	53.46	4	3	L	1	1
394051.4	98	5	83	47	5	3	E	1	1
P161-3	58	2	35	28.46	3	2	M	1	1
Q132-53	85	2	27	32.93	3	2	L	1	1
NY 123	48	1	18	16.53	2	2	E	1	1
L235-4	98	5	93	43.06	5	4	L	1	1
Kufri Jyoti (ch)	96	4	80	37.8	5	5	M	1	1
Desiree (ch)	100	5	85	40.13	5	4	E	1	1

E=Early, M=Medium, L=Late

Table 1.2b Yield characteristics of IET at NPRP Khumaltar, 2004/05

Clones	No. of plant Hvtd	Tuber grading (# & % wt)						Total		Adjusted yield (t/ha)	Tuber characteristics			
		US		SS		OS					Sha-pe	Col-or	Ey e	Pt. type
		#	wt	#	wt	#	wt	#	wt					
392657.8	12	35	4.79	92	71.88	13	23.32	140	5.26	21.48 bcdefghi	R	W	M	E
393280.64	13	20	2.38	73	56.93	18	40.68	111	5.53	23.62 abcdefgh	RF	LR	M	E
396010.42	13	38	5.59	86	70.45	11	23.95	134	4.76	20.98 cdefghij	RF	LR	S	E
392271.58	13	26	11.71	69	65.51	8	22.76	103	4.43	19.75 defghijkl	RF	W	S	S
391617.54	11	14	3.97	61	76.39	6	19.62	82	3.01	10.93 klm	R	W	M	E
393077.159	12	34	3.48	80	70.18	16	26.33	131	7.16	31.14 ab	RF	W	M	E
392637.10	11	26	3.57	76	60.17	13	36.25	115	4.80	17.84 fghijkl	R	W	S	E
389746.2	13	32	5.7	60	49.33	16	44.95	107	5.36	23.72 abcdefgh	RF	LR	M	S
393339.242	13	52	13.56	75	81.49	2	4.95	129	2.61	11.40 jklm	R	R	M	S
393385.39	12	71	9.08	91	62.59	13	28.32	174	5.23	20.62 cdefghijk	R	R	D	S
392228.66	10	52	7.74	62	66.07	8	13.75	122	5.25	18.40 fghijkl	O	R	S	S
393280.57	12	24	4.41	69	61.32	14	34.87	107	4.16	17 fghijkl	R	R	D	E
393382.44	13	41	4.56	106	67.37	17	28.05	164	6.56	29.77 abc	RF	R	M	E
391396.96	13	60	9.64	85	67.48	12	22.87	157	5.23	22.56 abcdefghi	R	DP	M	E
393077.54	13	38	4.25	69	45.58	26	50.16	133	6.65	29.42 abcd	R	W	M	E
K. Chipsona -1	13	99	14.5	117	74.96	3	5.32	219	5.16	23.87 abcdefg	O	W	S	E
K. Chipsona -2	13	139	25.28	125	67.80	5	6.90	269	6.33	29.32 abcde	R	W	S	S
K. Kanchan	11	78	33.71	40	63.51	1	2.77	119	1.70	6.87 mn	O	R	M	S
391002.6	10	88	2.87	56	68.29	9	28.83	153	3.54	12.75 ijklm	RF	W	D	E
395014.97	13	23	4.45	64	60.87	12	34.66	99	4.45	19.45 efghijkl	RF	R	M	E
394005.115	13	63	9.73	139	84.83	2	5.43	204	5.13	23.36 abcdefgh	RF	R	S	S
391061.73	10	39	4.51	70	54.10	20	41.37	128	5.93	20.80 cdefghijk	R	W	S	E
394007.55	12	52	7.95	73	67.40	12	24.64	137	5.28	22.15 abcdefghi	R	R	M	E
391058.38	12	29	7.06	73	80.91	4	12.01	106	3.57	15.04 ghijklm	R	W	M	E
394003.161	11	63	13.8	68	59.76	6	15.56	137	3.60	14.01 ghijklm	OB	R	S	S
391046.2	11	54	9.82	110	90.17	0	0.00	164	1.53	13.83 hijklm	OB	W	M	S
394036.103	12	79	10.54	152	80.00	6	9.44	237	6.23	26.14 abcdef	R	R	S	E
393574.72B	12	21	2.73	84	74.38	9	22.87	114	4.35	17.75 fghijkl	O	R	M	E
394051.4	12	19	2.48	68	48.76	21	48.75	109	5.33	22.38 abcdefghi	O	LR	S	S
P161-3	7	54	15.08	60	71.08	3	13.83	117	2.63	9.94 lmn	RF	W	M	S
Q132-53	11	28	9.6	39	78.22	3	12.16	70	1.75	6.65 mn	R	W	M	S
NY 123	5	28	100	0	0.00	0	0.00	28	0.31	0.62 n	R	W	S	E
I.235-4	13	259	29.54	192	70.45	0	0.00	491	7.10	31.74 a	R	CW	S	S
Kufri Jyoti (ch)	12	34	3.8	97	70.04	12	26.14	144	5.26	22.20 abcdefghi	O	W	S	S
Desiree (ch)	14	28	5.93	73	75.80	7	18.26	108	4.00	18.61 ghhijkl	O	R	S	S
CV										31.57%				
F-test										**				
LSD (0.05)										9.93				

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test. Rf =Round flat, R =Round, Ob= oblong, O =Oval, W=White, LR=Light red, R=Red, CW=Creamy white, DP=Dark purple, S=Shallow eye depth, M=Medium eye depth, D=Deep eye , E=Erect habit, S=Spreading habit,

At ARS (Horti.) Jumla, eighteen different germplasms were evaluated and compared with Desiree, Jumla Local and Kufri Jyoti (Table 1.3). Highest (100%) emergence was counted in clones 393339.242, 391002.6 and 391396.96 whereas lowest (21%) in 391617.54. Plant uniformity was highest (5) in 392657.8 followed by 391396.96 and the lowest (1) in 391617.54 in 1 to 5 scales. Plant uniformity of remaining clones was ranged from 3 to 4. Ground cover was found highest (100%) in 393339.242, 391002.6 and 391396.96. Average plant height was varied among the tested clones. Tallest (43cm) plant was measured in 393339.242 followed by 393280.64 (43cm) and dwarfest (13 cm) in 396082.7, Desiree and Kufri Jyoti. Number of main stems per plant was counted highest (5) in 385556.4, 393382.44, 392657.8, 392637.10, 393077.54 and 393385.39 whereas lowest (2) in 396082.7. Clones 396082.7, 395014.53 and 391617.54 were found highly resistant (1) to late blight disease whereas most of the tested clones were characterized as resistant ranged from 2 to 3 in 1 to 9 CIP scales.

With respect to yield and its attributes, clone 392661.18 yielded highest (57) number of seed size tubers whereas highest (51%) weight of seed size tubers were harvested from clone 393385.39.

Number of oversize tuber production was highest (22) in 393077.159 and weight (55%) was in 392637.10 followed by 393233.387 (53%) and 396009.16 (52%). Likewise, total tuber number and weight (kg) per plot were harvested also from 362661.18 with 155 and 4.1 kg, respectively.

The yield differences among the clones were statistically significant (Table 1.3). The maximum yield was harvested from 392661.18 (16.87 t/ha) followed by 393077.159 (16.41 t/ha) and 393280.64 (14.51 t/ha). Except the yield of clone 391617.54 (1.90 t/ha), 396082.7 (5.09 t/ha) and 395014.53 (5.3 t/ha), all the tested clones were produced higher yield than Kufri Jyoti (6.98 t/ha). Except the long tuber shape of 396082.7, all the clones were either oval or round tuber shapes. Clones 392382.44, 393339.242, 391396.96 and 393385.39 were found purple skinned whereas 393280.64, 396009.16, 395014.53, 393280.57 and 392661.18 were red skinned colored and rests of the clones were white skinned types. With regard to maturity, clone 392082.7 and 391617.54 were characterized as early maturing, 396009.16, 395014.53, 393233.38, 393077.54 and 393385.39 were medium and the rests were found late maturing type (Table 1.3).

Based on various agronomic and yield data observe from the trial, clones 392661.18, 393280.64, 392637.10, 393339.242, 391396.96, 393385.39, 396009.16, 385556.4 are promoted to coordinated varietal trials (CVTs). Clones 393280.57, 395014.53, 391002.6, 396233.38, 393382.44, 396082.7 and 393077.54 are discarded from the varietal evaluation and 385556.4 and 391617.54 are recommended for further testing one year more in high hill condition.

Table 1.3 Plant and yield characteristic of IET at ARS (Hort.) Jumla, 2004/05

Clones	Emer-	Unifor-	Ground	Plant	Stem	Late blight	No. of	Tuber grading (# & % wt)						Total/plot		Total	Tuber characteristics		Maturity
								US		SS		OS							
	gence	mity	cover	height	/plant	score	harv.	#	wt	#	wt	#	wt	#	wt(kg)	yield	Shape	color	
	(%)	(1-5)	(%)	(cm)		(1-9)	plants									(t/ha)			
385556.4	96	4	95	21	5	3	15	35	21	31	43	17	36	83	3.2	13.34 abcd	R	W	L
393382.44	96	4	96	28	5	2	15	34	24	23	38	15	37	71	1.8	7.48 defgh	R	P	L
393339.242	100	4	100	43	4	2	14	21	20	24	42	11	38	56	2.3	9.7 bcdeg	R	P	L
393280.64	96	4	96	43	4	2	16	26	16	26	36	20	48	72	3.48	14.51 abc	R	R	L
396082.7	65	3	64	13	2	1	8	36	22	15	25	6	20	56	1.2	5.09 fgh	L	W	E
393077.159	98	4	98	33	4	3	15	33	15	30	36	22	49	84	3.9	16.41 ab	O	W	L
396009.16	96	4	96	25	3	2	13	20	19	15	29	11	52	45	1.3	7.84 cdefgh	O	R	M
395014.53	98	3	98	26	3	1	15	28	32	17	38	8	30	54	2	5.30 efgh	R	R	M
393280.57	96	4	95	27	4	2	15	41	28	26	44	9	28	75	3.2	8.36 cdefgh	R	R	L
393233.38	90	3	87	39	3	2	15	25	13	24	34	18	53	67	2.7	13.40 abcd	R	W	M
392657.8	96	5	96	26	5	2	12	18	14	24	48	13	37	54	3.1	11.22 abcdef	R	W	L
392637.10	94	4	93	30	5	2	14	24	14	22	39	18	55	64	4.1	12.94 abcd	R	W	L
392661.18	90	3	89	20	4	3	15	84	34	57	42	14	24	155	3.2	16.87 a	R	R	L
393077.54	81	3	81	29	5	2	15	25	18	17	34	15	43	57	1.7	13.40 abcd	O	W	M
391002.6	100	4	100	33	4	3	14	15	14	15	42	9	44	40	2.86	7.02 defgh	O	W	L
391396.96	100	5	100	41	4	2	14	26	16	21	47	13	37	61	2.9	11.94 abcde	O	P	L
393385.39	98	4	98	34	5	2	15	56	21	38	51	13	39	107	0.5	12.11 abcde	R	P	M
391617.18	21	1	21	20	3	1	2	30	5	3	10	3	18	9	1	1.90 gh	O	W	E
Desiree (ch)	90	3	89	13	4	1	6	32	35	19	30	12	35	63	2.73	4.20 gh	L	R	E
Jumla Local (ch)	85	3	85	19	4	2	14	117	44	35	37	17	18	169	1.7	11.38 abcdef	L	W	M
Kufri Jyoti (ch)	92	4	91	13	4	4	12	33	27	23	41	9	31	65	1.7	6.98 defgh	O	W	M
CV(%)																41.06			
F-test																**			
LSD (0.05)																6.824			

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test. R=Round, L=Long, O=Oval, W=White, P=Purple, R=Red, L=Late, E=Early, M=Medium

1.1.2 COORDINATED VARIETAL TRIALS (CVT)

Introduction

This is the second step of multi-location on-station testing for clonal evaluation. The lines tested and promoted from IET are included in this study for further evaluation of their desirable characteristics in different locations of the country. Under this scheme, the candidate lines are assessed for two years and only the promising lines are promoted to farmers' field trials.

Materials and Methods

This trial was conducted in two different locations of terai (RARS Tarahara and Nepalgunj) and two locations of the hills (Pakhribas and Lumle). In all locations, the trials were laid out in randomized complete block design (RCBD) with 4 replications. The plot size was 7.2 m^2 with the spacing of 60 X 25 cm between the rows and plants, respectively.

Plots were fertilized at the rate of 100:100:60 kg NPK/hectare along with 20 mt compost as basal dose in furrow. Seed of 25 -50 g sizes were used in the trials and all other cultural practices were followed as per PRP recommendations. Analysis of variance (ANOVA) was performed using computer statistical analysis programme MSTAT - C. Treatment means were separated using LSD at 0.05 levels.

Potato clones and varieties tested in terai and hill locations are presented below.

TERAI (Winter season planting)		HILLS (Summer season planting)	
RARS Nepalgunj	RARS Tarahara	ARS Lumle	ARS Pakhribas
396233.25	388764.26LB	392661.18	392240.29
396082.21	396233.25	392236.6	392240.22
392254.33	396082.21	LBr 40	392243.17
392242.25	392254.33	392233.25	391598.75
392250.56	392242.25	BSUPO3	392236.6
LBr 44	392250.56	396233.64	392254.33
LBr 40	LBr 44	396009.16	LBR 40
392271.58	LBr 40	392233.24	396082.21
389746.2	396009.16	396082.7	396233.25
396233.64	396010.37	K. Giriraj	BSU PO3
396010.37	Kufri Sutlej	392254.33	Desiree (ch)
396010.42	392271.58	K. Jyoti (ch)	K. Jyoti (ch)
Kufri Sutlej	391011.17	Desiree (ch)	Sarkari Seto (ch)
Desiree (ch)	389746.2	Ghandruk Local (ch)	
K. Sindhuri (ch)	396233.34		
	Desiree (ch)		
	Kufri Sindhuri (ch)		

Results and Discussion

Terai

At RARS, Nepalgunj, thirteen different clones were evaluated with standard check varieties Desiree and Kufri Sindhuri (Table 1.4). Plant uniformity was observed highest (5) in clones 392242.25, 392250.26, LBr 44, LBr 40, 389746.2, 396010.37, Kufri Sutlej and check variety Kufri Sindhuri. Highest (99%) ground cover was recorded in LBr 44 and lowest (70%) in 396082.21 followed by 392271.58 (70%). Clone 396233.64 produced the tallest (75cm) plant

whereas dwarfest (51cm) in 396082.21. Average number of main stem per plant was counted highest (5) in 396233.25, LBr 44 and check variety Desiree. Clone 396233.25, 396082.21, LBr 44, LBr 40, 392271.58, 389746.2, 396233.64 were seemed highly resistant (1) to late blight disease in 1 to 9 scales whereas 396010.37 was susceptible to this disease. Based on this trial, clone 396233.25, 396082.21, 392254.33, 392250.56, LBr 44 were regarded as early and all others were medium maturing type.

With respect to yield and yield attributes, Kufri Sinduri, one of the check variety produced highest (167) number of seed size tubers. Desiree produced highest (59 %) weight of seed size tubers followed by 396010.37 (52%). Highest (82) number of oversize tuber and weight (64%) was produced from clone 389746.2. Likewise, total number of tubers per plot was counted highest (534) in Kufri Sindhuri followed by 392250.56 (431). Highest (23.41 kg) yield per plot was harvested from 389746.2 and the minimum (6.85kg)) in 396010.42 (Table 1.4).

Highly significant difference was observed in yield tons per hectare among the tested clones. Clone 389746.2 gave highest (32.5 t/ha) yield followed by LBr 40 (27.20 t/ha), 392242.25 (25.38 t/ha) and Kufri Sutlej (24.53 t/ha) (Table 1.4). Clone 392233.25, 389746.2 and 396233.64 were pink colored tuber. Except the red skinned tuber color of clone 396010.42, all others clones were white tubers skinned. Most of the tested clones were round shape and some of them were either long or oblong in shape. Regarding the eye depth, four clones were identified as deep eye, two clones were medium and seven clones were shallow eye depth.

On the basis of the results obtained from two years data, clone 392242.25, 392250.56, LBr 44 and LBr 40 are promoted to Coordinated Farmers Field Ttrials (CFFTs) and rests are recommended for further testing in the varietal evaluation scheme of the program. Clone 396233.25 is discarded from the evaluation and rests are recommended for further testing.

At RARS, Tarahara, fifteen different clones were tested along with the check varieties Desiree and Kufri Sindhuri (Table 1.5). Highest (98%) emergence was found in clone 392242.25 followed by 396082.21 (95%) whereas minimum (37%) in 392250.56. Plant uniformity varied among the tested clones. Except the uniformity of clone 391011.17 (2), plant uniformity of all the clones were ranged from 3 to 4 in 1 to 5 scales. Clone 392242.25 produced highest ground cover (97%) followed by 396233.64 (90). Average plant height was highest (53cm) in 396233.64 followed by 396082.21 (52 cm). Average number of main stems per plant was found highest (4) in 388764.26 LB, 392242.25, 392250.56 and Kufri Sindhuri whereas lowest in 396009.16(2) and 392271.58 (2).

Kufri Sindhuri produced highest (119) number and weight (22%) of undersized tuber. Desiree produced highest (183) number of seed size tubers whereas highest (69%) weight from 396082.21. In oversize tuber production, Kufri Sutlej gave the highest (40) number and clone 396010.37 gave the highest (53%) weight followed by 392271.58 (50%). Total number and weight (kg) of tubers per plot were harvested highest from Kufri Sindhuri (282) and 389746.2 (13.36 kg), respectively (Table 1.5).

Highly significant yield difference was observed among the tested clones (Table 1.5). Clone 389746.2 gave highest (18.56 t/ha) yield followed by 392242.25 (17.73 t/ha). Lowest yield was recorded in 396005.16 (4.42 t/ha), LBr 44 (5.18), 391011.17 (5.21 t/ha) and 396233.25 (5.65 t/ha) as compared to check variety Kufri Sindhuri (8.98 t/ha). Except the yield of clones 392242.25, 392250.56, 389746.2 and 392254.33, all the tested clones gave lower yield than both of the check variety. Tuber shapes of clones were either round or long type. Clone 396233.25, 396009.16 and 389746.2 were red skinned tuber and all clones were white skinned tubers. Plant types of tested clones were either erect or spreading types.

Table 1.4 Plant and yield characteristics of CVT at RARS Nepalgunj, 2004/05

Clones	Uniformity (1-5)	Ground cover (%)	Plant t heigh (cm)	Stems/ plant (#)	Late blight (1-9)	Maturity	Tuber grading (# & % wt) US #	US wt	SS #	SS wt	OS #	OS wt	Total #	Total wt (kg)	Total yield (t/ha)	Tuber characteristics Color	Tuber characteristics Shape	Eye depth
396233.25	4	80	63	5	1	E	174	29	133	48	28	23	309	11.32	15.72 f	P	Ro	M
396082.21	4	70	51	2	1	E	69	11	77	49	34	40	164	11.23	16.60 f	W	L	S
392254.33	4	79	46	3	4	E	47	13	31	28	30	59	109	8.11	11.26 g	W	L	S
392242.25	5	90	55	4	2	M	88	11	124	40	77	48	288	18.27	25.38 bc	W	L	S
392250.56	5	90	57	4	4	E	244	29	126	44	36	28	431	15.3	21.11 dc	W	Ob	S
LBr 44	5	99	68	5	1	E	228	26	150	51	31	22	408	15.02	20.86 de	W	Ro	S
LBr 40	5	94	64	4	1	M	163	11	137	41	77	48	377	19.58	27.20 b	W	Ro	D
392271.58	3	70	62	3	1	M	95	14	65	35	46	51	205	13.5	18.75 ef	CW	L	M
389746.2	5	98	67	3	1	M	93	9	86	23	82	64	261	23.41	32.5 a	P	Ob	D
396233.64	4	84	75	3	1	M	134	16	135	46	49	38	317	16.87	23.41bcd	P	Ro	D
396010.37	5	90	56	4	5	M	159	19	143	52	40	29	342	15.1	20.97de	W	Ro	S
396010.42	4	84	61	4	2	M	92	19	59	45	20	37	14	6.85	9.51g	R	Ro	D
Kufri Sutlej	5	94	56	3	4	M	81	11	90	37	59	32	229	17.66	24.53 bcd	W	L	S
Desiree (ch)	4	86	60	5	3	E	172	18	164	59	30	23	365	15.65	21.73 cde	R	L	M
K. Sindhuri (ch)	5	95	71	4	4	M	331	33	167	47	36	20	534	13.88	19.28 ef	R	Ro	D
CV (%)															13.67			
F-test															**			
LSD (0.05)															4.006			

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test E=Early, M=Medium, L=Late, P=Pink, R=Red, W=White, CW=Creamy white, Ro=Round, Ob=Oblong, L=Long, S=Shallow, M=Medium, D=Deep eye

Table 1.5 Plant and yield characteristics of CVT at RARS Tarahara, 2004/05

Clones	Emer-gence (%)	Uni-formity (1-5)	Ground cover (%)	Plant height (cm)	Stem/ plant (#)	Tuber grading (# & % wt) US #	US wt	SS #	SS wt	OS #	OS wt	Total #	Total wt (kg)	Yield (t/ha)	Tuber characteristics Shape	Tuber characteristics Color	Plant type
388764.26LB	86	4	82	40	4	73	12	153	67	15.7	21	242	7.71	10.71 bcde	Ro	P	S
396233.25	83	3	63	40	3	72	20	93.33	59	18	20	183	4.07	5.65 fgh	Ro	R	E
396082.21	95	4	87	52	3	48	7	119.3	69	18	25	186	8.16	11.34 bcde	O	W	S
392254.33	94	4	78	33	3	58	11	134.3	50	34	44	226	9.13	12.69 b	Ro	W	E
332242.25	98	4	97	48	4	40	7	109	57	34	39	183	12.76	17.73 a	Ro	W	E
392250.56	37	4	77	39	4	90	13	117	55	28	31	236	9.8	13.61 b	Ob	W	E
LBr 44	80	3	83	41	3	54	20	85	60	9	20	148	3.73	5.18 gh	Ro	W	E
LBr 40	86	4	78	44	3	51	8	76.33	49	34	46	161	8.71	12.1 bcd	Ro	W	E
396009.16	51	2	47	31	2	22	11	32	43	9	29	63	3.81	4.42 h	Ro	R	S
396010.37	78	3	68	35	3	51	11	61	44	25	53	136	5.7	7.91 efgl	Ro	W	E
Kufri Sutlej	83	4	82	39	3	44	8	87.66	55	40	37	171	8.33	11.57 bcde	L	W	E
392271.58	65	3	68	42	2	24	5	56.66	45	25	50	106	6.05	8.4 defg	L	W	S
391011.17	54	2	52	38	3	24	19	35.33	51	10	30	73	3.75	5.21 gh	O	W	S
389746.2	92	4	92	45	3	36	4	100	56	26	40	163	13.36	18.56 a	O	R	E
396233.64	93	4	90	53	3	73	6	118.7	56	29	36	221	8.43	11.71 bcd	Ro	W	S
Desiree (ch)	93	4	88	37	3	78	11	183	63	21	23	282	8.76	12.17 bc	L	R	E
Kufri Sindhuri (ch)	91	4	87	47	4	119	22	129	63	11	14	258	6.46	8.98 cdef	Ro	R	E
CV (%)														21.3			
F-test														**			
LSD(0.05)														3.708			

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test. Ro=Round, R=Red, L=long, W=White, Ob= oblong, P=Purple, L=Long S=Spreading, E=Erect

Based on the result obtained from two years, clones 392242.25, BSU PO3 and LBr 40 are promoted to Coordinated Farmers Field Trial (CFFTs). Clones 396233.25, 392250.56 and LBr 44 are discarded from the evaluation scheme and rests clones from the trials are recommended for one year more in RARS, Tarahara.

Hills

At ARS Pakhribas, twelve different clones were evaluated with the standard check varieties Kufri Jyoti, Desiree and Local Rato (Table 1.6). Clone 396233.64 showed highest (100%) emergence and lowest (75%) in clone 392243.17. Plant uniformity were highest (5) in 392661.18, 392236.6, LBr 40, 392233.25, 396233.64, 396233.24, 396082.21, 395014.53, Kufri Jyoti and Desiree whereas lowest (1) in 396009.16. Highest (93%) ground cover was recorded in 396082.21 followed by 396233.24 (91%), BSU PO3 (90%) and Kufri Jyoti (90%) whereas lowest (75%) in 396082.7. Similarly, average plant height was measured highest (47cm) in Local Rato and lowest (34cm) in Kufri Jyoti. Clone 392236.6 and BSU PO3 produced the highest (5) main stems per plant and whereas lowest (3) in most the tested clones. With respect to undersize seed production, highest number (214) and weight (44%) were harvested from BSU PO3 and 396233.64, respectively. In seed size tuber production, clone 392661.18 found highest (116) followed by BSU PO3 (110). Highest (44%) percentage of seed size tuber weight was produced from 392236.6. Similarly, Highest (57) number and weight (43%) of oversized tuber produced from LBr 40 and 392243.17, respectively. BSU PO3 produced the highest (373) number of tuber per plot. Total weight (kg) per plot was harvested highest (11.57 kg) in LBr 40 followed by 392661.18 (10.85 kg).

The yield was highly significant among the clones (Table 1.6). LBr 40 gave significantly higher (16.07 t/ha) yield. However, yield obtained from the clones LBr 40 (16.07 t/ha), 392661.18 (15.06 t/ha), BSU PO3 (14.82 t/ha), Local Rato (14.27 t/ha) and Kufri Jyoti (14.06 t/ha) were statistically at par. Clone 392661.18, 396233.64, 396009.16, 395014.53 were characterized red skinned tuber and rests clones were white skinned tubers. Regarding the tuber shape, most of the clones were round shape and few of them were long or oval shaped. Plant types of tested clones were either erect or spreading type.

Based on the agronomic and yield results of past two years data, LBr 40, BSU PO3 and 392233.25 are promoted to coordinated variety trial (CFFT). Clones 392243.17, 396082.21 and 392236.6 are discarded from the evaluation scheme and rests are recommended for CVT one year more in Pakhribas areas.

At RARS Lumle, eleven different clones were evaluated and compared with Kufri Jyoti, Desiree and Ghandruk Local (Table 1.7). Highest (3) numbers of sprouts were counted in LBr 40, 392233.25 and Desiree, one of the check variety. Plant emergence was recorded highest (91%) in Kufri Jyoti followed by 396233.64 (90 %), LBr 40 (89%) and BSU PO3 (89%). Except the uniformity of clone 396082.7 (2), plant uniformity of all the clones were ranged from 4 to 5 in 1 to 5 scales. Likewise, ground covers were also ranged from 10 % to 51 %. Highest (51%) ground cover was observed in LBr 40 and lowest (10%) in 396009.16. Variation among the average plant height was observed in the clones. Tallest (50cm) plant was measured in Ghandruk Local variety whereas dwarfest (17cm) height in 396082.7. Except the highest stem number of clone 392236.6 (5), average number of main stems per plant was ranged from 3 to 4. BSU PO3 showed highly resistant (1) to early blight disease among the clones. LBr 40 and 396082.7 were found highly resistant (1) to late blight disease (Table 1.7). Clone 396009.16 has recorded no observable symptoms of late blight disease.

Highest (268) number and weight (92%) of undersized tuber produced from 392236.6 and 396082.7, respectively. Similarly, clone 392661.18 and 392233.25 produced higher seed sized number (90) and weight (40%). Highest (29) number and weight (33%) over sized tuber was harvested from 392661.18. Total number of tuber per plot was highest (409) in 392661.18 and the lowest in 396009.16. Likewise, total weight (kg) per plot was harvested highest (11.32kg) in 392661.18 and lowest (1.2kg) in Desiree.

Table 1.6. Plant and yield characteristics of CVT at ARS Pakhribas, 2004/05

Clones	Emer-gence (%)	Uni-formity (1-5)	Ground cover (%)	Plant height (cm)	Stem/ plant (#)	No.of plant havst	Tuber grading (# & % wt)						Yield / plot		Yield (t/ha)	Tuber characteristics		Plant type
							US		SS		OS							
							#	wt	#	wt	#	wt	#	wt (kg)		color	shape	
392661.18	89	5	89	43	3	40	168	29	116	40	51	31	334	10.85	15.06 a	LR	L	S
392236.6	93	5	88	45	5	37	192	30	109	44	48	25	349	8.7	12.08 bc	W	R	E
LBr 40	95	5	90	40	3	42	151	26	102	35	57	39	310	11.57	16.07 a	W	R	E
392233.25	97	5	89	36	3	42	194	41	86	37	27	22	307	7.43	10.33 cde	W	R	E
BSU PO3	92	4	90	38	5	41	214	33	116	41	44	26	373	10.67	14.82 a	W	R	E
396233.64	94	5	86	43	3	40	157	34	87	39	33	27	277	6.82	9.47 cdef	R	R	E
396009.16	86	1	68	45	3	37	81	24	69	37	31	39	181	6.7	9.30 def	R	R	E
396233.24	100	5	91	42	4	40	183	44	85	37	25	19	293	6.88	9.56 cdef	W	R	S
396082.7	83	2	75	37	4	35	125	40	51	28	28	32	204	5.11	7.10 f	W	L	S
396082.21	95	5	93	39	3	38	125	29	81	40	40	32	245	8.42	11.69 bcd	W	L	S
392243.17	75	2	60	42	4	35	94	22	63	36	40	43	196	7.72	10.72 cde	W	R	E
395014.53	89	5	88	38	3	37	182	39	71	39	26	23	279	6.02	8.36 ef	LR	R	E
K. Jyoti (ch)	95	5	90	34	3	40	168	29	106	39	49	32	323	10.12	14.06 ab	W	O	S
Desiree (ch)	93	5	79	35	3	39	161	34	66	35	40	31	266	6.92	9.61 cdef	R	L	E
Local Rato (ch)	89	4	79	47	3	39	148	26	105	41	39	34	244	10.27	14.27 ab	R	R	E
CV (%)															16.54			
F-test															**			
LSD (0.05)															2.715			

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test. LR=Light red, W=White, R=Red, L=Long, R=Red, O=Oval, S=Spreading, E=Erect

Table 1.7 Plant and yield characteristics of CVT at RARS Lumle, 2004/05

Clones	No. of sprout	Emergence %	Uniformity (1-5)	Grd. cover (%)	Pt ht (cm)	Stem /pt (#)	Early blight (1-5)	Late blight (1-9)	No. of havsd plants	Tuber grading (# & % wt)						Yield / plot		Total yield (t/ha)	Tuber characteristics		Flower	Pt type
										US		SS		OS					Shape	Color		
										#	wt	#	wt	#	wt	#	kg					
392661.18	2	85	5	45	40	4	2	2	38	290	44	90	32	29	23	409	11.3	15.5 a	O	R	F	S
392236.6	2	83	5	43	44	5	2	2	35	268	48	79	36	17	16	364	7.72	10.75b	L	W	F	S
LBr40	3	89	5	51	37	3	4	1	34	152	45	38	33	14	21	204	4.72	6.57c	Ro	W	F	S
392233.25	3	79	3	23	30	3	3	2	25	106	56	21	40	2	4	129	1.97	2.75de	O	W	F	E
BSUPO3	2	89	5	18	33	4	1	2	33	178	49	35	33	12	18	226	4.5	6.22 cd	O	W	N	E
396233.64	2	90	4	23	34	3	2	2	25	145	59	21	17	14	23	180	3.07	4.27 cde	O	M	F	E
396009.16	2	53	4	10	36	4	3	0	25	75	60	7	7	14	33	96	2.1	2.90 cde	O	R	F	E
392233.24	2	88	4	23	31	3	3	2	21	89	59	10	19	8	21	107	2.05	2.82 cde	Ro	W	F	E
396082.7	2	61	3	13	17	3	3	1	20	104	92	3	7	0	0	107	1.2	1.67e	L	W	F	E
K. Giriraj	2	79	5	20	22	3	2	3	25	84	57	17	33	3	8	104	2.17	2.97 cde	O	W	F	E
392254.33	2	81	4	15	24	3	2	2	24	97	53	15	26	12	20	124	2.12	2.95 ce	R	W	F	S
K. Jyoti (ch)	2	91	5	28	23	3	2	3	29	139	52	33	31	10	17	181	4	5.57cd	R	W	F	E
Desiree (ch)	3	77	5	14	21	3	2	2	8	63	78	7	22	0	0	70	0.85	1.20e	L	R	F	E
Ghandruk Local (ch)	1	76	5	41	50	4	0	3	36	256	46	82	38	18	17	356	8.72	12.15ab	L	W	F	S
CV (%)																		26.06				
F-test																		**				
LSD (0.05)																		3.3				

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test.O= Oval, L=Long, Ro=Round, R=Red, W=White, F=Flower, N=Non-flower, S=Spreading, E=Erect

The yield variation was highly significant (Table 1.7). Clone 392661.18 yielded highest (15.5 t/ha) yield as compared to other varieties. Apart from the yield of clone 392661.18 (15.5 t/ha), yield of the entire clone remained lower than the yield of the local check Ghandruk variety. As far as shape is concerned, tuber shapes of the tested clones were oval, long or round. Clone 396009.16 was red skinned tuber. Besides the red tuber skinned of clone 396009.16 and 392661.18, all the clones were white skinned tubers. All the tested clones beside BSU PO3 were flowered in the agro climatic condition of Lumle. Plant types of tested clones were either erect or spreading.

Based on the agronomic and yield data, clone 392236.6, LBr 40, 392233.25 and BSU PO3 are promoted to coordinated varietal trial, clone 392254.33 was discarded from the evaluation and rests clones are recommended to test for one year more under CVTs at Lumle's agroclimatic condition.

1.1.3 COORDINATED FARMERS FIELD TRIALS (CFFT)

Introduction

Clones promoted from on-station trials are tested as coordinated farmers' field trials (CFFT) in different sites throughout the country. In addition to the important plant and yield parameters, feedback is obtained from farmers on yield, tuber appearance, foliage characteristics and taste in comparison to existing popular varieties from respective locations during this stage. Cultivars selected from CFFT are further verified under farmers' field conditions as farmer's acceptance tests (FATs) prior to release the varieties for larger scale cultivation.

Materials and Methods

In all the locations under CFFTs, plots consisted four rows, each planted with 12 tubers. Rows were spaced at 60 cm apart and tuber in row were planted 25 cm apart. The trials were designed at RCBD with four replications. Plots were fertilized at the rate of 100:100:60 kg NPK and 20 tons compost per hector as basal dose in furrow. Seed size used were 25 to 50 g. Cultural practices was followed as per PRP recommendations.

Observations taken

- Emergence counting after 15 and 30 days after planting
- Uniformity after 5 -6 weeks using 1 - 5 scale
- Ground cover (%) average of 5 plants
- Number of main stems per plant; average of 5 plants
- Maturity categories
- Late blight rating (1-9) scale
- Insect damage on foliage
- Number of tubers/plant
- Tuber yield (kg/plot) with tuber number and weight by size class
- Farmer's rating on plant, tuber and taste

The potato clones used in CFFT at different locations are presented in the result tables of the respective locations below.

Terai (Winter season)		Hills (Summer Season)	
RARS, Nepalgunj	RARS Tarahara	ARS Pakhribas	RARS Lumle
392258.11	392258.11	378711.7	388580.6
392206.35	392660.6	388764.26LB	800947
392260.6	392206.35	391598.75	388578.2D
392256.48	392256.48	K. Jyoti (ch)	378711.7
388574.6D	27/15	Desiree (ch)	Primicia
RW 8201.19	388576.3D	Local Hale Rato (ch)	388764.26
Desiree (ch)	Desiree (ch)		K. Jyoti (ch)
K. Sindhuri (ch)	K. Sindhuri (ch)		Desiree (ch)
			Ghandruk Local (ch)

Results and Discussion

Terai

RARS Nepalgunj

At RARS Nepalgunj, six different clones were evaluated and compared with Desiree and Kufri Sindhuri (Table 1.8). Plant height was measured highest (65cm) in 392256.48 and lowest (58cm) in 392260.6. Plant uniformity was observed similar trend among the clones. Clone 392258.11 was highest (100%) ground foliage followed by check variety Desiree (99%) and Kufri Sindhuri (99%). Average number of stem per plant remained 3 to 4 in all the clones. Except Kufri Sindhuri (4), all the clones were seemed resistant to late blight disease ranged from 2 to 3 in 1 to 9 scales. In respect to plant maturity, except 388574.6D (early), all the clones were found medium maturing type (Table 1.8).

With respect to yield and its attributes, Kufri Sindhuri produced highest number (376) and weight (23%) undersize tuber. Similarly, highest (389) number of seed size tuber produced from Kufri Sinduri. Desiree gave highest (76%) weight of seed size tuber. RW 8201.19 produced higher (78) number and weight (55%) of oversize tubers. Total number of tuber per plot was highest (779) in Kufri Sindhuri followed by 392258.11 (408) whereas highest weight (24.5 kg) per plot was harvested from 392258.11.

The yield was highly significant (Table 1.8). Clone 392258.11 gave the highest yield (34.02 t/ha) followed by RW 8201.19 (27.6 t/ha). Clone 388574.6D gave the lowest yield (13.49 t/ha) yield among the tested clones. Clones 392206.35, 392260.6 and 388574.6D were red skinned tuber whereas others clones were white skinned tuber. Most of clones were either round or oblong shape of tuber except 392256.48 (long shape). The overall farmers' reaction on plant, tuber and taste was ranked well in all the tested clones.

Based on the results and farmers reaction of plant and yield characters, clones 392256.48, RW 8201.19 are recommended for farmers' acceptance test (FAT). Clone 388574.6D is discarded from the evaluation scheme and all other clones were recommended for further one year more evaluation in the farmer's field.

RARS Tarahara

At RARS Tarahara, six different clones were tested along with the check variety Desiree and Kufri Sindhuri (Table 1.9). Plant emergence was highest (100%) in clone 392260.6 followed by 392258.11 (99%) and Kufri Sindhuri (99%). Except the number of main stem of clone 392260.6 (2), all the clones were remained same (3) number of main stems per plant. Total weight (kg) per plot was harvested highest (19.01kg) followed by 392260.6 (18.66kg) (Table 1.9).

Table 1.8 Plant and yield characteristics of CFFT at RARS Nepalgunj, 2004/05

Clones	Pt ht	Unifo rmity	Ground cover	Stem /plant	LB score	Mat-urity	Tuber Grading (# & % wt)								Total yield	Tuber characteristic		Overall Farmer's Reaction		
							US		SS		OS		Total							
	(cm)	(1-5)	(%)	(#)	(1-9)		#	wt	#	wt	#	wt	#	wt	(t/ha)	Color	Sha pe	Plant	Tuber	Taste
392258.11	61	5	100	3	2	M	112	4	237	58	59	36	408	24.5	34.02 a	W	Ro	V. Good	Good	Good
392206.35	59	5	89	4	2	M	146	9	197	61	39	26	382	15.6	21.70 b	R	Ro	V.Good	Good	Good
392260.6	58	4	91	3	2	M	99	8	221	56	45	37	364	18.8	26.13 b	R	Ob	V.Good	Good	Good
392256.48	65	5	96	3	2	M	113	8	187	46	38	32	337	18.3	25.41 b	W	L	V.Good	Good	Good
388574.6D	60	4	86	3	2	E	62	13	116	58	36	38	213	9.71	13.49 c	R	Ro	Fair	Good	Good
RW 8201.19	59	4	89	3	2	M	55	6	138	42	78	55	269	19.9	27.60ab	P	Ro	V.Good	Good	Good
Desiree (ch)	64	5	99	4	3	E	137	8	290	76	26	15	452	19.1	26.49 b	R	L	V.Good	V.Good	V.Good
K. Sindhuri (ch)	61	5	99	4	4	M	376	23	389	68	15	9	779	16.1	22.42 b	R	Ro	V.Good	Good	Good
CV (%)															19.89					
F-test															**					
LSD (0.05)															7.213					

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test M=Medium, E=Early , W=White, R=Red, P=Purple, Ro=Round, Ob=Oblong, L=Long, V=Very

The yield was insignificant among the tested clones. Clone 3922606.6 gave highest yield (25.92 t/ha). Based on two years plant and yield data obtained, clone 392256.48 is promoted for farmers acceptance test (FAT) and other are retested for one year more in Tarahara's command areas.

Table 1.9 Plant and yield characteristics of FFT at RARS Tarahara, 2004/05

Clones	Emergence (%)	Number of stem/plant	Weight (kg/plot)	Yield (t/ha)
392258.11	99	3	17.36	24.12
392660.6	100	2	18.66	25.92
392206.35	96	3	15.7	21.8
392256.48	92	3	19.01	26.41
27/15	92	3	16.6	23.05
388576.3D	94	3	15.3	21.25
Desiree (ch)	94	3	16.3	22.63
K. Sindhuri (ch)	99	3	16.2	22.5
CV (%)				12.42
F-test				ns

ns = non significant

Hills

ARS Pakhribas

At ARS, Pakhribas three potato clones were evaluated where Kufri Jyoti, Desiree and Local Hale Rato used as check (Table 1.10). Plant emergence (%) seemed almost similar trends in the entire clone. Plant uniformity was found highest (5) in 388764.26 LB followed by 391598.75 (5). Ground cover was observed highest (90%) in 388764.26 LB and lowest (16%) in Local Hale Rato. Similarly, 388764.26 LB had highest (48cm) plant height and Local Hale Rato had lowest (39cm). Number of main stems per plant counted highest (8) in 388764.26LB. Clone 388764.26 LB seemed highly resistant (1) to late blight disease. All the clones were produced highest number and weight (%) of undersized tubers. However, Kufri Jyoti, one of the check varieties produced highest (112) number of undersize tuber whereas highest weight (44%) from 378711.7. Similarly, 388764.26LB produced highest (75) number of seed size and weight (41%). Total number and weight (kg) per plot were harvested from Kufri Jyoti (378) and 388764.26 LB (12.12 kg), respectively.

Highly significant difference was observed in yield tons per hectare. Clone 388764.26 gave highest (16.88 t/ha) yield followed by Kufri Jyoti (15.03) (Table 1.10). Clone 388764.26 LB regarded as late maturing type and remaining clones were medium maturing types. On the basis of plant, yield performance, tuber and taste, the overall farmers reaction were found well in clone 388764.26LB followed by 391598.75.

Based on the past two years result, clone 388764.26LB is recommended to farmers acceptance test (FAT) and other clones would be retested one year more in Pakhribas's command areas.

RARS Lumle

At RARS Lumle, six different clones were tested and compared with the Kufri Jyoti, Desiree and Ghandruk Local (Table 1.11). Highest (3) number of sprouts were produced in clones 388580.6, 388578.2D, 388764.26 and Ghandruk Local variety. Plant emergence was recorded highest (96%) in Ghandruk Local followed by Primicia (94%). Similarly, clone 388578.2D produced highest (5) plant uniformity. Percent ground cover by foliage ranged from 13 to 69. Clones 388578.2D produced highest (69%) ground cover followed by Ghandruk Local (69%). Highest (49cm) plant height was recorded in Primicia followed by 388764.26 (46cm) and Ghandruk Local (45cm). Numbers of main stems per plant were counted highest (7) in Primicia followed by 388764.26 (7). Most of tested clones were resistant to early blight disease. Likewise, 378711.7

and Desiree were seemed more resistant (2) than other clones.

In yield and yield attributes, Ghandruk Local produced highest (623) number of undersize tuber whereas highest weight (94 %) harvested from Primicia. Likewise, Ghandruk Local produced maximum (114) number of seed size tuber. Clone 388580.6 produced highest (33%) weight of seed size tuber. In oversize tuber production, highest (55) number and weight (26%) were harvested from Ghandruk Local (792) and 388580.6 (13kg), respectively (Table 1.11).

The yield differences among the clones were statistically significant (Table 1.11). Clone 388580.6 gave significantly higher yield (18.10 t/ha) followed by Ghandruk Local check variety (17.37 t/ha). Clones 388580.6 and 388578.2D are identified as red skinned tuber. Clone 388764.26 was identified as purple tuber skinned. Most of tested clones were round shape tuber except 388580.6 (oval shape). Most of tested clones were flowered at Lumle condition except 378711.7. Clone 378711.7 was identified as early maturing varieties whereas other tested clones were either medium or late maturing types. Plants of tested clones were either erect or spreading types.

Based on the agronomic and yield data obtained, all the clones are recommended for further testing one year more in Lumle's command areas.

Table1.10 Plant and yield characteristics of CFFT at ARS Pakhribas, 2004/05

Clones	Emer-gence (%)	Uni-formity (1-5)	Grd cover (%)	Pt ht (cm)	Stem/ plant (#)	Late blight (1-9)	No.of plant havsd	Tuber grading (# & % wt)						Yield / plot		Yield	Maturity	Overall Famers' Reaction			
								US		SS		OS									
								#	wt	#	wt	#	wt	#	kg	(t/ha)		Plant	Yield	Tuber	Taste
378711.7	94	4	80	41	3	7	43	183	36	94	44	30	20	307	7.22	10.03 c	M	Fair	Fair	Fair	Fair
388764.26LB	99	5	90	48	8	1	46	139	23	108	36	75	41	321	12.12	16.88 a	L	V.Good	V.Good	Good	Good
391598.75	98	5	85	45	7	7	46	167	28	97	41	35	31	299	7.82	10.86 c	M	V.Good	V.Good	Good	Good
K. Jyoti (ch)	98	4	85	44	3	7	44	223	35	112	41	43	25	378	10.82	15.03 a	M	Good	Good	Fair	Fair
Desiree (ch)	97	4	83	41	3	7	45	146	29	77	37	37	34	260	6.82	9.47 c	E	Good	Good	Good	Good
Local Hale Rato (ch)	99	4	16	39	4	7	47	164	29	99	40	41	30	303	9.27	12.88 b	M	Good	Good	Good	Good
CV (%)																9.69					
F-test																**					
LSD (0.05)																1.829					

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test. E=Early, M=Medium, L=Late

Table 1.11 Plant and yield characteristics of CFFT at RARS Lumle, 2004/2005

Clones	No. of sprout	Emer gence (%)	Unifor mity (1-5)	Grd cover (%)	Pt ht (cm)	Stem /pt (#)	Early blight (1-5)	Late blight (1-9)	No. of havtd plants	Tuber grading (# & % wt)						Yield / plot		Total Yield	Tuber character		Flo- wer	Mat urity	Pt ty pe
										US		SS		OS									
										#	wt	#	wt	#	wt	#	kg	(t/ha)	Color	Shape			
388580.6	3	92	4	59	41	5	3	4	43	606	45	103	33	46	24	766	13	18.10 a	R	O	F	M	E
800947	1	64	2	13	32	4	3	3	7	159	49	32	32	10	21	202	4	5.06 c	W	Ro	F	M	S
388578.2d	3	91	5	69	37	4	3	3	44	436	65	87	26	15	9	538	8	11.29 b	R	Ro	M	M	E
378711.7	2	80	2	24	27	4	3	2	4	130	61	13	18	7	21	149	2	2.89 c	W	Ro	N	E	E
Primicia	1	94	2	20	49	7	2	3	10	154	94	5	6	0	0	159	2	2.32 c	W	Ro	M	L	S
388764.26	3	88	4	65	46	7	2	4	43	473	58	82	30	31	13	585	10	13.64 b	P	Ro	M	L	E
K. Jyoti (ch)	2	92	2	29	22	3	3	4	19	191	65	20	20	18	15	229	4	5.43 c	W	O	F	E	S
Desiree (ch)	1	85	2	18	19	2	1	2	5	161	82	7	6	2	10	170	2	2.90 c	R	O	F	M	E
Ghandak Local(ch)	3	96	4	69	45	4	2	3	41	623	165	114	114	55	57	792	9	17.37 a	W	O	M	M	E
CV (%)																		26.06					
F-test																		**					
LSD (0.05)																		3.3					

** Significant at 1% level. Data with common letter(s) are not significantly different at 5% level using LSD test R=Red, W=White, P=Purple, Ro=Round, F=Flower, N=Non flower, M= Medium, E= Early, L=Late, E=Erect S=Spreading

1.2 LATE BLIGHT EVALUATION OF LOCAL CULTIVARS

Introduction

Several land races of potatoes are traditionally grown all over the country. Due to their some desirable characteristics, cultivars like Ilam Blue, Chisapani Red, Khumbule, Bhotange, Tharu Local, Kathmandu Local, Jumli Local and Sarkari Seto are still popular among the farmers and consumers till these days.

Today a large variation can be observed in the local cultivars grown in different parts of the country. Although the farmer's traditional practices to keep smaller tubers as the seed accelerates the infection of seed stocks, these cultivars are complex, time tested and have cultivated since long duration in specific location and fit in the present food systems. These so-called local cultivars are found give fewer yields due to highly degenerated condition but have a great scope for improvement by positive selection for the time being and for breeding purpose in the future. Efforts of NPRP are underway to collect and evaluate local germplasms in the country. As in the continuation, of identification, evaluation, assessment the importance and minimize the duplications among local cultivars and to know the tuber and yield characteristics, local cultivars collected from different parts of the country were evaluated at Hattiban Research Farm of Khumaltar. The materials and methods and results obtained are presented below:

Materials and Methods

Total ninety-three different local cultivars were evaluated to late blight disease at Hattiban Farm, Khumaltar, Lalitpur during 2004/2005. The trial was planted in single replications in rod-row design with 1.2m^2 plot size. Chemical fertilizer was applied at the rate of 100:100:60 kg N, P_2O_5, K_2O in addition to composts at the rate of 20 tons per hectare. Spacing was maintained 60 cm as row to row and 25 cm plant to plant, respectively.

Observation were taken on emergence, uniformity, % ground cover, late blight disease and total weight kg per plot. First late blight disease observation was done in 30 days after planting and subsequent observations were taken in 15 days interval. Total five observation was taken and average of disease scored presented in Table 1.12. Occurrences of late blight disease were assessed visually and rated 1 to 9 score as mentioned in CIP manual.

Results and Discussion

Local cultivars named Suryamukhi, Butange, Jumli Local, Dolpa Local, Kagbeni, Kagbeni Red, Kao, Gumda Local Red, Gharya Seto, Desi Alu, Farmesgunj, Ladaniya, Simla Suthaniya, Local Red, Thakali Red, Ilam Blue, Thotange Red, Farse White, Jyalle, Local Seto Kanpur, Local Red, NPI T/0012, Kalo Alu and Thakali Red were showed highest (4) plant uniformity. Farse White, Nala Alu, Lumle Red (NPI T/0012) and Thakali Red were produced highest (65%) ground cover and lowest (10%) in Halen Red, Seto Alu-2, Lamjunge and Koshi Pari.

As far as late blight disease is concerned, Halen Red (1), Khumbule Red (1), Singhali Local (1.4), Hale (1.6), Local Red (1.8), Suryamukhi (2), Rato Alu (2), Kachhu Dallo (2), Lumle Red (2), Thakaki Red (2.4), Kagbeni Red (2.4), Hile (2.4), Seto Alu (2.4), Kagbeni Red (2.4), Ghariya Red (2.6), Khoiree(2.6), Laprak Local (2.6) and Tharu Local (2.8) were seemed resistant to late blight disease. On the other hand, Kagbeni (5), Desi Alu (5.4), Ladaniya (5.6) Kalankhe (5.8), Ghariya Seto (5.8), Pahadi (6.2), Gumda Local (6.2), Local Seto (6.2), Kathmandu Local (6.4), Farmesgunj (6.4), Musa (6.6), Bhutane (6.6) and Jumli Local (6.8) were seemed susceptible to late blight disease.
Regarding the total weight (kg) per plot, Local Red produced highest weight (2kg) followed by Nala Alu (1.8kg). Local Red gave the highest yield (14.58 t/ha) followed by Nala Alu (13.13 t/ha), Farse White (12.5 t/ha) and Thakai Red (10 t/ha).

Some of the local cultivars have high yield potential and late blight resistant as well. These cultivars should be subjected to diverse environment for further disease and yield verification. After verification of this disease in different environment, resistant variety should be put in cleaning process. After cleaning, these potential varieties can be taken as breeding purpose for further variety improvement programme.

1.12 Late blight evaluation of local cultivars at NPRP Hattiban Farm, 2004/05

S. N.	Local Germplasm	No of tuber planted	Emerg-ence (%)	Unifor-mity (1-5)	Ground cover (%)	Late blight (1-9)	No. of plant hvstd	Total weight (kg)	Adjusted yield (t/ha)
1	Kagbeni	8	100	3	50	5.2	7	1.1	8.02
2	Suryamukhi	8	100	4	40	2	8	0.4	3.33
3	Ghariya Red	8	88	3	30	2.6	7	0.05	0.36
4	Bhutange	8	100	4	60	3.8	8	1	8.33
5	Jumli Local	8	100	4	40	6.8	8	0.55	4.58
6	Dolpa Local	8	88	4	50	3.2	6	1.1	6.88
7	Valley Alu	8	100	3	40	4.4	7	0.6	4.38
8	Seto Alu 3	8	88	2	20	3.2	7	0.1	0.73
9	Khoiree	8	100	2	20	2.6	6	0.3	1.88
10	Khodpeli	8	75	1	15	3.4	5	0.3	1.56
11	Khorsani	8	100	3	35	2.6	7	0.5	3.65
12	Laprak Local	8	50	2	15	2.6	3	0.1	0.31
13	Gumda Local	8	100	2	20	3.4	7	0.25	1.82
14	Rato Alu	8	100	3	25	2	6	0.9	5.63
15	Sikha Aalu	8	50	2	20	3	4	0.05	0.21
16	Syandorje	8	50	1	15	3	4	0.05	0.21
17	Bhutani	8	88	3	30	6.6	5	0.4	2.08
18	Buete	8	88	3	35	4.4	7	0.4	2.92
19	Kagbeni	8	100	4	50	2.8	8	2.1	17.50
20	Kagbeni Red	8	100	4	45	2.4	8	1.2	10.00
21	Gajarawa	8	100	3	30	4.8	8	0.45	3.75
22	Kalo	8	100	4	50	3	8	0.9	7.50
23	Halen Red	8	38	1	10	1	3	0.2	0.63
24	Rato Alu Ta	8	100	2	20	3.6	8	0.7	5.83
25	Khumbule Red	8	38	1	15	1	3	0.1	0.31
26	Hale	8	63	1	15	1.6	5	0.15	0.78
27	Farse Red	8	100	2	30	3	6	0.5	3.13
28	Laprak Red Round	8	100	3	35	4.4	8	0.65	5.42
29	Gumda Local Red	8	100	4	45	6.2	8	1	8.33
30	Ghariya Seto	8	100	4	50	5.8	7	0.6	4.38
31	Sarkari seto	8	88	3	30	3.6	7	0.3	2.19
32	Desi Alu	8	88	4	50	5.4	7	0.5	3.65
33	Farse Red	8	88	2	15	4	6	0.1	0.63
34	Tharu Local	8	63	2	20	2.8	5	0.05	0.26
35	Farmesgunj	8	100	4	45	6.4	8	0.6	5.00
36	Gumbathane	8	88	2	15	4	7	0.05	0.36
37	Morange	8	100	3	15	3.6	6	0.05	0.31
38	Samata	8	88	2	35	4	7	0.35	2.55
39	Desi Alu	8	88	3	35	4.4	7	0.4	2.92
40	Jumli Local New	8	88	1	20	7	0.15	1.09	9.08
41	Ladaniya	8	100	4	40	5.6	8	0.9	7.50
42	Simla Suthaniya	8	100	4	45	5.4	8	1	8.33
43	Samata Alu	8	88	2	30	4.4	6	0.5	3.13
44	Kathchu Dallo	8	100	3	45	2	8	1.2	10.00
45	Seto Alu	8	88	2	30	3.6	7	0.5	3.65
46	Nagale Alu	8	100	3	40	3.6	7	0.6	4.38
47	Local Red	8	100	4	60	3	8	1	8.33
48	Thakali Red	8	88	4	55	2.4	7	1	7.29
49	Ilam Blue	8	88	4	50	3.4	7	1.15	8.39
50	Thotange Red	8	100	4	45	3.4	8	1.1	9.17

1.12 Cont...

S. N.	Local Germplasm	No of tuber planted	Emerg-ence (%)	Unifor-mity (1-5)	Ground cover (%)	Late blight (1-9)	No. of plant hvstd	Total weight (kg)	Adjusted yield (t/ha)
51	Kalo	8	88	2	20	3.2	6	0.3	1.88
52	Hile	8	75	3	25	2.4	5	0.55	2.86
53	Seto Alu 2	8	100	1	10	2.6	6	0.05	0.31
54	Sthaniya Seto-2	8	88	1	15	2.6	7	0.05	0.36
55	Kagbeni Local	8	88	2	20	4	6	0.15	0.94
56	Farse White	8	100	4	65	5.4	8	1.5	12.50
57	Suryamukhi	8	100	4	60	4.8	6	1.5	9.38
58	Kathchu Seto	8	100	3	50	4	8	1.1	9.17
59	Jyalle	8	100	4	55	4.2	7	1	7.29
60	Lanka	8	100	4	50	4.6	5	1.4	7.29
61	Seto Alu	8	63	2	25	5	5	0.5	2.60
62	Musa	8	100	3	20	6.6	5	0.3	1.56
63	C-140	8	88	3	20	4.8	6	0.5	3.13
64	Rosita	8	75	3	35	5	5	0.4	2.08
65	Chalnalu	8	75	2	20	5	4	1	4.17
66	Local Seto Alu	8	63	1	20	4.8	5	0.1	0.52
67	Local Seto	8	100	4	45	6.2	6	0.7	4.38
68	Lamjunge Local	8	100	2	15	3.8	5	0.3	1.56
69	Lamjunge	8	75	1	10	5	5	0.2	1.04
70	Sthaniya Seto	8	88	3	40	5.6	6	0.5	3.13
71	Fical	8	88	3	25	2.6	7	0.6	4.38
72	Kanpur	8	100	4	50	3.6	7	0.8	5.83
73	Nala alu	8	100	4	65	2.2	7	1.8	13.13
74	Sthaniya	8	100	2	15	4	5	0.4	2.08
75	Seto alu1	8	100	2	15	3	6	0.2	1.25
76	Rajendra	8	100	3	40	7	7	0.6	4.38
77	Kathmandu Local	8	100	3	40	6.4	7	0.7	5.10
78	Local Red	8	88	4	60	1.8	7	2	14.58
79	NPI t/0012	8	100	4	65	2	7	1.5	10.94
80	Kalo Alu	8	100	4	55	4	6	1	6.25
81	Singhali Local	8	100	3	40	1.4	8	1	8.33
82	Thotange	8	88	2	25	2	4	0.6	2.50
83	Birgunjia	8	75	1	15	2.6	6	0.1	0.63
84	Lal gulab	8	88	4	40	5	5	1.1	5.73
85	Lal gulab	8	88	3	35	4.2	6	0.9	5.63
86	Lalaka	8	88	2	20	4	5	1	5.21
87	Pahadi	8	10	3	30	6.2	5	1.1	5.73
88	Kal ankhe	8	88	3	50	5.8	6	0.65	4.06
89	Thakali Red	8	100	4	65	2.8	8	1.2	10.00
90	Kalankhe	8	100	3	35	5	7	0.6	4.38
91	Koshi pari	8	100	1	10	4	7	0.7	5.10
92	C-140	8	88	3	30	1.4	6	0.3	1.88
93	Nidule white	8	100	3	35	3	5	0.05	0.26

2.0 SOIL FERILTIY STUDIES

2.1 FERTILIZER DOSE VERIFICATION STUDY ON POTATO

Introduction

The present average yield of potato is very low in Nepal as compared to other potato growing countries of the world. Besides other reasons, the inadequate and imbalance uses of fertilizers are the major factor limiting the productivity of this crop. It is grown in different agro-climatic regions of Nepal. Fertilizer needs of the crop vary with the agro-climatic region and soil type. In addition, potato is considered as the high feeder crop and availability of chemical fertilizer during crop season is always a problem to the potato growers.

Among several, varieties Janak Dev, Kufri Jyoti and Cardinal are performing very well in Nepal. But, the information on the nutritional requirement of these varieties is lacking. As a result, the dose of chemical fertilizer on potato in different agro-ecological zones in the country has to rely on flat recommendations available. The past results on the use of FYM or compost almost agree on 20 tons/hectare but no such detail experiments were conducted on chemical fertilizer dose in different agro-ecological zones for particular varieties as it has been proposed here. So, to find out the accurate and economic dose of chemical fertilizer for specific varieties in major agro-ecological zones of the country, this experiment was proposed.

Materials and Methods

Experiments were established at Hattiban Potato Research Farm Khumaltar, Lalitpur and at Agricultural Research Station Pakhribas, Dhankuta.

In both the locations, field experiments were laid out in randomized complete block design (RCBD). Plot size was maintained with 7.2 m^2 (12 tubers/row and 4 rows/treatment) at Pakhribas and 9 m^2 (10 tubers/row and 6 rows/treatment) at Khumaltar. Row to row spacing was maintained at 60 cm and plant to plant 25 cm in both the locations. Most commonly grown variety Kufri Jyoti was used at Pakhribas and varieties Janak Dev, Kufri Jyoti and Cardinal were used at Khumaltar. Compost was applied @ 20 tons/ha for all the treatments. All the fertilizer and manure were applied in furrows at the time of planting.

At ARS Pakhribas, seventeen different treatments were taken from combinations of 4 levels of N (0, 50,100 and 150 kg/ha) through Urea and DAP, 4 levels of K_2O (0, 30, 60 and 90 kg/ha) through Murate of Potash along with phosphorus @ 100 kg/ha through single super phosphate and DAP in the trials. Besides this, one treatment without NPK and another with 100:100:60 kg NPK per hectare fertilizer were also included as a check plots. Likewise at Khumaltar, twelve different treatments were taken from 2 levels of N (150 and 200 kg/ha) through Urea and DAP and 2 levels of K_2O (30 and 60 kg/ha) through Murate of Potash as a second phase of the studies. All the cultural practices in the trials were followed as per the recommendations of National Potato Research Programme, Khumaltar. To minimize the treatment effects, bonds of 50 cm spacing was separated within each and every plots.

Soil samples were taken at 0-15 cm depth block-wise before planting and treatments wise after the harvest and analyzed for N, P_2O_5, K_2O, pH and OM% wherever possible.

Treatments

Fertilizer Doses

1. ***ARS Pakhribas***

N	P_2O_5	K_2O	
0	**0**	**0**	**Check**
0	100	0	
0	100	30	
0	100	60	
0	100	90	
50	100	0	
50	100	30	
50	100	60	
50	100	90	
100	100	0	
100	100	30	
100	**100**	**60**	**Check**
100	100	90	
150	100	0	
150	100	30	
150	100	60	
150	100	90	

2. ***PRP, Khumaltar***

N	Varieties	K_2O
150	Janak Dev	30
150	Janak Dev	60
150	Kufri Jyoti	30
150	Kufri Jyoti	60
150	Cardinal	30
150	Cardinal	60
200	Janak Dev	30
200	Janak Dev	60
200	Kufri Jyoti	30
200	Kufri Jyoti	60
200	Cardinal	30
200	Cardinal	60

The following observations were taken from the experiment:

Plant parameters: Emergence (%), Ground cover (%), Uniformity (1-5 scale), Plant vigor (1-5 scale), Stem number/plant, Average plant height (cm), Late blight disease incidence (1-9 scale)

Yield parameter: Maturity, Number and weight of under size (< 25 g), seed size (25-50 g) and over size (> 50 g) tubers and yield (tons per hectare).

Results and Discussion

ARS ARS, Pakhribas, plant emergence was recorded highest (100%) at the treatment level 0-100-60 kg NPK per hectare (Table 2.1). Plant uniformity was found highest (5) at the treatment level of 0-100-90, 50-100-0, 50-100-60, 100-100-0 and 100-100-90 NPK kg per hectare. Highest (100%) ground cover was recorded at 50 kg N and 0 kg K_2O per hectare and the lowest (83%) at 150 kg N and 0 kg K_2O level. Application of 150 kg N and 30 kg K_2O produced the tallest (46 cm) plant whereas the dwarfest (33 cm) at 0 kg N and 60 to 90 kg K2O followed by 50 kg N and 90 kg K_2O respectively. Average number of stems per plant was ranged from 3 to 4 except at the level of 0 kg N and 60 kg K_2O (2).

Variation of tuber size was found among the treatment. Highest (248) number of undersized tuber harvested from the application of 50 kg N and 30 kg K_2O per hectare whereas highest weight (49%) of undersized tuber harvested from where both N and K applied at zero level. Application of 100 kg N and 0 level of K_2O produced highest (167) number and weight (50%) of seed size tubers. Application of 100 kg and 90 kg K_2O per hectare produced highest (65) number and weight (37%) oversize tuber whereas lowest (19) number and weight (19%) was harvested from the control treatment. Total number and weight (kg) of tuber per plot was harvested highest (423 and 14.81 kg) from the treatment at 100-100-90 NPK kg per hectare.

The yield difference was found highly significant among the treatment (Table 2.1). Tuber yield was produced highest (20.57 t/ha) at the treatment level 100-100-90 NPK kg per

hectare. However, the yield of treatment level 100-100-90 NPK kg per hectare was significantly at par with the yield of treatment levels 100-100-60 (19.72 t/ha), 150-100-30 (18.49 t/ha), 150-100-60 (18.17 t/ha) and 100-100-0 (17.06 t/ha) NPK kg per hectare.

At NPRP Khumaltar, the effect of different doses of N and K fertilizer on vegetative and yield parameters of varieties Janak Dev, Kufri Jyoti and Cardinal were studied during 2004/05 at Hattiban Potato Research Farm, Khumaltar. Plant emergence recorded at 30 DAP was highest in all the treatment levels ranging from 95 to 100% ((Table 2.2). Highest (100%) emergence was recorded in Kufri Jyoti with the level of 150 kg N and 30 kg K_2O per hectare. Highest (5) plant uniformity was observed in Janak Dev variety with the level of 30 to 60 kg K_2O followed by 150 kg N per hectare. Ground cover (%) was ranged from 67 to 88. Application of 200 kg N and 60 kg K_2O per hectare at Janak Dev variety produced highest (88%) ground cover. There was no variation among the treatment to late blight and early blight disease. The incidence of late blight and early blight disease remained same (1) in all the treatment. Average number of main stem per plant was counted highest (4) in Kufri where 150 to 200 kg N and 30 to 60 kg K_2O applied. Average plant height was measured highest (70cm) in Janak Dev at 150 kg N and 60 kg K_2O level followed by 200 kg N and 60 kg K_2O per hectare in the same variety (69cm) whereas lowest (35cm) in cardinal at 150 kg N and 30 to 60 kg per hectare K_2O level.

In yield and tuber grading, application of 150 kg N and 30 kg K_2O in Kufri Jyoti produced highest (290) number of seed size tuber. Highest weight (79%) of seed size tuber was produced in cardinal with 200 kg N and 30 kg K_2O per hectare. Similarly, application of 150 kg N and 30 kg K_2O in Janak Dev produced highest (40) number and weight (34%) oversize tuber. Total number and weight per plot was harvested highest (421 and 12.30 kg) in Kufri Jyoti at 150 kg N, 30 kg K_2O and 60 kg K_2O at the same level of nitrogen.

The yield was highly significant among the treatments (Table 2.2). Application of 150 kg N and 60 kg K_2O per hectare in Kufri Jyoti produced highest yield (25.62 t/ha). Likewise, yield obtained from the use of 150 kg N and 60 kg K_2O per hectare in Kufri Jyoti was statistically at par with the use of 30 to 60 kg K_2O in each 200 kg N in same variety. Similarly, Janak Dev had equally response to different level of N and K like Kufri Jyoti variety. Yield obtained from the application of 30 to 60 kg K_2O and each of 150 to 200 kg N were statistically at par with yield at the level of 150 kg N and 60 kg K_2O in Kufri Jyoti variety. Cardinal had not showed the pronounced effect in yield and yield parameters to different level of N and K. This is due to poor quality of cardinal seed tuber used in the trial. There was no any significant difference in specific gravity in different fertilizer levels and dry matter content also.

Since this is the second year of this trial and repetition of same trial for one year more is recommended to get more valid and conclusive results.

Table 2.1 Vegetative and yield parameter in fertilizer dose verification trial at ARS Pakhribas during 2004/05

Clones	Emer-gence (%)	Unifo rmity (1-5)	Grd cover (%)	Pt ht (cm)	Stem/ plant (#)	No. pt Harve-sted	Tuber grading (# & % wt)						Yield / plot		Yield (t/ha)
							US		SS		OS				
							#	wt	#	wt	#	wt	#	kg	
0-0-0	99	4	85	36	3	41	187	34	98	47	19	19	304	6.46	8.98 g
0-100-0	98	4	90	34	3	42	165	49	69	31	27	20	261	7.15	9.93 g
0-100-30	98	5	93	39	3	42	231	37	70	34	35	29	337	7.6	10.55 fg
0-100-60	100	4	90	33	2	44	239	42	87	36	32	22	359	7.78	10.81 fg
0-100-90	98	5	93	33	3	43	206	41	77	38	24	21	307	7.21	10.02 fg
50-100-0	99	5	100	34	3	42	236	37	131	37	40	26	407	9.75	13.54 ef
50-100-30	96	4	88	34	4	41	248	37	112	40	38	23	399	10.6	14.72 de
50-100-60	92	5	92	37	3	41	222	34	106	38	46	28	374	10.9	15.13 cde
50-100-90	92	4	88	33	3	43	234	35	111	41	41	23	386	11.5	15.97 cde
100-100-0	93	5	93	36	3	41	205	22	167	50	41	28	413	12.28	17.06 abcde
100-100-30	99	4	88	30	3	43	210	28	111	41	47	30	368	12.15	16.87 bcde
100-100-60	99	4	93	39	4	45	220	27	148	40	64	33	431	14.2	19.72 ab
100-100-90	95	5	88	38	3	43	213	24	145	39	65	37	423	14.81	20.57 a
150-100-0	99	3	83	39	4	44	193	25	136	40	59	34	388	12.68	17.61 abcd
150-100-30	96	3	85	46	4	43	154	24	129	39	63	37	346	13.31	18.49 abc
150-100-60	94	4	90	41	4	45	173	20	128	48	57	32	358	13.08	18.17 abcd
150-100-90	95	4	85	41	4	42	209	33	107	37	45	30	360	11.6	16.11 cde
CV (%)															14.28
F-test															**
LSD (0.05)															3.55

** Significant at 1% level. Data with a common letter (s) are not significantly different at 5% level using LSD.

Table 2.2 Vegetative and yield parameter in fertilizer dose verification trial at NPRP Khumaltar during 2004/05

Treatments	Emer-gence %	Unifo-rmity (1-5)	Ground cover (%)	Pt ht (cm)	LB score (1-9)	Early blight (1-5)	Stem /pt (#)	Pt ht (cm)	No. hvtd pt	Tuber grading (# & % wt)						Total		Adj. yield (t/ha)	Specific gravity	DM Cont. (%)
										US		SS		OS		#	wt (kg)			
										#	wt	#	wt	#	wt					
150 : JD : 30	99	5	82	4	1	1	2	68	31	83	8	145	59	40	34	268	10.46	21.38 ab	1.073	18.1
150 : JD : 60	98	5	84	5	1	1	2	70	32	68	5	197	72	24	23	289	10.16	22.22 ab	1.072	18.1
150 : KJ : 30	100	4	75	5	1	1	3	41	32	107	8	290	69	24	23	421	11.46	23.88 ab	1.065	17.1
150 : KJ : 60	99	4	83	4	1	1	4	41	32	83	9	197	65	33	26	312	12.30	25.62 a	1.063	17.1
150 : Card :30	96	3	67	4	1	1	3	35	29	57	11	108	76	8	13	173	5.73	10.90 c	1.075	19.2
150 : Card: 60	99	4	76	4	1	1	3	36	31	63	10	130	73	9	17	202	6.53	13.94 c	1.077	19.2
200 : JD : 30	97	4	79	4	1	1	2	60	32	80	7	155	66	21	27	256	9.93	20.69 ab	1.073	18.1
200 : JD : 60	95	4	88	4	1	1	2	69	31	77	7	165	73	19	21	261	9.63	19.62 ab	1.069	18.1
200 : KJ : 30	99	4	83	5	1	1	4	46	31	100	7	225	70	26	24	351	11.67	23.82 ab	1.065	17.1
200 : KJ : 60	98	4	82	4	1	1	3	44	32	97	7	205	69	29	24	331	11.36	23.68 ab	1.005	17.1
200 : Card : 30	97	4	74	4	1	1	3	40	31	48	7	147	79	10	14	205	6.97	13.99 c	1.075	19.2
200 : Card : 60	97	3	77	4	1	1	3	40	30	47	7	132	73	11	19	190	6.65	13.27 c	1.075	19.2
CV (%)																		16.24		
F -test																		**		
LSD (0.05)																		5.32		

** Significant at 1% level. Data with a common letter (s) are not significantly different at 5% level using LSD.

3.0 TRUE POTATO SEED (TPS) RESEARCH

3.1 EVALUATION OF TPS FAMILIES FOR SEEDLING TUBER PRODUCTION

3.1.1 EVALUATION TPS FAMILIES FOR SEEDLING TUBER PRODUCTION IN THE NURSERY BED

Introduction

This experiment was conducted at NPRP, Khumaltar; RARS, Tarahara and ARS, Belachapi Dhanusa. The major objectives were to identify the suitable TPS F_1 progenies with good uniformity, color, shape and resistant to pest and diseases and high productivity, to recommend TPS families for mid hill and Terai and to evaluate the parental lines.

Materials and Methods

Twenty hybrid TPS families were sown at Khumaltar received from International Potato Center (CIP) Peru. Plot size was 1 m x 1 m. TPS families were sown in a randomized complete block design (RCBD) with 3 replications. Nursery bed was raised to 15 cm with a mixture of soil and farmyard manure (1:1 ratio). At the time of seed sowing ½ cm layer of fine compost was broadcasted and seeds were sown in the holes prepared by marker board and covered with further ½ cm layer of fine compost. Since seeds were very delicate and sensitive, beds were mulched with paddy straw. Plots were watered daily until seeds germinated well. Fertilizer was used at the rate of 150:100:50 NPK kg/ha. One hundred seedlings were accommodated in 1-m^2 beds with 25 cm x 4 cm spacing; excess plants were thinned out after germination. Earthing-up was done twice, once at 45 days after sowing (DAS) and another at 60 DAS. During the early growing season, 0.2% urea was sprayed for foliage development. Harvesting was done at full maturity of the crops.

Results and Discussion

Khumaltar

TPS family C 96 H 2.7 x TPS 67 was tallest (78.7 cm) followed by FLS 15 x TPS 13 (76.0 cm) (Table 3.1). Late blight disease was not observed till 90 days. The tuber yields among the TPS genotypes were statistically significant. TPS family C 95 LB 22.2 x TPS 67 produced the maximum yield (5.4 kg/m^2) followed by C 96 H 13.29 x TPS 13 (5.1 kg/m^2). Results of tuber number showed that C 95 LB 22.2 x TPS 67 produced the maximum number (592/m^2) followed by C 96 H 2.4 x TPS 13 (584.5/m^2). Regarding the tuber size FLS 14 x TPS 67 produced the maximum number (430/m^2) followed by FLS 12 x TPS 67 (390/m^2). TPS family FLS 14 x TPS 67 produced the maximum weight (1.6 kg/m^2) followed by MF I x C95 LB 13.2 and MF II x C95 LB 13.3 (1.5 kg/m^2). In case of 10-20 g size tuber FLS 15 x TPS 67 produced the maximum number (125/m^2) followed by FLS 15 x TPS 13 (123.5/m^2). TPS family FLS 15 x TPS 67 produced the maximum weight (1.7 kg/m^2) of 10-20 g size tubers followed by C 96 H 22.2 x TPS 13, C 96 H 10.27 x TPS 67, C 96 H 13.29 x TPS 13 and FLS 15 x TPS 13 (1.5 kg/m^2). C 95 LB 22.2 x TPS 67 produced the maximum number (84/m^2) of 20-40 g size tubers followed by C 95 LB 22.4 x TPS 67 (75/m^2). C95 LB 22.2 x TPS 67 produced the maximum tuber weight (2.2 kg/m^2) of 20-40 g size followed by HPS I/13 (1.9 kg/m^2). In case of > 40 g size tubers C 96 H 2.7 x TPS 13 produced the maximum number (20/m^2) and weight (1.0 kg/m^2).

Tarahara

Plants of C96H 02.7 x TPS 13 were tallest (56.5 cm) followed by C 96 H 10.25 x TPS 13 (55 cm). Regarding the tuber yield, FLS 14 x TPS 67 produced the maximum tuber weight (6.0 kg/m^2) followed by C96H 10.25 x TPS 67 (5.9 kg/m^2). Total tuber number per m^2 was

significantly maximum in FLS 15 x TPS 67 (525/m^2) followed by C96H 10.25 x TPS 67 (522.5/ m^2) (Table 3.2). Results of tuber grading showed that C95 LB 22.2 x TPS 67 produced the maximum number (322.5/m^2) of <10 g size tubers followed by C96H 10.25 x TPS 67 (320/m^2). TPS family C96H 2.4 x TPS 13 produced the maximum tuber weight (1.6 kg/m^2) of <10 g size tubers followed by FLS 12 x TPS 67 and the check HPS II/67 (1.4 kg/m^2). Number of 10-20 g size tubers was maximum in C96H 02.7 x TPS 67 (176.5/m^2) followed by FLS 14 x TPS 67 (168/m^2). Likewise, FLS 14 x TPS 67 produced the maximum weight (2.7 kg/m^2) of 10-20 g size tubers followed by C96 H 02.7 x TPS 67 (2.6 kg/m^2). C95 H 10.25 x TPS 67 produced the maximum number (79/m^2) of 20-40 g size tubers followed by MF II x C 95 LB 13.3 (77/m2). Maximum weight of 20-40 g size tubers was in C 96 H10.25 x TPS 67 (2.1 kg/m^2) followed MF II x C 95 LB 13.3 (2.0 kg/m^2). C95 LB 22.4 x TPS 67 produced the maximum number (27.5/m^2) of >40 g size tubers followed by C 96 H 13.29 x TPS 13 (23/m^2). The maximum weight of >40 g size tubers was produced in C95 LB 22.4 x TPS 67 and FLS 14 x TPS 13 (1.4 kg/m^2).

Belachapi

The check family HPS II/67vproduced significantly maximum tuber yield (7.03 kg/m^2) followed by HPS I/13 (6.23 kg/m^2). Total tuber number was significantly maximum in C96H 10.25 x TPS 13 (593.5/m^2) followed by HPS II/67 (554.5/m^2) (Table 3.3). Results of tuber grading showed that C96H 10. 25 x TPS 13 produced the maximum tuber number (396.5/m^2) and weight (1.43 kg/m^2) of <5 g size tubers. Minimum tuber number (91.5/m^2) and weight (0.33 kg/m^2) of <5 g size tubers was produced by C96H 10.27 x TPS 67. TPS family FLS 15 x TPS 67 produced the maximum number (156.5/m^2) of 5-10 g size tubers followed by HPS II/67 (139.5/m^2). FLS 15 x TPS 67 produced the maximum tuber weight (1.28 kg/m^2) of 5-10 g size followed by HPS II/67 (1.19 kg/m^2). The check family HPS II/67 produced the maximum number (99/m^2) and weight (1.55 kg/m^2) of 10-20 g size tubers followed by FLS 12 x TPS 13, 86.5 and 1.42 kg/m^2, respectively. HPS I/13 produced the highest number (57.5/m^2) and weight (1.43 kg/m^2) of 20-40 g size tubers and minimum in C96 H 13.29 x TPS 13 (15.5 and 0.42, kg/m^2, respectively). HPS II/67 produced the maximum number (50/m^2) and weight (2.44 kg/m^2) of >40 g size tubers.

Table 3.1 Evaluation of TPS families in the nursery bed at NPRP Khumaltar, 2004/05

TPS Family	Plant height (cm)	Tuber yield by number and weight per m^2									
		<10 g		10-20 g		20-40 g		>40 g		Total	
		No.	Wt. (kg)	No.	Wt. (kg)	No.	Wt. (kg)	No.	Wt. (kg)	No.	Wt. (kg)
C 95 LB 22.2 x TPS 13	67.7	317.5	0.9	114.0	1.5	61.5	1.6	13.5	0.6	506.5	4.6
C 95 LB 22.2 x TPS 67	67.2	374.0	1.1	120.0	1.4	84.0	2.2	14.0	0.8	592.0	5.4
C 95 LB 22.4 x TPS 67	59.0	374.0	1.0	100.0	0.9	75.0	1.7	16.5	0.7	565.5	4.2
C 96 H 02.4 x TPS 13	60.0	385.0	1.0	122.5	1.3	58.5	1.4	18.5	0.9	584.5	4.5
C 96 H 02.4 x TPS 67	65.8	356.5	1.3	96.5	1.2	65.0	1.4	17.0	0.7	535.0	4.6
C 96 H 02.7 x TPS 13	68.5	258.0	0.9	87.5	1.2	67.5	1.5	20.0	1.0	433.0	4.5
C 96 H 02.7 x TPS 67	78.7	353.5	1.2	95.5	1.3	69.0	1.7	19.5	0.8	537.5	4.9
C 96 H 10.25 x TPS 13	72.0	312.5	1.2	94.5	1.1	69.0	1.6	20.0	0.9	496.0	4.7
C 96 H 10.25 x TPS 67	60.7	269.0	0.8	112.5	1.4	58.5	1.4	16.5	0.7	456.5	4.3
C 96 H 10.27 x TPS 67	61.9	366.0	1.2	115.5	1.5	60.5	1.5	7.0	0.3	549.0	4.5
C 96 H 13.29 x TPS 13	73.5	328.0	1.0	118.5	1.5	75.5	1.8	16.0	0.8	538.0	5.1
C 96 H 13.29 x TPS 67	65.2	299.0	1.1	91.0	1.1	67.5	1.5	15.5	0.7	473.0	4.3
MF I x C 95 LB 13.2	66.5	365.5	1.5	109.0	1.4	52.0	1.3	10.0	0.5	536.5	4.6
MF II x C 95 LB 13.3	65.0	395.5	1.5	106.5	1.4	51.0	1.3	8.5	0.5	561.5	4.6
FLS 14 x TPS 67	67.0	430.0	1.6	101.0	1.2	43.5	1.1	5.5	0.3	580.0	4.1
FLS 15 x TPS 13	76.0	349.0	1.3	123.5	1.5	51.5	1.3	7.0	0.4	531.0	4.4
FLS 15 x TPS 67	69.7	389.0	1.2	125.0	1.7	50.0	1.3	5.5	0.3	569.5	4.4
FLS 12 x TPS 67	59.7	390.0	1.1	88.5	1.1	44.0	1.0	4.0	0.2	526.5	3.3
FLS 14 x TPS 13	59.0	256.0	0.7	74.0	0.9	47.5	1.1	4.5	0.3	382.0	2.9
FLS 12 x TPS 13	56.0	276.5	0.7	95.0	1.2	62.5	1.4	6.5	0.3	440.5	3.6
HPS I/13	64.0	251.0	0.8	93.0	1.2	69.0	1.9	8.5	0.4	421.5	4.2
HPS II/67	63.9	295.0	1.0	93.5	1.2	65.0	1.5	7.5	0.3	461.0	3.9
CV%	5.62	4.48	9.74	10.25	10.69	11.13	7.71	17.06	21.17	3.68	4.46
F-test	**	**	**	**	**	**	**	**	**	**	**
LSD (0.05)	7.70	31.29	0.22	22.05	0.28	14.17	0.24	4.20	0.24	39.27	0.40

Table 3.2 Evaluation of TPS families for seedling tuber production at RARS, Tarahara, 2004/05

TPS Family	Plant height (cm)	Tuber yield by number and weight per m^2									
		<10 g		10.20 g		20-40 g		>40 g		Total	
		No.	Wt (kg)	No.	Wt (kg)	No.	Wt (kg)	No.	Wt (kg)	No.	Wt (kg)
C 95 LB 22.2 x TPS 13	40.0	191.5	0.6	103.5	1.9	47.0	1.2	9.0	0.6	351.0	4.2
C 95 LB 22.2 x TPS 67	41.5	322.5	1.2	124.5	1.8	37.0	1.3	14.0	0.7	498.0	5.0
C 95 LB 22.4 x TPS 67	47.0	229.5	0.6	140.0	1.8	67.5	1.7	27.5	1.4	464.5	5.4
C 96 H 02.4 x TPS 13	50.0	289.5	1.6	107.0	1.7	45.5	1.1	19.5	0.9	461.5	5.3
C 96 H 02.4 x TPS 67	50.0	222.0	0.8	71.5	0.9	64.5	1.5	20.0	1.0	378.0	4.2
C 96 H 02.7 x TPS 13	56.5	142.5	0.6	130.5	2.0	53.5	1.7	17.5	1.1	344.0	5.3
C 96 H 02.7 x TPS 67	45.0	223.5	0.8	176.5	2.6	43.5	1.2	14.5	0.9	458.0	5.4
C 96 H 10.25 x TPS 13	55.0	126.5	0.7	113.5	1.6	53.0	1.4	18.0	1.1	311.0	4.7
C 96 H 10.25 x TPS 67	49.0	320.0	1.3	107.5	1.6	79.0	2.1	16.0	0.8	522.5	5.9
C 96 H 10.27 x TPS 67	44.5	288.5	1.0	66.5	0.8	64.5	1.5	15.5	1.1	435.0	4.4
C 96 H 13.29 x TPS 13	47.0	121.5	0.5	94.5	1.6	66.5	1.3	23.0	1.1	305.5	4.5
C 96 H 13.29 x TPS 67	43.5	203.5	1.1	75.0	1.3	55.0	1.6	17.0	0.6	350.5	4.6
MF I x C 95 LB 13.2	47.0	158.5	0.9	125.0	1.9	34.5	1.1	12.0	0.8	330.0	4.8
MF II x C 95 LB 13.3	43.5	207.0	0.7	120.5	1.6	77.0	2.0	13.5	0.8	418.0	5.1
FLS 14 x TPS 67	53.0	235.0	1.3	168.0	2.7	50.0	1.3	16.0	0.7	469.0	6.0
FLS 15 x TPS 13	54.7	157.0	0.9	83.0	1.3	49.5	1.5	9.5	0.7	299.0	4.4
FLS 15 x TPS 67	50.0	317.0	1.1	154.0	2.0	46.5	1.3	7.5	0.4	525.0	4.8
FLS 12 x TPS 67	49.4	260.0	1.4	98.5	1.6	38.0	1.2	7.0	0.4	403.5	4.6
FLS 14 x TPS 13	42.1	189.0	1.0	86.5	1.4	63.5	1.6	22.5	1.4	361.5	5.4
FLS 12 x TPS 13	54.0	175.0	0.8	68.0	1.1	48.0	1.7	11.5	0.7	302.5	4.3
HPS I/13	45.5	214.0	0.9	139.5	2.3	42.5	1.4	12.5	0.8	408.5	5.5
HPS II/67	55.3	313.0	1.4	122.5	1.9	52.0	1.4	11.5	0.6	499.0	5.3
CV%	7.32	5.56	6.88	6.27	2.99	5.29	3.64	8.67	8.44	3.84	1.63
F-test	**	**	**	**	**	**	**	**	**	**	**
LSD (0.05)	7.36	25.78	0.13	14.68	0.11	5.89	0.11	2.75	0.15	32.31	0.17

Table 3.3 Evaluation of TPS families for seedling tuber production in the nursery bed at ARS, Belachapi, 2004/05

TPS Family	Tuber yield by number and weight per m^2											
	<5 g		5-10 g		10-20 g		20-40 g		>40 g		Total	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
C 95 LB 22.2 x TPS 13	135.0	0.45	59.0	0.49	58.0	0.88	42.0	0.79	32.5	1.57	326.5	4.18
C 95 LB 22.2 x TPS 67	210.0	0.70	111.5	0.85	54.5	0.69	37.5	0.85	10.0	0.40	423.5	3.48
C 95 LB 22.4 x TPS 67	200.5	0.63	67.5	0.60	59.5	0.74	53.5	1.21	8.5	0.39	389.5	3.55
C 96 H 02.4 x TPS 13	149.0	0.51	94.5	0.64	43.5	0.60	30.0	0.73	6.5	0.43	323.5	2.91
C 96 H 02.4 x TPS 67	226.0	0.74	101.5	0.84	48.0	0.84	30.5	0.71	8.0	0.34	413.5	3.46
C 96 H 02.7 x TPS 13	99.5	0.38	99.5	0.75	52.5	0.87	30.0	0.76	8.5	0.39	289.5	3.15
C 96 H 02.7 x TPS 67	242.0	0.84	103.0	1.04	36.0	0.62	36.0	0.78	14.5	0.74	431.0	4.00
C 96 H 10.25 x TPS 13	396.5	1.43	92.5	1.00	33.0	0.52	39.0	0.83	32.0	1.31	593.5	5.08
C 96 H 10.25 x TPS 67	251.5	0.91	99.5	1.11	33.0	0.68	24.0	0.76	10.5	0.58	418.0	4.02
C 96 H 10.27 x TPS 67	91.5	0.33	73.0	0.47	31.0	0.42	24.0	0.57	6.5	0.24	226.0	2.02
C 96 H 13.29 x TPS 13	122.5	0.37	80.5	0.62	46.0	0.83	15.5	0.42	12.0	0.49	276.5	2.72
C 96 H 13.29 x TPS 67	112.5	0.48	98.5	0.66	52.0	0.75	30.5	0.73	7.5	0.36	301.0	2.97
MF I x C 95 LB 13.2	156.0	0.49	92.5	0.73	49.5	0.77	38.0	0.96	13.5	0.63	349.5	3.57
MF II x C 95 LB 13.3	158.0	0.53	77.5	0.51	70.0	0.82	42.0	0.92	14.5	0.50	362.0	3.27
FLS 14 x TPS 67	153.5	0.50	95.5	0.68	77.5	1.17	36.0	0.78	8.5	0.32	371.5	3.44
FLS 15 x TPS 13	167.0	0.54	124.5	0.94	62.0	0.97	44.5	1.02	17.0	0.94	415.0	4.39
FLS 15 x TPS 67	174.0	0.58	156.5	1.28	58.5	0.81	46.5	1.03	24.0	1.08	459.5	4.78
FLS 12 x TPS 67	195.0	0.65	97.0	0.80	62.5	0.86	40.5	0.96	17.0	0.71	411.0	3.97
FLS 14 x TPS 13	177.0	0.57	92.0	0.78	55.5	0.87	32.0	0.92	24.0	1.01	381.0	4.14
FLS 12 x TPS 13	193.0	0.61	87.5	0.72	86.5	1.42	50.0	1.30	43.0	2.14	460.0	6.18
HPS I/13	143.5	0.53	115.0	1.14	72.5	1.14	57.5	1.43	40.5	2.00	429.0	6.23
HPS II/67	219.0	0.66	139.5	1.19	99.0	1.55	47.0	1.19	50.0	2.44	554.5	7.03
CV %	8.02	12.18	7.11	8.94	10.23	6.70	9.16	5.33	17.59	15.72	6.33	5.71
F-test	**	**	**	**	**	**	**	**	**	**	**	**
LSD (0.05)	30.12	0.15	14.50	0.15	12.00	0.11	7.15	0.09	6.80	0.28	51.47	0.48

3.1.2 EVALUATION OF TPS FAMILIES FOR SEEDLING TUBER PRODUCTION IN THE FARMERS' FIELD

Introduction

The major objectives were to identify the suitable TPS F_1 progenies with color, shape and resistant to pest and diseases and high productivity by farmers' participation to recommend TPS families for eastern terai and evaluate the parental lines.

Materials and Methods

Seven hybrid TPS families (C95C 16.5 x TPS 13, CFK 69.1 x TPS 67, CFK 69.1 x TPS 13, LT 8 x TPS 13, LT 8 x TPS 67 received from International Potato Center, Lima, Peru and locally produced HPS II/67 and HPS 7/67 were sown in the farmers field in Itahari-2, Shantinagar (eastern terai) and Mahendranagar and Santipur VDC of Dhanusa district. Plot size was 1 m x 1 m. TPS families was sown in a randomized complete block design (RCBD) with 3 replications; a farmer is treated as a replication. Nursery bed was raised up to 15 cm with soil and farmyard manure (1:1 ratio). At the time of seed sowing ½ cm layer of fine compost was broadcasted and seeds were sown in the holes prepared by marker board and covered with further ½ cm layer of fine compost. Since seeds were very delicate and sensitive, beds were mulched with paddy straw. Plots were watered daily until seeds germinated well. Fertilizer was used at the rate of 100:100:50 NPK kg/ha and well decomposed farm yard manure (FYM) 20 t/ha. One hundred seedlings were accommodated in 1-m2 beds with 25 cm x 4 cm spacing; excess plants were thinned out after germination. Earthing-up was done twice, once at 45 days after sowing (DAS) and another at 60 DAS. Harvesting was done at full maturity of the crops.

Results and Discussion

Dhanusa

C95C 16.5 x TPS 13 produced the maximum tuber yield (5.6 kg/m²) followed by CFK 69.1 x TPS 67 (5.17 kg/m²) and minimum in CFK 69.1 x TPS 13 (3.57 kg/m²). Fig. 1 showed that in the command area of Belachapi TPS family C95C 16.5 x TPS 67 performed better compared to others.

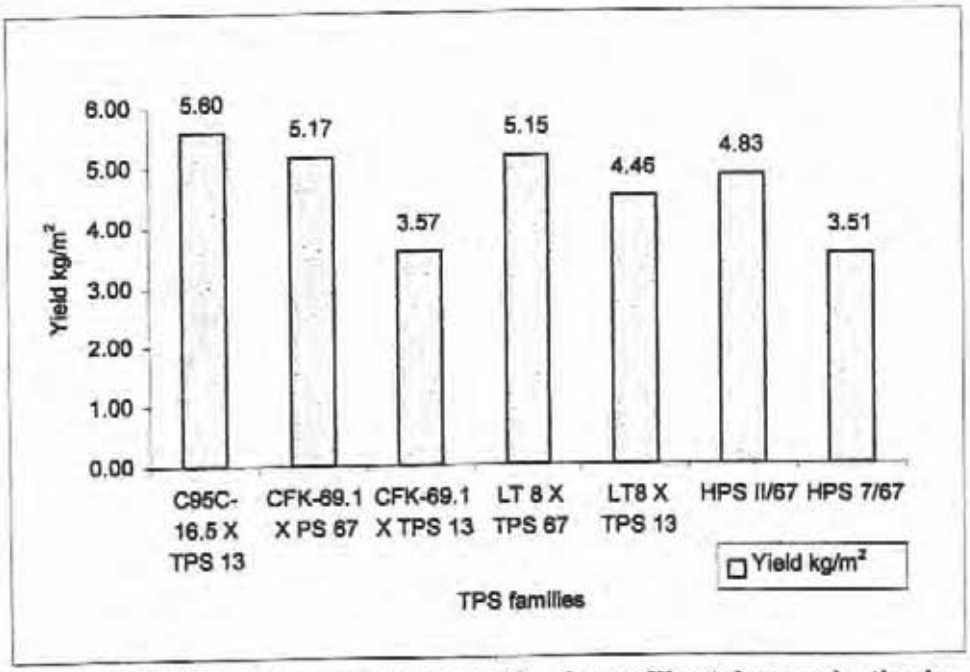

Figure 1. Yield performance of TPS families for seedling tuber production in the farmers' field, Dhanusa district

Sunsari

In the farmers field of Sunsari seven TPS families were evaluated and compared with the check families HPS II/67 and HPS 7/67 (Fig. 2). Total tuber yield was maximum in the check family HPS II/67 (4.80 kg/m²) and minimum in CFK 69.1 x TPS 67 (3.67 kg/m²).

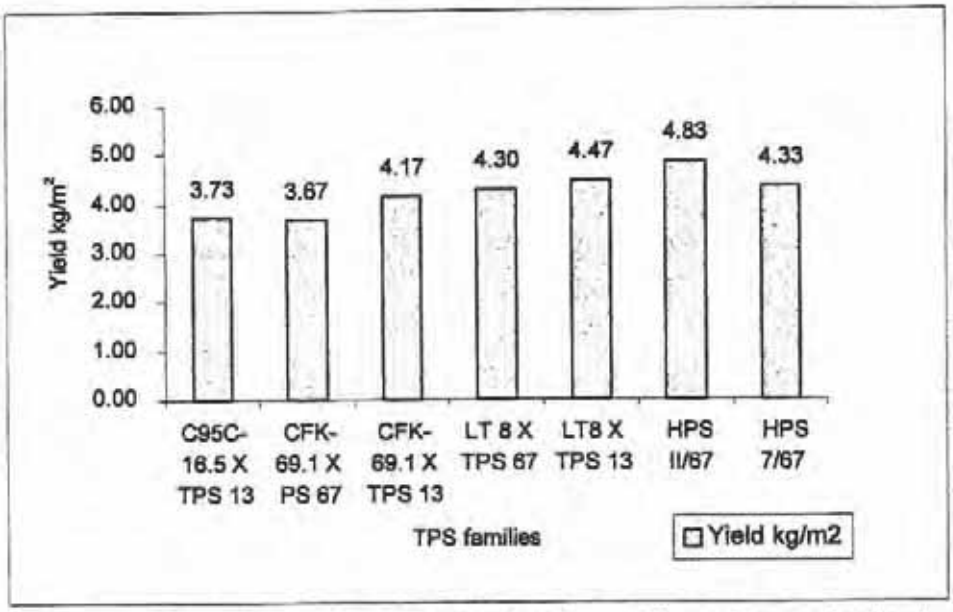

Figure 2. Yield performance of TPS families for seedling tuber production in the farmers' field, Sunsari district

3.2 EVALUATION OF TPS PROGENIES

3.2.1 TPS F_1C_1 TUBERLETS EVALUATION

Introduction

This experiment was conducted at PRP, Khumaltar and RARA, Tarahara. The major objectives were to identify the suitable TPS progenies with good uniformity, color, shape and resistant to pest and diseases and high productivity, to recommend TPS families for mid hill and to evaluate the parental lines and ware potato production.

Materials and Methods

This trial was conducted using tuberlets from previous year's nursery bed trial. Seven TPS families were planted where Desiree and Khumal Seto-1 were used as check varieties. Seed tubers (20-40g) were planted on ridges by maintaining ridge-to-ridge 60 cm and plant-to-plant 25 cm distance. Fertilizer was used at the rate 100:100:60 NPK kg/ha with 20 t FYM/ha. Each TPS Family was three times replicated. No fungicide application was applied and other management practices were followed as per PRP recommendation.

Results and Discussion

Khumaltar

The percent plant emergence was ranged from 97.2 to 100 percent. Plant height differences among the TPS families were statistically significant (Table 3.4). Plants of TS 15 x TPS 13 were tallest (58.1 cm) followed by AL 204 x TPS 67 (57.8 cm). Percent ground cover was highest in CFK 69.1 x TPS 13 (83.7%) and lowest in MF I x C95 LB 13.2 (70%). Regarding the tuber yield CFK 69.1 x TPS 13 produced the maximum tuber weight (26.07 kg/7.2 m²) followed by TS 15 x TPS 13 (23.33 kg/7.2 m²). Total tuber number was also maximum in CFK 69.1 x TPS 13

(810/7.2 m²) followed by AL 624 x TPS 13 (756/7.2 m²). Results of tuber grading showed that AL 624 x TPS 13 produced the maximum number of <25 g size tubers (327/7.2m²) and minimum in TS 15 x TPS 67 (143.33/7.2 m²). CFK 69.1 x TPS 67 produced the maximum weight (2.9 kg/7.2 m²) of <25 g size tubers followed by MF II x TS 15 (2.5 kg/7.2 m²). Maximum number of seed size (25-50 g) tubers was maximum in CFK 69.1 x TPS 13 (485/7.2 m²) followed by AL 624 x TPS 13 (389/7.2 m²). CFK 69.1 x TPS 13 also produced the maximum weight (18.6/7.2 m²) of 25-50 g tubers followed by AL 624 x TPS 13 (15.3 kg/7.2 m²). The check variety Khumal Seto-1 produced the maximum number (83) and weight (8.8 kg/7.2 m²) of large size (>50 g) tubers.

Tarahara

In F_1C_1 tuberlet evaluation trial at RARS, Tarahara, total of seven TPS families were evaluated and compared with the local check Kufri Sinduri (Fig 3). In the harvest, maximum tuber yield was recorded in MF I x TPS 67 (17.23 kg/7.2 m²) followed by HPS II/67 (16.23 kg/m²). With respect to tuber yield, all the tested TPS families gave the higher yield over the check Kufri Sinduri.

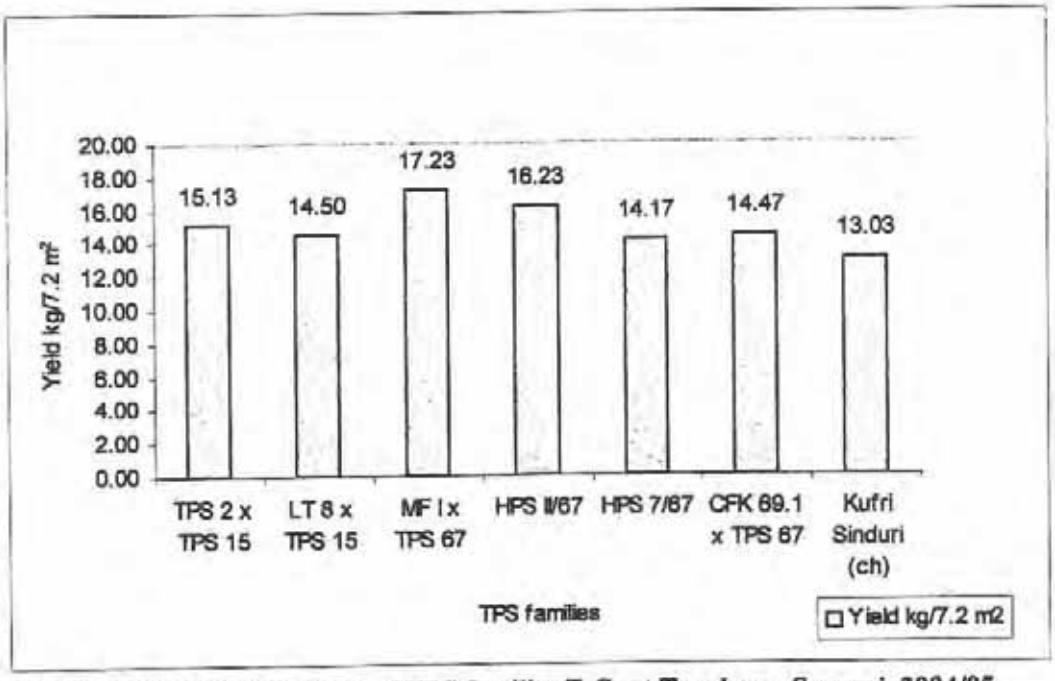

Figure 3. Yield performance of TPS families F_1C_1 at Tarahara, Sunsari, 2004/05

Table 3.4 Evaluation of F_1C_1 TPS tuberlets at NPRP, Hattiban, Khumaltar , 2004/05

TPS family	Germi-nation (%)	Plant height (cm)	Stem/ hill	Ground cover (%)	Tuber yield by number and weight per m^2							
					<25 g		25-50 g		>50 g		Total	
					No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
AL 204 x TPS 67	100.0	57.8	3.0	80.7	205.00	1.9	323.33	12.8	45.67	5.6	574.0	20.27
AL 624 x TPS 13	99.3	55.5	2.9	81.7	326.67	2.3	389.00	15.3	40.33	4.4	756.0	22.03
AL 624 x TPS 67	100.0	54.8	3.1	78.7	203.33	1.9	316.67	13.1	59.33	7.4	579.3	22.40
Achirina x TS 15	100.0	50.3	3.1	78.3	166.67	1.8	311.67	13.4	61.67	7.3	540.0	22.50
Atzimba x TPS 15	100.0	51.6	3.3	77.7	280.00	2.4	350.00	13.8	44.33	4.9	674.3	21.13
CFK 69.1 x TPS 13	99.3	55.9	2.9	83.7	281.67	2.4	485.00	18.6	43.33	5.1	810.0	26.07
CFK 69.1 x TPS 67	100.0	51.2	3.4	82.7	313.33	2.9	329.00	13.5	42.67	5.3	685.0	21.77
C95C-16.5 x TPS 13	100.0	56.9	3.5	78.3	256.67	2.0	341.67	14.2	50.67	5.6	649.0	21.77
LT 8 x TS 15	100.0	48.7	2.5	77.3	233.33	1.7	352.33	13.9	44.67	5.3	630.3	20.80
MF I x TS 15	100.0	43.9	2.5	81.7	209.00	1.5	269.00	12.2	54.67	6.9	532.7	20.60
MF I x C 95 LB-13.2	99.3	53.7	2.7	70.0	291.67	2.3	353.33	12.8	23.33	2.8	668.3	17.90
MF IIx TS 15	100.0	49.9	2.6	80.0	241.67	2.5	345.00	14.9	41.00	4.3	627.7	21.77
TPS 25 x TS 15	97.2	54.4	2.6	78.0	230.00	2.2	333.33	14.7	43.67	4.8	607.0	21.73
TPS 7 x TS 15	99.3	50.6	2.6	72.7	200.00	1.7	319.00	11.8	46.00	5.1	565.0	18.67
TS 15 x TPS 13	98.6	58.1	2.9	76.0	143.33	1.0	318.33	12.9	71.00	9.4	532.7	23.33
TS 15 x TPS 67	100.0	50.5	2.7	76.7	233.33	2.0	330.67	13.0	50.67	5.7	614.7	20.70
HPS II/67	100.0	52.1	2.9	77.3	195.00	1.5	281.67	11.7	44.33	5.4	521.0	18.57
HPS 7/67	100.0	54.4	2.2	78.7	206.67	1.4	295.00	11.8	39.00	5.1	540.7	18.30
Khumal Seto-1	99.3	53.7	2.4	75.3	176.00	1.3	330.00	12.3	82.67	8.8	588.7	22.42
Desiree	99.3	54.6	3.0	70.7	165.00	1.2	278.33	9.3	67.33	5.7	510.7	16.27
CV%	1.01	11.41	26.41	8.06	20.85	32.0	15.40	14.23	29.28	26.18	10.93	10.72
F-test	NS	*	NS	NS	**	*	*	**	**	**	**	**
LSD (0.05)		9.98			78.56	0.99	84.67	3.13	24.21	2.49	110.30	3.71

3.2.2 TPS F_1C_2 TUBER EVALUATION

Introduction

This experiment was conducted at PRP, Khumaltar. The major objectives were to identify the performance of F_1C_2 tubers and selection of suitable TPS progenies with resistant to pest and diseases and high productivity, to recommend TPS families for mid hill and to evaluate the parental lines and ware potato production.

Materials and Methods

This trial was conducted using tuber from previous years. 20 TPS families were planted where Desiree and Khumal Seto were used as check varieties. Seed tubers (20-40g) were planted on ridges by maintaining ridge-to-ridge 60 cm and plant-to-plant 25 cm distance. Fertilizer was used at the rate 100:100:60 NPK kg/ha with 20 t FYM/ha. Each TPS Family was 3 times replicated. No fungicide application was applied and other management practices were followed as per PRP recommendation.

Results and Discussion

The yield differences among the treatments were statistically significant (Table 3.5). TPS family MF I x TPS 67 produced maximum tuber yield (19.23 kg/5.4 m^2) followed by the check variety Khumal Seto-1 (18.67 kg/5.4 m^2) and AL 624 x TPS 67 (17.93 kg/m^2). Total

Table 3.5 Yield performance of TPS F_1C_2 tubers at NPRP, Khumaltar, 2004/05

TPS family	Tuber yield by number and weight / 5.4 m^2							
	<25 g		25-50 g		>50 g		Total	
	No.	Wt.(kg)	No.	Wt.(kg)	No.	Wt.(kg)	No.	Wt.(kg)
CFk 69.1 x TPS 67	263.3	2.3	230.0	9.7	47.3	5.4	540.7	17.4
CFk 69.1 x TPS 13	236.7	2.1	190.0	8.1	50.0	5.7	476.7	15.9
TS 15 x TPS 13	173.3	1.4	175.7	7.9	55.3	7.0	404.3	16.3
TS 15 x TPS 67	180.0	1.4	250.0	9.9	44.3	5.0	474.3	16.4
C 95 C 16.5 x TPS 13	181.7	1.4	200.0	8.2	59.3	7.1	441.0	16.7
AL 204 x TPS 13	53.3	0.4	130.0	5.7	63.3	8.6	246.7	14.6
AL 204 x TPS 67	106.7	0.9	164.3	6.7	61.3	7.4	332.3	15.0
AL 624 x TPS 13	163.3	1.5	205.0	9.0	49.0	6.0	417.3	16.5
AL 624 x TPS 67	223.3	2.1	286.3	10.8	45.0	5.1	554.7	17.9
Achirina x TS 15	171.7	1.6	218.3	9.4	57.7	6.0	447.7	17.1
Atzimba x TS 15	151.7	1.4	222.7	9.1	42.7	4.7	417.0	15.2
LT 8 x TS 15	145.0	1.1	195.0	8.4	54.3	6.3	394.3	15.9
MF I x TS 15	116.7	0.9	183.3	8.1	52.7	6.2	352.7	15.2
MF II x TS 15	123.3	1.0	174.0	7.4	57.0	7.1	354.3	15.5
TPS II x TS 15	101.7	1.0	158.3	6.8	57.7	6.7	317.7	14.5
TPS 25 x TS 15	106.3	0.9	138.3	6.4	61.0	7.6	305.7	14.8
TPS 7 x TS 15	130.0	1.1	205.0	9.0	42.0	4.9	377.0	15.0
MF I x C 95 LB 13.2	186.0	1.4	276.7	10.2	48.3	5.2	511.0	16.8
MF II x TPS 67	176.7	1.5	232.7	10.0	50.3	6.1	459.7	17.6
MF I x TPS 67	231.0	2.0	313.3	11.8	50.7	5.4	595.0	19.2
Desiree (ch)	89.0	0.6	223.3	7.8	42.7	4.3	355.0	12.6
Khumal Seto (ch)	148.0	1.1	325.7	12.7	42.0	4.9	515.7	18.7
Cv%	9.02	12.10	6.90	4.07	6.70	5.40	5.02	3.14
F-test	**	**	**	**	**	**	**	**
LSD (0.05)	23.37	0.27	24.29	0.59	5.69	0.54	34.95	0.83

tuber number was also maximum in MF I x TPS 67 (595/5.4 m^2) followed by AL 624 x TPS 67 (555/5.4 m^2). Results of tuber grading showed that CFK 69.1 x TPS 67 produced the maximum number (263/5.4 m2) and weight (2.33 kg/5.4 m^2) and minimum in the check variety Desiree 89 and 0.58 kg/5.4 m^2, respectively. Khumal Seto-1 produced the maximum number (326/5.4 m^2) and weight (12.73 kg/m^2) of 25-50 g size tubers followed by MF I x TPS 67 (313 and 11.77 kg/5.4 m^2). AL 204 x TPS 13 produced the maximum number (63/5.4 m^2) and weight (8.57 kg/m^2) of large size (>50 g) tubers followed by TPS 25 x TS 15 (61 and 7.57 kg/5.4 m^2).

3.2.3 TPS F_1C_3 TUBER EVALUATION

Introduction

This experiment was conducted at PRP, Khumaltar. The major objectives were to study the performance of F_1C_3 tubers and selection of suitable TPS progenies with resistant to pest and diseases and high productivity, to recommend TPS families for potato production.

Materials and Methods

This trial was conducted using tuber from previous years. Seven TPS families were planted where Desiree and Khumal Seto-1 were used as check varieties. Seed tubers (20-40g) were planted on ridges by maintaining ridge-to-ridge 60 cm and plant-to-plant 25 cm distance using 6 m^2 plot size. Fertilizer was used at the rate 100:100:60 NPK kg/ha with 20 t FYM/ha. Each TPS Family was 3 times replicated. No fungicide application was applied and other management practices were followed as per PRP recommendation.

Results and Discussion

A total of seven TPS families were evaluated and compared with Desiree and Khumal Seto-1 (Fig. 4). In the harvest, maximum tuber yield was recorded from MF I x TPS 67 (19.47 kg/6 m^2) followed by LT 8 x TPS 13 (17.83 kg/6m^2). With respect to tuber yield all the tested TPS families produced higher or at par yield over Desiree (14.03 kg/6m^2) and Khumal Seto-1 (17.07 kg/6m^2) except Atzimba x TPS 67 (12.9 kg/6 m^2).

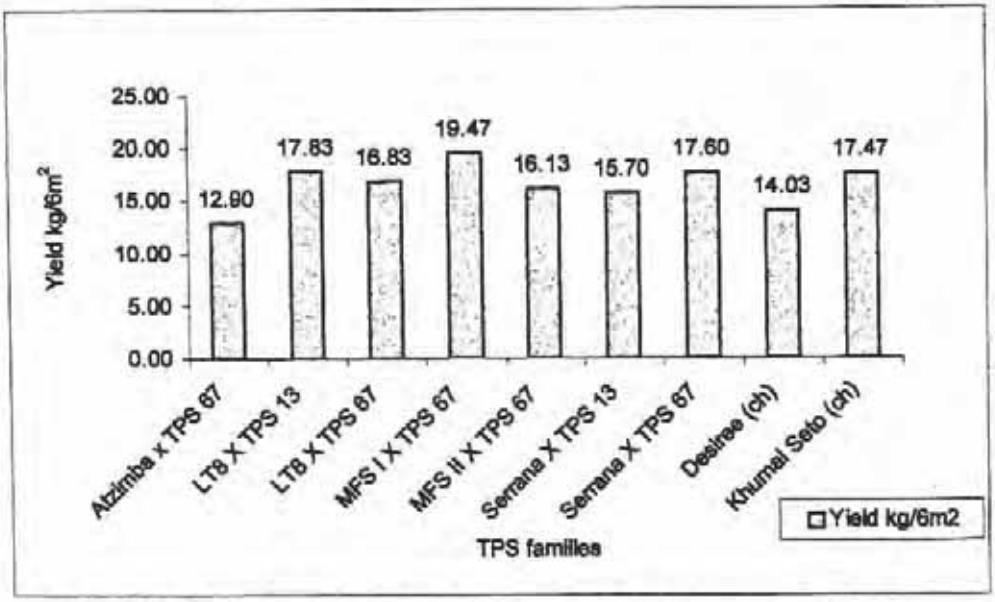

Figure 4. Yield performance of TPS families F_1C_3 at Khumaltar, 204/05

4.0 RESEARCH ON POTATO DISEASES

Potato is prone to many diseases because of its succulent nature. More than hundred types of diseases have been reported to be associated with potato. Out of them, Late blight, Bacterial wilt (*Ralstonia solanacearum*), Wart (*Sinchytrium endobioticum*), Black scurf (*Rhizoctonia solani*) and viral diseases particularly PVA, PVS, PVM, PVY, PVX and PLRV are of major concern. Among these diseases bacterial wilt, wart and black scurf are location specific and season specific. Yield loss due to individual disease ranges 15-40 % depending on potato varieties grown the conducive weather prevailing at a particular location.

4.1 STUDIES ON LATE BLIGHT DISEASE

Late blight disease of potato is caused by fungus *Phytophthora infestans* (Mont) de Bary is the most dreaded disease of potato. In high hills above 2000 m a s l disease occur every year with the significant yield loss whereas, in Terai disease epidemic usually occur after 2-3 years causing substantial yield losses. Yield loss may reach up to 75 % in the worst year. The monitory loss due to late blight is estimated up to 1.8 billion annually when yield is estimated to a minimum level of 20 percent.

4.1.1 POTATO GERMPLASM SCREENING AGAINST LATE BLIGHT

Despite of small country Nepal has highly-diversified climate. Potato is grown almost all the season in Nepal. Potato planting time varies as per the altitudes and local weather conditions of terai, hills and mountain. Broadly country is divided into three agro ecological zones terai, hills and mountains. Single crop is grown in Terai and mountains where as in mid hills like Kathmandu valley two potato crops are grown in a year. Regarding with causal organisms of Late blight two types of *P. infestans* namely Mating type-A_1 and Mating type-A_2 have been reported. Based on agro ecological zones National Potato Research Programme exploring late blight disease screening at three sites Parawanipur, Khumaltar and Nigale represents Terai, hills and mountains respectively. This year disease screening was performed in two locations Parawanipur and Khumaltar because of budget and conflicts situation in the country.

Materials and Methods

A number of potato germplasm 83 for Khumaltar and 67 for Parawanipur were selected from previous screenings. Test potato clones were planted in rod row design with the spacing of 25 x 60 cm. Experiment was none replicated. Eleven tubers were planted per row along with one disease susceptible infector plant of Kufri Jyoti in Kathmandu and Kufri Sindhuri at Parawanipur. Compost 10 t/ha and fertilizer 150:100:60 kg NPK /ha was applied as basal dose. In Khumaltar, experiment was planted on September whereas in Parawanipur on second week of November. In addition to infector plant in each row, respective susceptible check variety was planted after each 9 rows of test clones for creating inoculums pressure to the test materials in both the locations.

Disease severity was scored on 1-9 CIP disease rating scale. Where 1 indicates no LB infection and 9 indicate more than 95% leaves and stem damaged. Disease was scored three times 50, 60 and 70 DAP. Disease score of 70 DAP was used for comparing the disease reaction of the clones. Tuber yield of individual row was harvested and analyzed. Late blight resistant reaction showing up to 3 CIP rating scale, high tuber yield along with the red skin tuber have been considered as selection criteria. Test clones were categorized into three groups, i.e. (1) Resistant or moderately resistant under Khumaltar conditions, (2) Resistant or moderately resistant under Parawanipur conditions and, (3) Resistant under both the conditions.

Results and Discussion

Khumaltar

Out of 83 potato clones screened at Khumaltar CIP-384321.15, CIP-389746.2, CIP-

391058.35, CIP-391396.96, CIP-392240.29 and other 10 clones were found moderately resistant to late blight with the disease score ranging 2-3 CIP scale, where as susceptible check Kufri Jyoti showed highly susceptible reaction with the score of 8 scale (Table 4.1and 4.2).

Table 4.1. Performance of potato clones in Khumaltar and Parawanipur agro-climatic conditions to LB severity and tuber yield

S.N.	Clones	Tuber Shape	Tuber Color	Khumaltar		Parwanipur	
				LB Score (1-9)	Yield (Kg/plot)	LB Score (1-9)	Yield (Kg/plot)
1	CIP-378711.7	O	W	8	6.0	4	2.40
2	CIP-383178.22	L	W	4	3.0	3	1.50
3	CIP-384321.15	O	Pink	3	4.6	3	1.00
4	CIP-384329.21	L	W	6	4.5	4	2.10
5	CIP-385021.12	O	W	5	4.3	6	1.50
6	CIP-385556.4	O	W	4	6.3	2	2.50
7	CIP-386201.3	O	R	6	3.4	6	2.00
8	CIP-388576.3	R	B	5	3.1	5	1.30
9	CIP-389746.2	O	R	2	6.7	3	2.80
10	CIP-391002.6	R	W	4	4.6	4	2.86
11	CIP-391046.2	L	W	5	4.1	2	2.50
12	CIP-391058.35	L	W	3	4.2	3	2.32
13	CIP-391059.75	L	W	5	3.5	7	1.96
14	CIP-391061.73	O	W	5	4.0	6	2.32
15	CIP-391062.72	O	W	7	5.0	6	2.53
16	CIP-391396.96	R	B	3	3.1	5	2.31
17	CIP-391617.54	R	Light pink	4	4.9	2	2.53
18	CIP-392228.66	O	W	6	4.9	6	1.47
19	CIP-392240.29	O	W	2	4.8	3	2.34
20	CIP-392241.37	O	W	5	3.1	4	1.76
21	CIP-392242.25	O	W	6	4.4	8	2.80
22	CIP-392243.17	O	W	4	6.0	3	3.67
23	CIP-392243.46	O	W	8	4.2	8	2.42
24	CIP-392243.52	R	W	5	2.6	4	1.65
25	CIP-392258.11	O	W	6	2.7	3	2.31
26	CIP-392270.32	R	W	4	4.5	3	2.69
27	CIP-392271.58	O	W	4	2.9	2	2.30
28	CIP-392278.41	R	R	8	2.8	7	1.65
29	CIP-392637.1	O	Pink eye	2	2.3	2	3.71
30	CIP-392657.8	R	Pink eye	2	4.4	2	4.20
31	CIP-392661.18	L	R	2	4.1	1	3.18
32	CIP-393077.159	L	Red eye	2	5.5	2	3.40
33	CIP-393077.54	O	Red eye	2	6.5	2	2.86
34	CIP-393280.57	R	R	2	1.4	2	3.61
35	CIP-393280.64	R	R	2	1.4	2	1.43
36	CIP-393339.242	R	B	3	2.5	2	2.31
37	CIP-393382.44	R	R	4	5.3	6	2.30
38	CIP-393385.39	R	R	4	3.1	2	2.50
39	CIP-394005.115	L	R	9	2.7	8	2.80
40	CIP-394007.55	O	R	7	2.2	6	2.42
41	CIP-394036.103	O	R	7	4.5	6	1.32
42	CIP-394051.4	R	R	6	2.3	7	3.30
43	CIP-395014.97	R	R	8	0.0	6	0.90
44	CIP-395034.100	R	R	6	2.2	6	0.55

Table 4.1. Cont...

SN	Clones	Tuber Shape	Tuber Color	Khumaltar		Parwanipur	
				LB Score (1-9)	Yield (Kg/plot)	LB Score (1-9)	Yield (Kg/plot)
45	CIP-396010.37	O	R	4	5.6	6	1.80
46	CIP-396010.42	R	R	4	2.2	4	3.19
47	CIP-396233.38	R	R	4	2.5	2	2.09
48	CIP-397119.28	R	R	7	1.5	4	1.10
49	CIP-800982	O	W	5	4.5	4	0.40
50	CIP-384331.10 LB	O	W	6	3.4	4	3.00
51	CIP-387146.48 LB	R	R	5	2.5	4	2.93
52	CIP-388572.1 K	R	R	8	0.0	4	2.50
53	CIP-388574.6D	R	R	6	2.4	3	2.44
54	CIP-388578.2 D	R	B	3	4.2	4	1.73
55	CIP-388764.26 LB	O	B	4	1.1	3	2.80
56	CIP-393574.72 B	R	R	6	2.4	3	2.38
57	AKK-69.1	R	R	6	1.2	5	1.54
58	CEZ-69.1	R	R	6	2.0	3	0.47
59	Curza-27	-	-	-	-	5	1.83
60	K. Kanchan	O	W	5	1.4	4	1.65
61	K.Chipsona-1	O	W	8	0.0	4	1.30
62	K.Chipsona-2	O	W	4	4.1	3	4.24
63	Khumal Seto-1	R	R	4	2.2	3	2.60
64	Kinga	O	W	5	3.0	5	1.20
65	LT-9X TPS-67	O	R	5	2.5	3	2.02
66	RW-8201.19	O	W	3	5.9	4	0.90
67	LBr-40	R	w	3	2.7	2	3.96
68	CIP-390347.50	O	W	5	4.0		
69	CIP-391533.21	O	W	6	2.7		
70	CIP-391598.75	O	W	7	3.9		
71	CIP-392206.15	-	-	8	2.7		
72	CIP-392206.35	O	W	5	2.9		
73	CIP-392225.41	O	W	4	4.8		
74	CIP-392227.15	R	W	5	2.8		
75	CIP-392636.54	L	W	4	1.9		
76	CIP-393108.71	O	R	8	2.4		
77	CIP-394003.161	O	W	2	3.9		
78	CIP-394038.105	-	-	8	2.6		
79	CIP-388572.4 K	O	W	8	2.0		
80	LT-5	O	W	6	2.6		
81	Mex-750838	R	W	4	6.6		
82	T-55X TPS67	O	R	5	5.1		
83	Veri Karnali	O	R	4	6.8		
84	K.Sindhuri (Ch)	R	R	-	-	6	3.20
85	Kufri Jyoti (Ch)	O	W	8	2.6		

Shape: O= oval, R= Round Colour: W= white, L= Long; PE= Pink eye; B= Blue, R= red
LB scoring on 1-9 rating scale: where 1= no symptoms at all; 9= more than 90 % foliage damage due to LB (1-2= resistant; 3-4= moderately resistant; 5-6= susceptible; and 7-9= highly susceptible)

Parawanipur

Out of 67 potato clones screened at Parawanipur CIP-383178.22, CIP-384321.15, CIP-385556.4, CIP-389746.2, CIP-391058.35 and other 24 clones were found moderately resistant to late blight with the disease score ranging 2-3 CIP scale, where as susceptible check Kufri Sindhuri showed moderately susceptible reaction with the score of six scale (Table 4.1and 4.2). Over all late blight severity was low at Parawanipur as compared to September planting potato at Khumaltar.

Potato clones performed better in both the conditions were CIP-384321.15, CIP-389746.2, CIP-391058.35, CIP-392240.29, CIP-392637.1, CIP-392657.8, CIP-392661.18, CIP-393077.159, CIP-393077.54, CIP-393280.57, CIP-393280.64, CIP-393339.242 and LBr-40. Out of these promising clones showing resistant reaction in both the conditions needs to be multiplied and included in the varietal improvement scheme and should go under multiplication testing.

Table 4.2 Selected potato clones in different locations during 2004/05

Khumaltar		Parawanipur		Resistant in both location	
SN	Clones	SN	Clones	SN	Clones
1	CIP-384321.15	1	CIP-383178.22	1	CIP-384321.15
2	CIP-389746.2	2	CIP-384321.15	2	CIP-389746.2
3	CIP-391058.35	3	CIP-385556.4	3	CIP-391058.35
4	CIP-391396.96	4	CIP-389746.2	4	CIP-392240.29
5	CIP-392240.29	5	CIP-391046.2	5	CIP-392637.1
6	CIP-392637.1	6	CIP-391058.35	6	CIP-392657.8
7	CIP-392657.8	7	CIP-391617.54	7	CIP-392661.18
8	CIP-392661.18	8	CIP-392240.29	8	CIP-393077.159
9	CIP-393077.159	9	CIP-392243.17	9	CIP-393077.54
10	CIP-393077.54	10	CIP-392258.11	10	CIP-393280.57
11	CIP-393280.57	11	CIP-392270.32	11	CIP-393280.64
12	CIP-393280.64	12	CIP-392271.58	12	CIP-393339.242
13	CIP-393339.242	13	CIP-392637.1	13	LBr-40
14	RW-8201.19	14	CIP-392657.8		
15	LBr-40	15	CIP-392661.18		
		16	CIP-393077.159		
		17	CIP-393077.54		
		18	CIP-393280.57		
		19	CIP-393280.64		
		20	CIP-393339.242		
		21	CIP-393385.39		
		22	CIP-396233.38		
		23	CIP-388764.26 LB		
		24	CIP-393574.72 B		
		25	CEZ-69.1		
		26	K. Chipsona-2		
		27	Khumal Seto-1		
		28	LT-9X TPS-67		
		29	LBr-40		

4.1.2 OPTIMUM USE OF FUNGICIDE AGAINST LATE BLIGHT OF POTATO UNDER KATHMANDU VALLEY CONDITIONS

Materials and Methods

Under natural epiphytotic conditions an experiment was conducted at Khumaltar during autumn season (Sept-Dec) of 2004. In this experiment Late Blight susceptible variety (Kufri Jyoti) was used. Potato crop was kept late blight disease free for fixed periods of time ranging from 30 days after planting (DAP) to 80 DAP by applying different frequencies of Krinoxyl Gold (Metalaxyl 8%+ Mancozeb 64%). Spraying of fungicide was done at 10 days intervals starting from 25 DAP to 75 DAP to keep the crop late blight free periods 30,40,50,60,70 and 80 days of crop age. It was estimated that single spray at 25 DAP would protect the crop LB free up to 30 days. Likewise two sprays at 25 and 35 DAP for 40 days, 3 sprays for 50 Days, and 4 sprays for 60 days, 5 sprays for 70 days and 6 sprays for 80 days. The total treatment were 7 including check (without any spray). Spray solution volume was made variable depending on the crop canopy ranging 250 to 1000 L/ha. Dose of Krinoxyl was 1.5 g/L of water along with the adjuvant APSA-80 at 1 ml/5 lit spray solution in all the sprays.

Plot size was 2.4 m x 3 m to fit 60 cm wide 4 rows of 3m long. Treatments were replicated thrice with randomized complete block design. Late blight susceptible variety 'Kufri Jyoti" was planted at the spacing of 25x60 cm. FYM 10 t/ha and fertilizer 150:100:60 Kg NPK was applied. Except Nitrogen all the nutrients were applied as basal. Half of N was applied as top dressing during first intercultural operation.

Record of LB Incidence on Tuber

Late blight incidence on tubers was recorded based on the symptoms appeared on the surface of tubers at harvest. Disease incidence was calculated as follows:

$$\text{Late blight incidence \%} = \frac{\text{Number of tubers infected} \times 100}{\text{Total tubers produced/plot}}$$

Record of RGL % on Foliage

Out of 24 plants in the central two rows 5 plants were randomly selected and numbered as 1-5 and tagged on main stem. Observation was taken at 10 days intervals at 30, 40, 50, 60, 70 and 80 days of crop age. Parameters for computing RGL %, defoliated leave, necrotic leaves, remained green leaves and the estimated area damage percent on remained leaves recorded. Based on these data remained green leaves percent (RGL %) was calculated.

$$\text{RGL \%} = \frac{100 - \{(\text{Defoliated leaves} + \text{necrotic leaves} + (\text{remained green leaves No.} \times \text{Area damage \%}) \times 100\}}{\text{Total number of leaves}}$$

Results and Discussion

Effects on Foliage

Under conducive weather conditions for Late blight, infection starts from lower leaves and in the presence of relatively high humid and low temperature conditions white colony fungal growth could be observed on lower side of leaves. However, symptoms may appear simultaneously on upper leaves, petioles, or growing buds or on stems under prolong conducive weather condition.

Remained green leaf (RGL) area after 80 DAP in six sprays of Krinoxyl was found significantly highest (73.25 %) followed by Krinoxyl five sprays (64.84 %) whereas in check

plot RGL was 9.98 percent. RGL value of single and double spray was comparable but when three sprays were given RGL value increased significantly 51.88 %. The RGL value of three sprays was found comparable with four and five sprays 56.86 % and 64.84 % respectively which were found at par (Table 5.3). The difference of RGL values between the check and three sprays was high (44.90%) as compared to three sprays and six sprays (18.37 %). Data clearly shows that three sprays at 10 days interval can protect the crop with 54 % green leaf foliage (Table 4.3). RGL % estimation method seems to be more accurate but tedious than the conventional scoring of 1-9 scoring scale. There were significant differences on the disease and yield due to the impact of frequencies of Krinoxyl sprays during September planted potato crop at Khumaltar condition.

Table 4.3 Effects of different frequencies of Krinoxyl sprays against LB disease control and tuber yield increase of potato under field condition

Trt #	Treatments	RGL %	Total Foliage loss%	LB incidence on tuber %	Yield t/ha	Yield increase over check %
1	Singe spray	32.87 b	67.13	3.37	20.32 a	6.55
2	Two spray	41.86 b	58.14	2.67	21.39 ab	12.17
3	Three spray	54.88 c	45.12	0.8	23.98 b	25.75
4	Four spray	56.86 c	43.14	0.0	25.09 b	31.57
5	Five spray	64.84 cd	35.16	0.0	26.76 b	40.33
6	Six spray	73.25 d	26.75	0.0	27.22 b	42.74
7	Check	9.98 a	90.02	4.47	19.07a	0
	F test	**		**	**	
	Cv%	13.75		33.0	16.89	
	LSD	11.43		0.95	3.37	

Late Blight Incidence on Tuber

On sever infection on foliage, pathogen tends to infect uncovered tubers in the soil and develop symptoms that lead to rotting of tubers during the storage. The level of LB incidence on tubers of whole experiment was low ranging 0.0 to 4.47 percent. Late blight tuber infection was not observed on four, five and six times sprayed plots. Among the tuber-infected plots infection was minimum (0.8%) in three times sprayed plots (Table 4.3). However, the level of tuber infection was low 4.47 % even in the controlled plots. Since Late blight is also of seed borne nature that may enhance the rotting of seed and ware potatoes during storage. *Phytophthora infestans* harboring onto the tuber may serve as primary inoculums of the disease development in the succeeding crop.

Effects on Tuber Yield

Tuber yield in the experimental plot was comparatively poor because of poor soil fertility and poor drainage facility developed. However, highest tuber yield was produced in the six times sprayed plots sprays (27.92 t/ha) followed by five (26.76t/ha) and four sprays (25.09 t/ha) and three sprays (23.98 t/ha). Tuber yield produced in three, four, five and six times sprayed plot were at par (Table 4.3).

Results clearly showed that three times spray was the optimum and economical for Late blight management to have considerably good harvest (Fig 1). However, RGL value was significantly highest in six sprays but tuber yield was at par with three sprays of Krinoxyl. Results of this experiment also indicated that yield could be increased 25 to 43 % by managing late blight through Krinoxyl spray under field conditions during autumn potato in Kathmandu valley conditions.

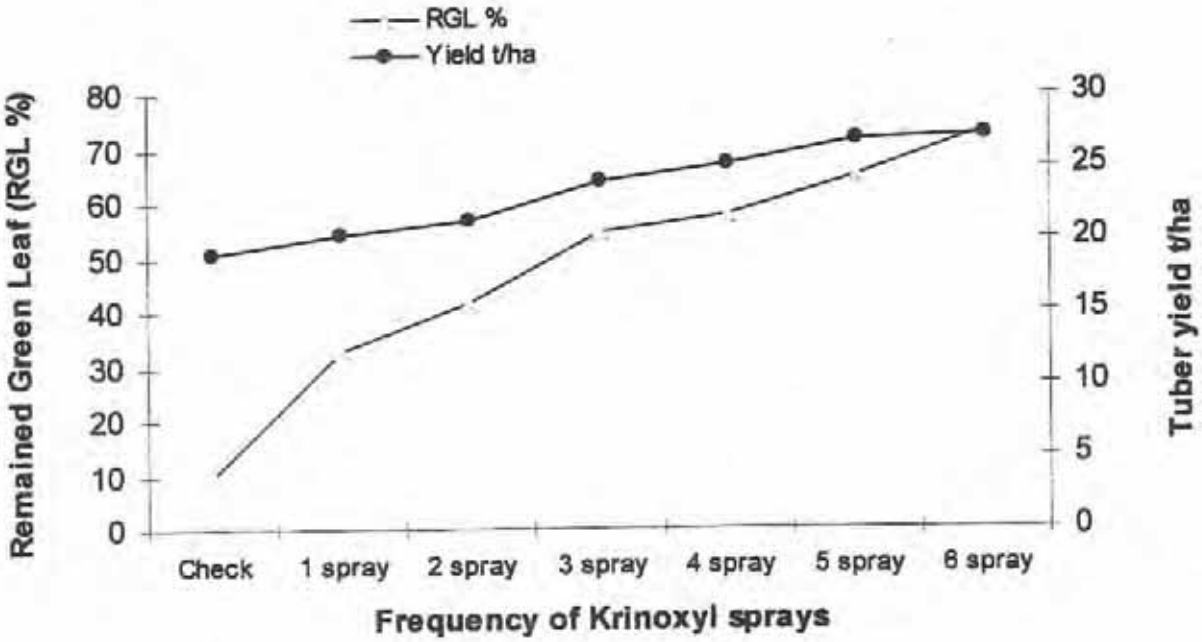

Figure1. Effets of frequencies of Krinoxyl sprays on green foliage and tuber yield t/ha on autumn potato at Khumaltar in 2004/05

4.2 SURVEY AND MANAGEMENT OF BLACK SCURF (*RHIZOCTONIA SOLANI*) DISEASE OF POTATO

Introduction

Black scurf caused by *Rhizoctonia solani* is one of the most important diseases of potato. Disease is pronounced when black sclerotia cover the tuber surface. Black scurf disease can be found on all underground parts of the plant at different times during the growing season. The fungus survives from season to season primarily as black structures called sclerotia, which are present in soil and on potato seed tubers. Sclerotia that can be seen on potato seed tubers after washing with water are often referred to as the "dirt that won't wash off".

Under minimum disease severity it just lower down the market price but may not reduce the yield. Under severe conditions, when sclerotia cover more than 50 % area hinders germination of tubers, if get germinated there will be poor plant growth and leads to low yield.

Black scurf disease of potato occurs each year in North Carolina state of USA, but usually is not recognized by growers because disease symptoms develop underground. Consequently, yield losses associated with Black scurf disease usually do not become evident until after harvesting. Although yield losses associated with this disease are not well documented in North Carolina, losses of 10 to 15% are observed frequently in potato production areas outside of North Carolina.

In Nepal yield losses due to this disease has been estimated ranging 5-60 percent. Mid western region particularly Mainapokhar Bardiya is one of the black scurf affected areas, where highest yield losses observed during the survey conducted in 2003. Some recommendations have been made for disease control through seed tuber treatment with Sodium hypochloride (NaOCl), Acetic acid + Zinc sulphate and Boric acid of 3 % as well as

soil sterilization with Metham-sodium and Methyl bromide. Despite of these recommendations almost none of the farmers are using these chemicals against this disease. Keeping these points in view farmer's participatory Black scurf management study was conducted at Mainapokhar where potato being grown continuously for more than a decade and Black scurf problem is in increasing trend.

Materials and Methods

A heavily infested field with *R. solani* was selected prior to experimentation. Treatments were fixed on consultation with participant farmers. Experiment was laid out in randomized complete block design with three replications. There were seven treatments as shown in Table 4.4. Experiment was planted in November 11, 2004. Plot size was 2.4 m x 3.0 m. Tubers were planted in 25 cm x 60 cm spacing. Manures 10 t/ha and fertilizers 150:100:60 kg NPK/ha was applied as basal except Urea. Incase of urea it was split into two parts half was top dressed during first earthing-up operation. As per treatment plan soil was sterilized with Formalin fumigation at 1.0 % (Formaldehyde 39 % of commercial grade) concentration ten days prior to planting. *Trichoderma harzianum*, which was commercially available in the form of 'NIPROT', was also multiplied in well-decomposed compost. NIPROT was mixed with compost and covered with polyethylene sheet for 10 days with the agitation of two days intervals.

Treatment Detail

- Seed treatment with *Trichoderma harzianum:* Two percent suspension (20 g NIPROT/ Lit of water) of *Trichoderma* (NIPROT) was made and seed tubers were dipped into it for 30 minutes, shade dried and planted. Left over suspension was applied on to respective plots.
- Seed treatment with Boric acid: Three and two percent solution of Boric acid was made and seed tubers were dipped into it for 30 minutes shade dried and planted.
- Soil treatment with *Trichoderma*: *Trichoderma* is multiplied in well-decomposed FYM @ 10 g NIPROT/ Kg FYM. NIPROT is well mixed in FYM and kept for 7-10 days under polyethylene cover. Mixture is turn over in every 3 days for better growth of bio agent. This mixture was applied on to furrows opened during planting.
- Soil sterilization with Formaldehyde: Soil is drenched with 1.0 % (25 ml Formaldehyde/ L water) Solution of Formaldehyde commercial grade (39%) and plot is covered making air tight with white polyethylene sheet for 7days. Plots were exposed thoroughly by agitating soils 2-3 times. Two liters solution was applied to drench 1sq m area.
- Seed treatment and soil drenching with Thiophanate methyl 70 WP: One percent suspension of Thiophanate methyl (**Roko**) was made and tubers were dipped for 30 minutes and shade dried before planting. After germination drench with the same fungicide of 0.5 % suspension (7.2 L water /plot).

Crop was harvested at 120 days after planting. Total yield/plot was recorded. Finally, black scurf severity was recorded on percentage comparing the corresponding pictorial severity scale developed. Black scurf severity index was computed as-

$$DI = \frac{\text{Sum of numerical ratings of damage} \times 100}{\text{Highest score x Total tuber sample}}$$

Efficacy Test of Antagonist (T. Harzianum) against Black Scurf

Trichoderma harzianum was isolated from the commercial product "NIPROT" and cultured on PDA. Similarly, causal pathogen *Rhizoctonia. solani* was also isolated from infected tubers collected from experimental plot and cultured on to PDA medium.

For competitive studies 10 mm size culture disk was inoculated onto the freshly made PDA. *Trichoderma* culture was placed in the center and *R. solani* culture was placed four sides around the antagonistic fungus. Five such inoculated plates were incubated for 7 days at 22° C for their colony development.

Results and Discussion

Disease Index

On an average severity of Black scurf was low (29 %) even in the untreated check plot. This severity was two percent higher than the previous experiment. It was significantly low as compared to existing adjoining farmers own crop of same variety "Cardinal". The reason behind it could be the timely irrigation and shallow planting which enhanced the early germination and reduced the infection. However, there were significant differences in the disease index observed due to the treatments. The plots having healthy seed (PBS) planted in sterilized plots controlled the disease by 89.4 % followed by Boric acid treated seed planted plots (74.2 %) and in seed and soil treated soil with *T. harzianum* (36.4 %). Seed treatment with Thiophanate methyl could not found effective in controlling the Black scurf under field conditions (Table 4.4).

There was no significant differences between the disease control in the plots of 3% boric acid treated seed and of Boric acid 2 % concentration, disease index were 7.56 and 8.44 % respectively. Application of antagonistic fungus (*T. harzianum*) to tuber treatment, soil treatment and drenching was found comparable with infected seeds planted in sterilized soil with formaldehyde (Table 5.4). Results suggest that use of Trichoderma alone can check the black scurf and yield could be increased by 12 percent (Table 4.4).

In-vitro studies also showed that growth of *R. solani* was completely covered and suppressed by the profuse growth of *T. harzianum* that was isolated from "NIPROT" under the temperatures of 22° C.

Table 4.4 Effects of tuber treatment and soil treatment on black scurf disease control and tuber yield at Mainapokhar of Bardiya during 2004/05

S N	Treatments	Disease Incidence %	Dis. Index %	Dis. Control %	Yield t/ha	Yield increase %
1	Seed and Soil treatment with T. harzianum	41.33	18.67	36.4	25.12	11.70
2	Boric acid (3%) treated seed in sterilized soil	16.00	7.56	74.2	28.76	27.90
3	Boric acid treated (2%) seed in infected soil	21.33	8.44	71.2	27.66	23.00
4	Infected seed in sterilized soil	54.67	22.22	24.2	26.50	17.90
5	Treated seed with Thiophenate Methyl	58.67	28.00	4.5	22.89	1.80
6	Healthy seed in sterilized soil	9.33	3.11	89.4	30.50	35.60
7	Infected seed in infected soil (Check)	69.33	29.33	0.0	22.49	0
	F test	**	**		**	
	CV %	8.75	22.20		4.47	
	$LSD_{0.05}$	12.84	6.82		2.13	

Effects on Yield

Tuber yield from the plot of pre basic seed (PBS) planted in sterilized plot was highest (30.5 t/ha) followed by seed treatment with Boric acid 3% planted in sterilized plot and *Trichoderma harzianum* applied plot (28.76 t/ha). This yield was comparable with the yield (27.66 t/ha) of Boric acid 2 % treated plot (Table 4.4). Significantly higher tuber yield was produced in *T. harzianum* treated plot (25.12 t/ha) as compared to check (22.49 t/ha). Results indicate that Biological control through *T. harzianum* is one of the new options for

long-term Black scurf management under mid western terai conditions of Nepal. When population of *R. solani* get well established in the soil, disease could be controlled around 89 % and yield could be recovered around 35.6 % (Table 4.4).

Results obtained from the experiment under naturally infected field conditions of Mainapokhar Bardiya, antagonistic fungus *T. harzianum* could be the environmental friendly and alternative methods of Black scurf disease control. Effectiveness of such antagonistic fungi may be increased in the succeeding crops because of its multiplication in the soil. Previously recommended dose of boric acid (3%) could be reduced down to 2 % because of showing comparable performance on disease control and tuber yield production. Other two treatments were also effective when soil was sterilized with formaldehyde at 1.0 percent. Soil fumigation with formaldehyde requires better technical skill otherwise it may be hazardous to health. Control of *R. solani* population in the soil certainly would help in growing legumes and vegetable crops.

4.3 MONITORING OF POTATO DISEASES

Disease monitoring in central terai particularly in the research stations and the periphery of stations/ OR sites was done during the first week of January and during February in Banke and Bardiya. Moderate level of severity of Late Blight was observed in central and mid western terai regions. However, incidence of LB frequently observed in almost all potato fields visited. Regarding with the other leaf spots early blight (*Alternaria solani* frequently observed. Apart from late and early blight other type of leaf spots i.e. Septoria (*Septoria lycopersici* Speg) Phoma (*Phoma andian* Turkensteen) and Cercospora (*Cercospora concors* Casp) were observed in Bardiya. Regarding with yield losses due individual leaf spots diseases have not been estimated so for in Nepal. a significant yield could be estimated with the cumulative effects of these leaf spots. Effective management practices needs to be developed for the years.

Shankhu, Mulpani, Nala, Panauti and Panchkhal are the major potato growing area in the central mid hill in and around Kathmandu valley. Potato is grown in two seasons Sept-Nov and Jan-April under potato-Rice-potato cropping system in irrigated low land. Bacterial wilt (*Ralstonia solanacearum*) was not found as serious problem in this cropping system. In maize-potato or Soybean-potato cropping pattern wherever followed Bacterial wilt was found sever up to the estimated loss ranging 20 to 80 % depending on the cropping pattern and crop rotation followed. The incidence of Bacterial wilt was found low in maize-potato than soybean-potato cropping pattern. Wilt incidence was minimum in spring season potato planted after rice.

Late blight was found epidemic in autumn planting potatoes but very less in spring potatoes in Kathmandu valley. There was minimum Late blight incidence till second week of December in mid - western Terai region.

Normally TPS progenies are being considered as resistant to late blight. However, TPS progenies were also found severely infected by late blight in some of the seed lots planted in Mainapokhar Bardiya in a farmer's field as it was reported in the previous year.

5.0 STUDIES ON SEED PRODUCTION

5.1 SUSTAINABILITY STUDIES FOR PRE-BASIC SEED PRODUCTION

Introduction

Higher cost of *in vitro* plantlet production is one of the major constraints for pre-basic seed potato production. Chemicals like agar, sucrose, and glassware, e.g. culture tubes, and electricity charge to run the incubation rooms are the major cost factors. Similarly, high mortality rate during acclimatization and transplantation at glasshouse/screenhouse is another factor for the high cost of pre-basic seed (PBS) potatoes.

Since 1990, National Potato Research Programme (NPRP) has been producing two hundred thousand PBS annually. Out of which, approximately 25% PBS was under 0.5 g size in weight, which are difficult to utilize under farmers' field condition. NPRP is expending more than Rs. 500,000.00 for the production of about 200,000 pre-basic seed potatoes each year. However, the programme is providing the pre-basic seeds to the farmers at a highly subsidized price so as to make it affordable to them. So, due to the higher cost of production, NPRP has been bearing the subsidy of more than Rs. 300,000.00 each year. To sustain such a high cost pre-basic seed production programme, there is no other alternative other than to reduce the cost of production.

By reducing the mortality rate it will reduce the total cost of planting material. Similarly, limited *in vitro* plants can be used as mother plants to produce the rooted stem cuttings in large number with very cheap price to replace the *in vitro* plants as planting materials.

The objective of the study was to reduce the production cost of pre-basic seed potatoes in a sustainable way. This year, three activities included in the study were :-

- Effect of hilling and planting materials on PBS production under screenhouse condition;
- Effect of minitubers size and spacing on basic seed (BS) production under midhill condition, and
- Effect of cultivar and planting materials on basic seed (BS) production under midhill condition.

5.1.1 EFFECT OF HILLING AND PLANTING MATERIALS ON PBS PRODUCTION UNDER SCREENHOUSE CONDITION

This study was conducted to evaluate the performance of different planting materials, viz. *in vitro* plantlets, rooted stem cuttings and minitubers, i.e. undersized (<0.5 g) pre-basic seed (PBS), under two hilling conditions with full (25 cm) and half-filled (15 cm) benches of sand soil substrate in the screenhouse for the production of PBS potatoes during spring season. The variety used was Desiree, an early variety. The planting materials – *in vitro* plantlets, rooted stem cuttings and undersized minitubers were planted in Feb. 21, 2005 and the crop was harvested on May 19, 2005.

The study revealed that *in vitro* plantlets produced seven tuberlets per plant as against six from minitubers and about four from rooted stem cuttings (Table 5.1). However, about 43% tuberlets produced by stem cuttings were greater than one gram sized, whereas minitubers produced about 40% and *in vitro* plantlets produced only about 15% of >1 g sized PBS. Accordingly, the largest tuberlets of 2.4 g were produced by stem cuttings and the *in vitro* plantlets produced the smallest tuberlets of 0.9 g size. These results indicated the size and number of tuberlets produced had reciprocal relationship. Regarding the per unit area of production, minitubers produced the highest number (604) as well as the maximum yield (1.2 kg) of PBS per square metre.

Similarly, the study on the sand soil substrate depth indicated that seed multiplication rate varies significantly from about five tuberlets in half-filled bench to about six in full benches. Accordingly, there was significantly higher number (457) of PBS production per square meter in full bench than in half-filled bench (374). Thus there was about 22% more tuberlets production per unit area in full benches as compared to half filled benches.

Table 5.1 Effect of hilling and planting materials on PBS production under screenhouse condition, Spring 2004/05

Treatments	Multipl[n] rate*	MTS+ (g/PBS)	% PBS yield (#)			PBS yield	
			>1 g	0.5-1 g	<0.5 g	#/m²	g/m²
Sand Soil Substrate							
Half-filled bench	5.4[q1]	1.9[p]	34.3[p]	34.7	31.0[q]	374.0[q]	683.0
Full bench	5.9[p]	1.6[q]	30.5[q]	34.7	34.9[p]	456.7[p]	740.9
Planting Materials							
In vitro plantlets	7.0[x2]	0.9[z]	14.7[y]	38.0[x]	47.4[x]	348.2[y]	291.4[z]
Rooted stem cuttings	3.9[z]	2.4[x]	42.7[x]	29.7[y]	27.6[y]	293.7[y]	677.1[y]
Minitubers (PBS)	6.0[y]	2.0[y]	39.7[x]	36.3[x]	24.0[y]	604.2[x]	1167.3[x]

* Multiplication rate = ratio of total number of PBS harvested to number of units planted.
\+ MTS = Mean tuber size
1 Means within sand soil substrate followed by the same letter (p, q or r) are not significant at 0.05 level.
2 Means within crop duration followed by the same letter (x, y or z) are not significant at 0.05 level.

5.1.2 EFFECT OF MINITUBERS SIZE AND SPACING ON BASIC SEED (BS) PRODUCTION UNDER KHUMALTAR CONDITION

This study was conducted to find out the optimum plant spacing for different size categories of PBS potatoes under basic seed (BS-1) production. The cultivar used was Kufri Jyoti.

Four different PBS size categories (<0.5 g, 0.5-1 g, 1-10 g and >10 g) and four plant spacing (50 x 10 cm, 50 x 15 cm, 50 x 20 m and 50 x 25 cm) had been tested. The results indicated that seed multiplication rate and number of basic seed (BS-1) produced per unit area were not affected by the size of PBS used (Table 5.2). However, mean tuber size and the yield of basic seed were increased with the increase in minituber size. The percentage of seed size tubers produced from 0.5-1 g, 1-10 g and >10 g sized minitubers were at par ranging from about 70 to 74%, which was significantly higher than that of <0.5 g sized minitubers (65%).

Table 5.2 Effect of minitubers size and spacing on basic seed (BS) production under Khumaltar condition, Spring 2004/05

Treatments	SMR* (#/pt)	MTS+ (g/tuber)	BS size distribution (% wt)			BS yield	
			US	SS	OS	#/m²	t/ha
PBS size							
< 0.5 g	8.3	11.4[r1]	31.8[p]	65.0[q]	3.1[r]	102.9	11.6[r]
0.5-1 g	7.3	17.1[q]	21.7[q]	72.6[p]	5.7[qr]	89.1	14.8[q]
1-10 g	8.4	18.6[q]	20.7[q]	69.9[pq]	9.4[pq]	101.7	18.6[p]
> 10 g	8.7	20.5[p]	14.4[r]	74.2[p]	11.4[p]	102.5	20.9[p]
Spacing							
50 x 10 cm	5.9[y2]	15.2[y]	28.3[z]	68.2	3.5[y]	118.5[z]	17.2[z]
50 x 15 cm	8.3[z]	16.8[zy]	20.8[y]	72.7	6.5[y]	111.0[z]	18.1[z]
50 x 20 cm	9.0[z]	17.5[x]	20.5[y]	72.3	7.2[y]	90.2[y]	15.9[zy]
50 x 25 cm	9.5[z]	18.2[z]	19.0[y]	68.5	12.4[x]	76.3[y]	14.2[y]

* SMR = ratio of total number of seed (BS) harvested to number of units (PBS) planted.
\+ MTS = Mean tuber size
1 Means within PBS size followed by the same letter (p, q or r) are not significant at 0.05 level.
2 Means within spacing followed by the same letter (x, y or z) are not significant at 0.05 level.

In case of plant spacing, production of seed size tubers were uniform ranging from about 68 to 73%. Seed multiplication rate and mean tuber size were increased with the increase in plant spacing. However, the yield of basic seed was higher at the closer spacing – the highest number of seed per unit area (118.5/m²) under 50 x 10 cm spacing and the highest yield (18.1 t/ha) under 50 x 15 spacing.

5.1.3 EFFECT OF CULTIVAR AND PLANTING MATERIALS ON BASIC SEED (BS) PRODUCTION UNDER MIDHILL CONDITION, SPRING 2004/05

This study was conducted to study the performance of minitubers with and without shoot tip harvesting in four potato cultivars, viz. Cardinal, Desiree, Kufri Jyoti and Janak Dev for basic seed (BS-1) potato production. Minitubers used were 0.5-1 g sized pre-basic seed potatoes.

The results indicated that harvesting of shoot tips from 40 days old plants caused significant reduction in seed multiplication rate and basic seed yield (in terms of number of BS-1 produced per square meter as well as tonne per hectare) (Table 5.3). However, mean tuber size and percent seed size distribution in terms of seed number were unaffected. In case of cultivars there were significant varietal responses on all yield parameters based on maturity groups. Janak Dev, the late cultivar, produced the highest yield (23.2 t/ha) and largest tubers (19.1 g/tuber), and Cardinal and Desiree, the early cultivars, gave lowest yield (about 11 t/ha) and smallest tubers (about 11 g/tuber). Seed multiplication rate, percent seed size tubers and number of BS-1 produced per square meter of Kufri Jyoti, the medium maturity type cultivar, and Janak Dev were significantly higher than those of Cardinal and Desiree.

Tables 5.3 Effect of cultivar and planting materials on basic seed (BS) production under midhill condition, Spring 2004/05

Treatments	SMR*	MTS-	BS size distribution (% wt)			BS yield	
	(#/pt)	(g/tuber)	US	SS	OS	#/m^2	t/ha
Planting Materials							
Minitubers (PBS)	5.9^z	14.3	33.5	55.3	11.1	118.5^z	17.6^z
Minitubers with shoot tips harvested	5.2^y	13.2	37.4	54.8	7.8	104.9^y	14.4^y
Cultivars							
Cardinal	5.0^q	11.1^r	41.8^p	51.4^{qr}	6.8^q	99.3^q	11.4^r
Desiree	4.9^q	10.8^r	43.3^p	47.0^r	9.7^{pq}	98.2^q	11.0^r
Janak Dev	6.0^p	19.1^p	24.1^r	62.4^p	13.5^p	120.8^p	23.2^p
Kufri Jyoti	6.4^p	14.1^q	32.7^q	59.4^{pq}	7.9^{pq}	128.4^p	18.4^q

* SMR = ratio of total number of seed (BS) harvested to number of units (PBS) planted.
\- MTS = Mean tuber size.
: Means within cultivars followed by the same letter (p, q or r) are not significant at 0.05 level.
: Means within planting materials followed by the same letter (x, y or z) are not significant at 0.05 level.

5.2 LOWCOST ICM APPROACHES FOR SEED POTATO PRODUCTION

5.2.1 LOWCOST ICM APPROACHES FOR CLEAN SEED POTATO PRODUCTION

A three factor RCBD experimentation had been carried to produce clean seed (BS-1) from 0.5-1 g sized PBS, the factors being moisture resume (mulched vs irrigated condition), cultivars (Kufri Jyoti, Desiree and Cardinal) and plant spacing (50 x 10 cm and 50 x 15 cm).

The results indicated that seed multiplication rate, mean tuber size and BS-1 yield in terms of both number of tubers per square meter and ton per hectare in mulched plots were significantly higher as compared to irrigate plots (table 5.4). However, percentage of seed size (25-50g) tubers produced were unaffected. In case of cultivars, all yield parameters in Kufri Jyoti, the medium maturity cultivar, was significantly higher than those in Cardinal and Desiree, the early cultivars. Pre-basic seeds planted with 50 x 15 cm spacing produced higher seed multiplication rate and mean tuber size, and less number of basic seeds per square meter as compared to those planted at 50 x 10 cm spacing. So overall yield of basic seeds in terms of ton per hectare and seed size tuber production were unaffected.

Tables 5.4 Lowcost ICM approaches for clean seed potato production under Khumaltar condition, Spring 2004/05

Treatments	SMR* (#/pt)	MTS+ (g/tuber)	BS size distribution (% wt)			BS yield	
			US	SS	OS	#/m^2	t/ha
Moisture Status							
Mulched	7.5^{p1}	18.0^{p}	19.1^{q}	69.0	12.0^{p}	121.8^{p}	21.7^{p}
Irrigated	6.1^{q}	16.2^{q}	23.1^{p}	68.4	8.5^{q}	97.4^{q}	15.8^{q}
Cultivars							
Kufri Jyoti	7.6^{x2}	19.7^{x}	17.3^{y}	65.9^{y}	16.7^{x}	123.5^{x}	24.3^{x}
Desiree	6.6^{y}	15.4^{y}	21.4^{xy}	69.6^{xy}	9.0^{y}	107.7^{y}	16.5^{y}
Cardinal	6.0^{y}	13.1^{y}	24.5^{x}	70.6^{x}	4.9^{z}	97.6^{y}	15.3^{y}
Spacing							
50 x 10 cm	5.9^{b3}	16.3^{b}	23.7^{a}	67.5	8.8^{b}	117.2^{a}	19.2
50 x 15 cm	7.7^{a}	17.8^{a}	18.4^{b}	69.9	11.6^{a}	102.0^{b}	18.2

* SMR = Ratio of total number of seed (BS) harvested to number of units (PBS) planted.
\+ MTS = Mean tuber size.
1 Means within moisture status followed by the same letter (p, q or r) are not significant at 0.05 level.
2 Means within cultivars followed by the same letter (x, y or z) are not significant at 0.05 level.
3 Means within spacing followed by the same letter (a, b or c) are not significant at 0.05 level.

5.2.2 LOWCOST ICM APPROACHES FOR WARE SEED POTATO PRODUCTION

A three factor RCBD experimentation had been carried to produce ware seed from basic seed of Kufri Jyoti, the factors being moisture resume (mulched vs irrigated condition), Fertilizer supply (full vs half dose) and seed type (whole vs cut seed). The full dose of fertilizer recommended was 20 t/ha compost and 100:100:60 kg N:P:K per hectare.

The results indicated that mean tuber size and tuber yield in terms of ton per hectare were significantly higher in mulched plots as compared to irrigated plots (Table 5.5). However, seed size tuber production in terms of weight was higher under irrigated condition. In case of seed type, though whole seeds produced higher percentage of seed size tubers, all other yield parameters were at par with cut seeds. So use of cut seeds would be quite profitable than whole seed for ware seed potato production. In case of fertilizer dose, mean tuber size and seed yield (t/ha) were significantly higher with full dose of fertilizer as compared to only dose of fertilizers. However, percent seed size tuber yield was higher with half dose of fertilizers. Seed multiplication rate and number of tubers produced per square meter were unaffected by different fertilizer doses.

Tables 5.5 Lowcost ICM approaches for ware seed potato production under Khumaltar condition, Spring 2004/05

Treatments	SMR* (#/pt)	MTS+ (g/tuber)	Seed size distribution (% wt)			BS yield	
			US	SS	OS	#/m^2	t/ha
Moisture Status							
Irrigated	10.1	34.1^{q1}	9.8	63.5^{p}	26.8^{q}	67.2	22.9^{q}
Mulched	10.3	36.9^{p}	9.1	58.5^{q}	32.4^{p}	68.8	25.2^{p}
Seed Type							
Whole seed	9.8	36.5	8.5^{y2}	62.7^{x}	28.8	65.5	23.8
Cut seed	10.6	34.5	10.3^{x}	59.3^{y}	30.4	70.4	24.3
Fertilizer Dose							
Full dose	10.2	37.8^{a3}	8.4^{b}	57.7^{b}	33.9^{a}	67.7	25.6^{a}
Half dose	10.2	33.2^{b}	10.5^{a}	64.2^{a}	25.3^{b}	68.2	22.6^{b}

* SMR = Ratio of total number of seed (BS) harvested to number of units (PBS) planted.
\+ MTS = Mean tuber size.
1 Means within moisture status followed by the same letter (p, q or r) are not significant at 0.05 level.
2 Means within seed type followed by the same letter (x, y or z) are not significant at 0.05 level.
3 Means within fertilizer dose followed by the same letter (a, b or c) are not significant at 0.05 level.

6.0 SEED POTATO PRODUCTION

6.1 ACTIVITIES UNDER TISSUE CULTURE LABORATORY

Since the establishment of tissue culture laboratory and the glasshouse 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 2004/05:

6.1.1 GERMPLASM MAINTENANCE

A total of 87 potato germplasms were maintained under i*n vitro* condition in the laboratory (Appendix V). Further 22 *in vitro* germplasms including six old ones were introduced from CIP, Lima (Appendix VI). Out of them, eight recommended cultivars and six TPS parental lines (Table 6.1) were used for PBS production this year.

6.1.2 RAPID PROPAGATION

In each season virus-free mother plantlets are propagated by subcultures using single nodal cutting technique and grown in a growth chamber under 2000 Lux light intensity, 20±2°C temperature and 16 hr photoperiod. Depending on the cultivar, a fully grown plantlet can be 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 26,345 *in vitro* plantlets of 11 cultivars were supplied to the glasshouse in August 2004 and 11 cultivars totaling 21,479 plantlets were made available in Jan.-Feb., 2005 (Table 6.1).

Table 6.1 ***In vitro*** **plantlets supplied for plantation in the glass/screen houses, 2004/05**

S.N.	Cultivars	August, 2004	Jan.-Feb., 2005	Total
1	Desiree	7,680	7,070	14,750
2	Cardinal	6,550	8,050	14,600
3	Kufri Sindhuri	4,109	-	4,109
4	Khumal Rato -2	2,949	-	2,949
5	Janak Dev	1,630	2,550	4,180
6	Kufri Jyoti	952	760	1,712
7	Khumal Seto -1	670	835	1,505
8	Perricholli	540	-	540
9	MF II	515	465	980
10	TPS 7	400	446	846
11	TPS 67	350	426	776
12	TPS 13	-	460	460
13	MF I	-	227	227
14	Serrana Inta	-	190	190
	Total	26,345	21,479	47,824

6.2 GLASSHOUSE ACTIVITIES FOR PRE-BASIC SEED PRODUCTION

6.2.1 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.

Before autumn season plantation this year, old sand soil substrate of five glasshouse benches, viz. G.5, G.6, G.7, G.14 and G.16, were replaced with new substrate.

6.2.2 SOIL STERILIZATION

Formaldehyde solution (0.8%) was sprayed 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.

6.2.3 TRANSPLANTING

In August 2004, altogether 24,251 *in vitro* plantlets comprising of eight cultivars and three TPS parental lines were transplanted in the glass/screen house (Table 6.2), whereas in January/February 2005, a total of 17,460 plantlets of five cultivars and five TPS parental lines were transplanted in the glass/screenhouse for pre-basic seed production (Table 6.3).

6.2.4 MINITUBERS AND STEM CUTTING

In January 2005, a total of 3,082 minitubers (<0.5 g size) of Cardinal, Desiree and Khumal Seto-1 were planted in the glasshouse and a sum of 1,344 rooted stem cuttings of Cardinal were planted in the screenhouse (Table 6.3).

6.2.5 PRE-BASIC SEED (PBS) PRODUCTION

Pre-basic Seeds were produced in the glasshouse during two seasons, the first one during autumn 2004 and the second one during spring 2005. During autumn 2004, total of 100,160 PBS comprising eight cultivars and three TPS parental lines were produced. The cultivars were Desiree, Cardinal, Janak Dev, Kufri Sindhuri, Perricholi, Khumal Seto-1, Kufri Jyoti and Khumal Rato-2 and three TPS lines being TPS 7, TPS 67 and MF II. The average PBS multiplication rate in the glasshouse for *in vitro* plants was 3.8 ranging from 1.2 in TPS 7 to 6.6 in Janak Dev. In case of screen house it was 4.1 ranging from 3.4 in Khumal Rato-2 to 7.0 in Kufri Sindhuri (Table 6.2).

Table 6.2 Plantation and PBS production in the glasshouse and screenhouse during autumn, 2004/05

S.N.	Cultivars	Number planted				Number of PBS harvested			
		In vitro	Minituber	Cuttings	Total	In vitro	Minituber	Cuttings	Total
A.	Glasshouse								
1	Desiree	7,452	0	0	7,452	24,570 (3.3)	0	0	24,570
2	Cardinal	4,968	0	0	4,968	20,560 (4.1)	0	0	20,560
3	Janak Dev	1,656	0	0	1,656	10,925 (6.6)	0	0	10,925
4	Kufri Sindhuri	828	0	0	828	4,320 (5.2)	0	0	4,320
5	Perricholi	270	0	0	270	606 (2.2)	0	0	606
6	Khymal Seto-1	558	0	0	558	1,785 (3.2)	0	0	1,785
7	Kufri Jyoti	828	0	0	828	2,487 (3.0)	0	0	2,487
8	TPS 7	400	0	0	400	464 (1.2)	0	0	464
9	TPS 67	350	0	0	350	1,070 (3.1)	0	0	1,070
10	MF II	515	0	0	515	1,010 (2.0)	0	0	1,010
	Sub-total	17,825	0	0	17,825	67,829 (3.8)	0	0	67,797
B.	Screenhouse								
1	Cardinal	918	0	0	918	3,480 (3.8)	0	0	3,480
2	Kufri Sindhuri	2,754	0	0	2,754	19,411 (7.0)	0	0	19,411
3	Khumal Rato-2	2,754	0	0	2,754	9,472 (3.4)	0	0	9,472
	Sub-total	6,426	0	0	6,426	32,374 (5.0)	0	0	32,363
	Grand Total	24,251	0	0	24,251	100,203 (4.1)	0	0	100,160

* Figures in parentheses are PBS multiplication rates.

In Spring 2005, altogether 90,760 pre-basic seed potatoes comprising five cultivars and five TPS parental lines were produced. Among them, Khumal Seto-1 had the highest multiplication rate of 5.6, and Desiree had the lowest (3.4) for *in vitro* plantlets in the glasshouse. In case of minitubers the multiplication rate ranged from 1.8 in Desiree to 8.8 in Khumal Seto-1. Similarly, in screen house the highest multiplication rate (13.2) was found in Desiree and the lowest (0.5) was recorded in TPS 7 for *in vitro* plants (Table 6.3).

Table 6.3 Plantation and PBS production in the glasshouse and screenhouse during spring, 2004/05

S.N.	Date	Cultivar	Plantation				PBS Havest			
			In vitro	Cuttings	Minituber	Total	*In vitro*	Cuttings	Minituber	Total
A.	Glasshouse									
1		Cardinal	5,796	0	1,656	7,452	23,247 (4.0)	0	4,123 (2.5)	27,370
2		Desiree	4,968	0	814	5,782	16,807 (3.4)	0	1,466 (1.8)	18,273
3		Janak Dev	1,656	0	0	1,656	8,552 (5.2)	0	0	8,552
4		Khumal Seto-1	558	0	612	1,170	3,142 (5.6)	0	5,358 (8.8)	8,500
5		Kufri Jyoti	486	0	0	486	2,594 (5.3)	0	0	2,594
		Sub-total	13,464	0	3,082	16,546	54,366 (4.0)	0	10,960 (3.6)	65,289
B	Screenhouse									
1		Cardinal	918	1,344	0	2,262	13,047	0	0	13,047 (5.8)
2		Desiree	756	0	0	756	9,970 (13.2)	0	0	9,970
3		Janak Dev	198	0	0	198	202 (1.0)	0	0	202
4		TPS 7	918	0	0	918	500 (0.5)	0	0	500
5		TPS 13	324	0	0	324	297 (0.9)	0	0	297
6		TPS 67	342	0	0	342	235 (0.7)	0	0	235
7		MF II	378	0	0	378	510 (1.3)	0	0	510
8		Serrana Inta	162	0	0	162	710 (4.4)	0	0	710
		Sub-total	3,996	1,344	0	5,340	25,503 (6.4)	0	0	25,471 (4.8)
		Grand Total	17,460	1,344	3,082	21,886	79,868	0	10,960	90,760 (4.1)

Figures in parentheses are PBS multiplication rate.

6.3 COLD STORAGE

All the pre-basic seed potatoes harvested in autumn 2004 and spring 2005 were graded into four categories, viz. <0.5 g, 0.5-1.0 g, 1.0-5.0 g and >5.0 g size. The PBS were packed in nylon net bags and then stored in Kohinoor Coldstore, Balaju on rent, as the existing National Potato Research Program's own coldstore was not functioning properly.

Mini tubers harvested in winter have 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 fiscal year 2005/06 (2062/63).

About 55 per cent of the PBS produced in autumn 2004 were larger than one gram sized. In case of spring 2005 production, only about 40 per cent tubers were larger than 1g sized (Tables 6.4 and 6.5). In the overall production of 190,930 pre-basic seed potatoes this year, about 48% were larger than 1g and about 14% were smaller than 0.5 g (Table 6.6).

6.4 PRICING AND DISTRIBUTION OF PRE-BASIC SEEDS

The per unit price of the pre-basic seed potatoes fixed for the fiscal year 2004/05 was Rs. 3.00 for larger than one gram sized minituber, Rs. 2.00 for 0.5-1 g sized and Rs. 1.00 for smaller than 0.5 g sized mini tubers (Table 6.7).

Last year (2003/04) 104,289 pre-basic seeds produced during autumn season and 103,186 produced during spring season were stored in Khumal Cold Store, NPRP for terai season and hill season distribution respectively. During 2004/05 altogether 233,568 pre-basic seed potatoes were distributed (150,303 during terai season and 83,265 during hill season) in coordination with the National Potato DevelopmentProgramme, Department of Agriculture, Khumaltar.

During terai season of 2004/05 a total of 130,627 pre-basic seeds (> 0.5 g size) of 10 different cultivars were distributed to seed potato growers through District Agriculture Development Offices, NGOs and others throughout the country (Table 6.8). Similarly, 19,676 undersized (<0.5 g size) pre-basic seeds were distributed to different Agricultural Research Stations/ Seed Potato Producers for recycling purpose (Table 6.9).

During hill season of 2004/05 a total of 80,896 pre-basic seeds (>0.5 g size) of six different cultivars were distributed to seed potato growers through District Agriculture Development Offices, NGOs and others throughout the country (Table 6.10). Similarly, 2,369 undersized (<0.5 g size) pre-basic seeds were distributed to different Agricultural Research Stations and Seed Potato Producers for recycling purpose (Table 6.11).

Table 6.4 PBS production during Autumn 2004/05 (2061-62 1st Lot) (To be distributed for terai season, 2005/06)

S. N.	Cultivars	PBS yield				
		>5 g	1-5 g	0.5-1 g	<0.5 g	Total
1	Cardinal	2,647	12,240	8,055	1,098	24,040
2	Desiree	939	10,759	10,192	2,680	24,570
3	Kufri Sindhuri	670	11,425	10,091	1,545	23,731
4	Khumal Rato-2	1,407	4,905	2,250	910	9,472
5	Janak Dev	345	4,220	4,830	1,530	10,925
6	Khumal Seto-1	55	1,000	640	100	1,795
7	Kufri Jyoti	495	1,422	570	-	2,487
8	Perricholi	70	406	130	-	606
9	TPS lines	194	1,415	935	0	2,544
	Grand Total	6,822	47,792	37,693	7,863	100,170
	%	6.8	47.7	37.6	7.8	100.0

Table 6.5 PBS production during Spring, 2004/05 (2061-62 2nd Lot) (To be distributed for hill season, 2005/06)

S. N.	Cultivars	PBS yield				
		>5 g	1-5 g	0.5-1 g	<0.5 g	Total
1	Cardinal	5873	16,040	14,133	4,371	40,417
2	Desiree	598	6,940	13,970	6,735	28,243
3	Janak Dev	-	1,999	3,890	2,865	8,754
4	Khumal Seto-1	320	2,610	3,020	2,550	8,500
5	Kufri Jyoti	170	873	818	733	2,594
6	TPS Lines	151	641	790	670	2,252
	Grand Total	7,112	29,103	36,621	17,924	90,760
	%	7.8	32.1	40.3	19.7	100.0

Table 6.6 Overall PBS production during 2004-05 (2061-62)

S. N.	Cultivars	PBS yield				
		>5 g	1-5 g	0.5-1 g	<0.5 g	Total
1	Autumn season	6,822	47,792	37,693	7,863	100,170
2	Spring season	7,112	29,103	36,621	17,924	90,760
	Grand Total	13,934	76,895	74,314	25,787	190,930
	%	7.30	40.27	38.92	13.51	100.00

Table 6.7 Pre-basic seed potato pricing of the last nine years

S. N.	PBS Grade	Per unit PBS price (Rs.)								
		1996/97 (2053/54)	1997/98 (2054/55)	1998/99 (2055/56)	1999/00 (2056/57)	2000/01 (2057/58)	2001/02 (2058/59)	2002/03 (2059/60)	2003/04 (2060/61)	2004/05 (2061/62)
1.	>1 g size PBS	1.00	1.00	1.25	1.40	1.50	1.60	2.70	3.00	3.00
2.	0.5-1 g size PBS	0.25	0.50	0.50	0.60	0.70	0.80	1.50	1.70	2.00
3.	0.25-0.5 g size PBS	0.00	0.00	0.20	0.25	0.30	0.40	0.75	1.00	1.00
4.	<0.25 g size PBS	-	-	0.00	0.05	0.05	0.05	0.75	1.00	-

Table 6.8 Distribution of pre-basic seed potatoes (> 0.5 g size) during terai season, 2004/05

Cultivars	ADOs					Farms/ Stations	NGOs/ Others	Total
	EDR	CDR	WDR	MWDR	FWDR			
>1 g size								
Cardinal	0	150	1,900	16,712	4,000	660	3,750	27,172
Desiree	900	300	1,100	3,240	3,496	0	0	9,036
Janak Dev	1,000	120	500	3,874	720	0	0	6,214
Kufri Sindhuri	7,538	2,066	0	4,799	500	0	0	14,903
Khumal Rato-2	3,810	2,054	0	0	1,000	0	0	6,864
Kufri Jyoti	200	800	500	500	1,000	0	0	3,000
Perricholi	0	0	0	2,600	0	40	0	2,640
NPI-106	0	900	0	0	0	0	0	900
Khumal Seto-1	0	0	505	0	500	0	0	1,005
Kufri Badshah	225	0	0	0	0	0	0	225
Sub-total	13,673	6,390	4,505	31,725	11,216	700	3,750	71,959
0.5-1 g size								
Cardinal	0	230	2,850	9,500	2,355	0	3,500	18,435
Desiree	1,855	0	590	2,900	1,500	0	240	7,085
Janak Dev	1,853	0	500	5,877	500	0	0	8,730
Kufri Sindhuri	9,088	723	500	3,856	0	0	500	14,667
Khumal Rato-2	1,743	200	500	1,000	1,000	0	0	4,443
Kufri Jyoti	0	0	0	0	0	0	2,055	2,055
Perricholi	0	0	0	1,565	0	178	0	1,743
NPI-106	0	260	0	0	0	0	0	260
Khumal Seto-1	0	0	0	500	500	0	0	1,000
Kufri Badshah	250	0	0	0	0	0	0	250
Sub-total	14,789	1,413	4,940	25,198	5,855	178	6,295	58,668
Grand Total	28,462	7,803	9,445	56,923	17,071	878	10,045	130,627

Table 6.9 Distribution of pre-basic seed potatoes (< 0.5 g size) during terai season, 2004/05

Cultivars	RARS, Tarahara	RARS, Nepalgunj	RARS, Parwanipur	ADO, Dhanusa	Total
Cardinal	837	638	532	3,159	5,166
Desiree	705	540	500	2,857	4,602
Janak Dev	641	550	-	2,325	3,516
Kufri Sindhuri	540	496	499	-	1,535
Khumal Rato-2	-	-	475	400	875
Kufri Jyoti	-	-	-	2,310	2,310
Perricholi	-	234	400	-	634
NPI-106	-	-	-	-	0
Khumal Seto-1	-	-	-	1,000	1,000
Kufri Badshah	-	-	38	-	38
Grand Total	2,723	2,458	2,444	12,051	19,676

Table 6.10 Distribution of pre-basic seed potatoes (> 0.5 g size) during hill season, 2004/05

Cultivars	ADOs					Farms/ Stations	NGOs/ Others	Total
	EDR	CDR	WDR	MWDR	FWDR			
>1g size								
Cardinal	-	7,070	-	-	1,532	985	150	9,737
Desiree	-	8,402	131	1,238	-	-	-	9,771
Janak Dev	-	3,377	-	500	-	-	-	3,877
Khumal Seto-1	-	3,385	-	320	-	725	-	4,430
Kufri Jyoti	-	3,626	500	687	-	735	-	5,548
NPI-106	-	1,015	-	1,939	-	-	-	2,954
Sub-total	0	26,875	631	4,684	1,532	2,445	150	36,317
0.5-1 g size								
Cardinal	1,000	6,829	510	2,430	2,598	-	-	13,367
Desiree	2,300	12,814	-	500	-	-	-	15,614
Janak Dev	1,543	5,551	-	500	-	-	-	7,594
Khumal Seto-1	-	2,437	-	1,000	-	-	-	3,437
Kufri Jyoti	-	3,297	-	570	-	-	-	3,867
NPI-106	200	500	-	-	-	-	-	700
Sub-total	5,043	31,428	510	5,000	2,598	0	0	44,579
Grand Total	5,043	58,303	1,141	9,684	4,130	2,445	150	80,896

Table 6.11 Distribution of pre-basic seed potatoes (<0.5 g size) during hill season, 2004/05

Cultivars	PRP, Khumaltar	HRS, Jumla	NSPC, Taukhel	Total
Janak Dev	-	-	800	800
Khumal Seto-1	-	585	-	585
Kufri Jyoti	280	-	-	280
NPI-106	-	704	-	704
Grand Total	280	1,289	800	2,369

7.0 RESEARCH ON POTATO INSECT PESTS

Introduction

Like other crops potato is damaged by a variety of insect pests. It has been reported that more than 40 insects species have been found to be associated with potato crops in Nepal. Frequently occurring and economically important insect pests are Aphids (*Myzus persicae*), Red ant (*Dorylus orientalis*), Jassids (*Emposka* spp.),Cut worms(*Agrotis ipsilon/segetum*), white grubs (*Phyllophaga* spp.), Epilachna beetles (*Epilachna vigintoctapunctata*), Semi looper (*Plusia orichalcea*), Leaf miner (*Liriomyza huidobrensis*), Hairy caterpillar (*Spilosoma obliqua*) and potato tuber moth (*Pthorimaea operculella*). Of them aphids and potato tuber moth (PTM) is the most important insect pest of potato in Nepal causing substantial yield losses. Aphid cannot cause heavy loss on potato directly by damaging foliage but it serves as a vector of transmitting virus diseases that leads to degeneration of crops and reduce tuber yield in the succeeding years. PTM could be considered as number one insect that can cause up to 100 % of ware and seed potato stored under normal room conditions in terai and mid hill conditions. Significant damages get noticed on stored potato but its infestation starts right from the field during plant growth. Adult flies lay eggs into the soft lower surface of leaf blades and if adults get enter through soil cracks that can also lay eggs into eyes of developing tubers as well. There are many options for PTM management through organic and inorganic insecticides applications on stored potatoes. Use of insecticides on ware potato against PTM may hazardous to consumers. National Potato Research Programme (NPRP) was seeking to find potato varieties resistant to PTM. Fortunately NPRP got an opportunity to test some PTM resistant potato clones provided by the University of Idaho USA under the collaborative research project.

7.1 RESEARCH ON POTATO TUBER MOTH (PTM)

This project was implemented with an effective collaboration between University of Idaho, Moscow, USA, and Entomology Division and National Potato Research Program, Nepal Agricultural Research Council (NARC) in Nepal. The project aims to investigate on promising potato lines (NY 123, P 161-3, L 235-4, Yagana, Q 115-6, and Q 132-53) against potato tuber moth under laboratory and field conditions of Nepal. Outputs achieved by NPRP during the project period are briefly presented.

Outputs

1. *Six promising in vitro potato plant materials tissue culturally multiplied.*

   Six in *vitro* plantlets received from the Idaho were multiplied. In 2001-02, total of 600 *in vitro* plantlets of six potato clones were multiplied in the NPRP laboratory.

2. *Seed tubers of six promising potato plant materials for field planting produced under screenhouse*

   Four hundred plantlets have been transplanted in the screenhouse for minituber (pre-basic seed, PBS) production during August of 2002. Tuberlets of undersized (<0.5 g) were further recycled in the screenhouse in the succeeding season (February planting). A total of 1,130 tuberlets ranging from 0.5-10 g in size were produced in 2002. Required number of minitubers was made available to Entomology Division for screening PTM resistant clones in the Laboratory.

3. *PTM infestation-free potato tuber produced in field.*

   Minitubers (PBS) produced in the screenhouse were multiplied as basic seed (BS-1) tuber in the Hattiban farm in 2002 and 2003. Tubers of six test clones along with Desiree and Kufri Jyoti as check potato varieties were made available to Entomology division for field study in Mulpani VDC of Kathmandu. It was of farmer's participatory variety selection against PTM as well as other agronomic characters.

4. *Selected potato clones evaluated under terai and valley conditions*

Out of six, four promising potato clones P 161.3, Q 132-53, NY 123 and L 235.4 were evaluated under two different agro-ecological conditions - RARS, Parwanipur (Central Terai) and NPRP's Hattiban farm (midhill valley). First fortnight of November and second fortnight of January are the main potato-planting seasons of Terai and Kathmandu valley, respectively. These selected exotic potato clones had been included in the routine IET (initial yield evaluation trial) of National Potato Research Programme in 2004-05 (2061-62). Yield attributing characters and tuber yield were compared with the check standard varieties Desiree, Kufri Jyoti, and Kufri Sindhuri.

Multi location trial results

Parwanipur

Of four test clones, L 235-4 showed good ground coverage (80%), plant height medium (36 cm), good plant vigor (4) in 1-5 scale, late maturity with comparable tuber yield 14.76 t/ha to Desiree (11.36 t/ha and Kufri Sindhuri (11.82 t/ha). Regarding with PTM infestation there was no significant difference between the clones under particular crop season. In case of late blight severity clone L 235-4 was found quite field resistant (4) in 1-9 rating scale to late blight under terai conditions. Other three clones were not found agronomically suitable to terai conditions of Nepal (Table 7.1).

Khumaltar

Same sets of potato clones were evaluated in Hattiban farm, Khumaltar for agronomical characters and reaction to late blight and potato tuber moth infestation under natural environmental conditions. Of four test clones, L 235-4 showed good ground coverage (93%), plant height medium (43 cm), late maturity with comparable tuber yield 31.74 t/ha to Desiree (18.61 t/ha) and Kufri Jyoti (22.20 t/ha). So far as late blight severity is concern disease severity was scored 1 in 1-9 rating scale for all the clones tested (Table 7.2). The reason could be that we could not create artificial environmental condition conducive for late blight development in the spring season. There was no winter rainfall and sufficient humidity to develop *Phytophthora infestans* population up to a pathogenic level.

Physical facilities for research developed under the project

During the project period some physical facilities of National Potato Research Programme were developed. Two screenhouses renovated. Due to replacement of glass sheets on roof, sufficient light get into the screenhouses for growing potato plant that helped in crossing efficiently. An air conditioner for tissue culture laboratory was purchased and installed. Sony digital camera of 7.2-mega pixel was purchased. Similarly, two hand compression sprayers, three sodium vapor lamps (150 watt Phillips), a computer monitor and other computer accessories were also purchased.

Table 7.1 Characteristics of potato clones at Parwanipur, 2004/2005

SN	Clones	Plant height (cm)	Ground cover (%)	Late blight scale (1-9)	Early blight (1-9)	Tubers no./plot	Tuber wt kg/plot	Yield t/ha	Tuber color	Tuber shape
1	396082.16	45	63	5	3	39	1.36	8.21 gh	W	R
2	I-1035	36	52	4	3	22	1.19	12.20 efgh	W	RC
3	392247.19	30	63	7	1	37	1.32	7.41 h	W	O
4	392287.48	48	70	6	2	60	1.83	9.90 fgh	W	Ob
5	392661.18	62	87	3	1	100	5.45	23.93 bc	LR	R
6	385556.4	45	60	2	2	64	3.97	32.13 a	W	R
7	392657.8	54	33	2	1	23	1.98	30.75ab	W	RF
8	393280.64	61	90	5	1	104	4.53	20.17cde	R	RC
9	392617.54	65	67	2	3	68	4.54	25.10abc	W	RC
10	392637.10	60	82	3	2	102	4.21	20.11 cde	W	O
11	393077.159	48	60	2	1	44	3.25	25.16 abc	W	O
12	393385.39	50	70	2	3	73	2.91	22.40 cd	R	RF
13	393339.242	58	75	3	3	127	3.43	15.33 defgh	Lp	RF
14	394005.115	48	87	7	1	91	3.13	17.69 cdef	R	L
15	393619.8	45	78	7	1	90	3.02	13.89 efgh	R	L
16	394051.4	41	52	6	1	29	1.35	10.7fgh	LR	L
17	394050.110	28	22	3	1	15	0.46	9.72 fgh	W	RF
18	393574.61	46	75	6	3	86	2.80	12.16 efgh	LR	L
19	392244.3	41	57	6	1	53	1.58	20.18 cde	R	R
20	394007.55	47	77	6	2	57	2.23	11.44 fgh	R	L
21	394036.103	17	73	6	2	119	1.95	8.84 gh	R	R
22	393574.72B	39	82	6	2	68	2.42	12.20 efgh	R	L
23	384003.161	39	62	7	1	63	1.61	8.8 hg	R	RF
24	K.Chipsona 1	55	70	4	2	56	1.80	7.68 gh	W	O
25	K. Chipsona 2	40	75	2	2	134	4.11	17.15 cdef	W	R
26	NY 123	40	63	4	3	67	2.83	13.73 efgh	W	R
27	P 161-3	37	82	5	3	113	3.58	15.48 defg	W	R
28	Q 132-53	48	75	7	1	76	2.51	10.8 fgh	W	R
29	L 235-4	36	80	4	2	172	3.26	14.76 defgh	W	R
30	Desiree (ch)	45	63	6	3	66	2.26	11.36 fgh	R	L
31	K. Sindhuri (ch	57	65	5	1	98	1.90	11.82 fgh	R	R
	CV							31.75		
	F-test							**		
	LSD (0.05)							8.06		

Tuber colour: W=white, R=red, LR=Light red, Lp= Light purple ,
Tuber shape: RF=round flat, R= Round, RC = Round compressed, , L=Long, O=Oval, Ob = Oblong

Table 7.2 Characteristics of potato clones at Khumaltar, 2004/05

SN	Clones	Plant height (cm)	Ground cover (%)	Late blight (1-9)	Early blight (1-9)	Tuber no./ plot	Tuber wt kg/plot	Yield (t/ha)	Tuber color	Tuber shape
1	392657.8	57.73	80	1	1	140	5.26	21.48 bcdefghi	W	R
2	393280.64	69.46	68	1	1	111	5.53	23.62 abcdefgh	LR	RF
3	396010.42	50.73	87	1	1	134	4.76	20.98 cdefghij	LR	RF
4	392271.58	45.73	77	1	1	103	4.43	19.75 defghijkl	W	RF
5	391617.54	67.33	57	1	1	82	3.01	10.93 klm	W	R
6	393077.159	57.93	87	1	1	131	7.16	31.14 ab	W	RF
7	392637.10	61.2	73	1	1	115	4.80	17.84 fghijkl	W	R
8	389746.2	51.33	80	1	1	107	5.36	23.72 abcdefgh	LR	RF
9	39339.242	61.53	65	1	1	129	2.61	11.40 jklm	R	R
10	393385.39	58.6	72	1	1	174	5.23	20.62 cdefghijk	R	R
11	392228.66	38.46	68	1	1	122	5.25	18.40 fghijkl	R	O
12	393280.57	43.06	70	1	1	107	4.16	17 fghijkl	R	R
13	393382.44	64.2	82	1	1	164	6.56	29.77 abc	R	RF
14	391396.96	93.6	72	1	1	157	5.23	22.56 abcdefghi	DP	R
15	393077.54	57.66	87	1	1	133	6.65	29.42 abcd	W	R
16	K. Chipsona 1	54.33	78	1	1	219	5.16	23.87 abcdefg	W	O
17	K. Chipsona 2	57.26	78	1	1	269	6.33	29.32 abcdc	W	R
18	K. Kanchan	44.93	68	1	1	119	1.70	6.87 mn	R	O
19	391002.6	58.4	50	1	1	153	3.54	12.75 ijklm	W	RF
20	395014.97	71.66	72	1	1	99	4.45	19.45 efghijkl	R	RF
21	394005.115	45.73	98	1	1	204	5.13	23.36 abcdefgh	R	RF
22	391061.73	59.33	68	1	1	128	5.93	20.80 cdefghijk	W	R
23	394007.55	54.46	80	1	1	137	5.28	22.15 abcdefghi	R	R
24	391058.38	46	80	1	1	106	3.57	15.04 ghijklm	W	R
25	394003.161	43.13	80	1	1	137	3.60	14.01 ghijklm	R	Ob
26	391046.2	45.73	57	1	1	164	1.53	13.83 hijklm	W	Ob
27	394036.103	57.33	87	1	1	237	6.23	26.14 abcdef	R	R
28	393574.72	53.46	82	1	1	114	4.35	17.75 fghijkl	R	O
29	394051.4	47	83	1	1	109	5.33	22.38 abcdefghi	LR	O
30	P161-3	28.46	35	1	1	117	2.63	9.94 lmn	W	RF
31	Q132-53	32.93	27	1	1	70	1.75	6.65 mn	W	R
32	NY 123	16.53	18	1	1	28	0.31	0.62 n	W	R
33	L235-4	43.06	93	1	1	491	7.10	31.74 a	CW	R
34	K. Jyoti (ch)	37.8	80	1	1	144	5.26	22.20 abcdefghi	W	O
35	Desiree (ch)	40.13	85	1	1	108	4.00	18.61 ghhijkl	R	O
	CV							31.57%		
	F-test							**		
	LSD (0.05)							9.93		

Tuber color: W=white, CW = Creamy white, DP = Dark pink, R=red, LR=Light red, Lp= Light purple
Tuber shape: RF=round flat, R= Round, RC = Round compressed, , L=Long, O=Oval, Ob = Oblong

Summary of outputs

Out of six potato clones received from University of Idaho, USA, potato clones Q132.53, Q115.6 and NY 123 have been found possessing comparative resistant to PTM under field and stored conditions of Kathmandu valley. Besides, Q115.6 and L-235 have shown a good standing capacity against Late Blight (*Phytophthora infestans*) under field conditions. Further multi location testing research under farmer's field and storage conditions also needs to be explored.

8.0 PUBLICATION AND PRESENTATION

Publication (Full papers)

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Appendix I. Annual Budget Allocation and Expenditure, 2004/2005 (2061/62)

Code Account Budget Heads	Budgets approved	Budget Received	Budget Expenditure	Balance
40 JK STAFF EXPENSES				
4000 Staff salary	2,153,452.74	1,977,452.74	1,977,452.74	0.00
4010 Staff allowance	167,600.00	167,600.00	167,600.00	0.00
4020 Provident fund	197,745.27	197,745.27	197,745.27	0.00
4030 Medical fund	-	-	-	-
4040 Uniform Expenses	8,900.00	8,900.00	8,900.00	0.00
4050 Dashain Expenses	160,880.00	160,880.00	160,880.00	0.00
4060 Over time expenses	-	-	-	-
Sub-total	2,688,578.01	2,512,578.01	2,512,578.01	0.00
41JK OPREA. EXPENSES				
4100 Travel Expenses	252,370.00	173,570.00	149,606.50	23,963.50
4110 Vehicle fuel	106,700.00	106,700.00	106,687.82	12.18
4120 Wages	635,700.00	520,700.00	520,666.00	34.00
4130 Lab supplies	348,500.00	287,500.00	287,456.10	43.90
4140 Farm supplies	498,200.00	430,200.00	430,133.85	66.15
4150 Book & journals	38,800.00	32,800.00	31,786.50	1,013.50
4160 Training/seminar	-	-	-	-
4180 Farm Repair	292,730.00	192,730.00	192,197.67	532.33
Sub-total	2,173,000.00	1,744,200.00	1,718,534.44	25,665.56
42 JK ADM. EXPENSES				
4200 Rent, utilities	472,471.99	472,471.99	460,702.21	11,769.78
4210 Commun. Expenses	40,000.00	40,000.00	40,000.00	0.00
4220 Repair/ maintenance	131,950.00	129,950.00	129,762.00	188.00
4230 Stationary & printing	46,000.00	46,000.00	45,937.10	62.90
4260 Contingency expenses	23,000.00	23,000.00	23,000.00	0.00
4280 Other admin expenses	-	-	-	-
Sub-total	713,421.99	711,421.99	699,401.31	12,020.68
43 JK CAPITAL EXPENSES				
4300 Freehold Land Cost	0.00	0.00	0.00	0.00
4310 Land & Land Dev. Cos	0.00	0.00	0.00	0.00
4320 Building & other cost	0.00	0.00	0.00	0.00
4330 Furniture & fixture	0.00	0.00	0.00	0.00
4340 Machinery &Equip.	135,000.00	132,950.00	132,950.00	0.00
4350 Vehicles Cost	0.00	0.00	0.00	0.00
4360 Computer & Accessory	0.00	0.00	0.00	0.00
4370 Other fixed assets	0.00	0.00	0.00	0.00
Sub-total	135,000.00	132,950.00	132,950.00	0.00
Grand Total	5,710,000.00	5,101,150.00	5,063,463.76	37,686.24

Appendix II. Existing Manpower Situation in NPRP, Khumaltar, 2004/05 (2061/62)

SN	Name	Designation/Level	Qualification	Remarks
1.	Mr. Gyan Prasad Rai	Coordinator (S-5)	M.Sc.Ag. (Horticulture)	
2	Mr Buddhi Prakash Sharma	Senior Scientist (S-4)	M.Sc.Ag. (PtPathology)	
3.	Mr. Puspa Raj Bhurtel	Senior Scientist (S-4)	M.Sc.Ag. (Horticulture)	
4.	Mr. Ram Chandra Adhikari	Senior Scientist (S-4)	M.Sc.Ag. (Horticulture)	On deputation to NARI
5.	Dr. Shambhu Prasad Dhital	Senior Scientist (S-3)	Ph.D. (Pt. Pathology)	
6.	Mr. Binesh Man Sakha	Senior Scientist (S-3)	M.Sc.Ag. (Veg. Crops)	
7.	Mr. Bhim Bahadur Khatri	Senior Scientist (S-3)	M.Sc.Ag. (Horticulture)	On study leave
8.	Mr. Binod Prasad Luintel	Scientist (S-1)	M.Sc.Ag. (Horticulture)	
9.	Mr. Ram Chandra Ghimire	Technical Officer (T-6)	B.Sc.Ag	On deputation to NMRP
10.	Mr. Ram Bharosh Nepal	Technical Officer (T-6)	SLC	
11.	Mr. Hari Bahadur K.C.	Technician (T-5)	SLC	
12.	Mr. Krishna Chandra Upreti	Technician (T-5)	SLC	
13.	Mr. Duryodhan Chaudhary	Technician (T-5)	I.Sc.Ag.	
14.	Mrs. Radhadevi Joshi (Shrestha)	A-5	M.Com.	
15.	Mr. Sita Ram Ojha	A-5	B.A.	
16.	Mrs. Anjali Bajracharya	A-4	B.Com.	
17.	Mr. Keshav Khadka	A-4	10 Class	
18.	Mrs. Bhawani Thapaliya	T-1	I.A.	
19.	Mr. Ramesh Chandra Khatiwada	T-1		
20.	Mr. Yadav Kumar Shrestha	T-1	I.A.	
21.	Mr. Tej Prasad Ghimire	T-1	S.L.C.	
22.	Mr. Pancha Maharjan	T-1	8 Class	
23.	Mrs. Sharda Thapamagar	T-1	7 Class	
24.	Mr. Bidur K.C.	T-1		
25.	Mr. Shiva Bahadur Sapkota	A-1		
26.	Mr. Bidur Pokharel	A-1		
27.	Mr. Dirgu Man Jirel	A-1		

Appendix III. Revenue Collection in F.Y. 2004/05 (2061/62)

S.N.	Sources of Revenue	Total
A.	RESEARCH	
1.	Seed Potato	44,892.50
B.	PRODUCTION	
1.	Pre basic seed (PBS)	596,659.50
2.	Basic Seed	60,772.00
3.	Ware Potato	17,094.00
4.	Rice	19,250.00
	Subtotal	693,775.50
C.	SERVICE	
1.	Service	10,147.00
2.	Others (Broad bean, Straw, etc.)	600.00
	Subtotal	10,747.00
	Grand Total	749,415.00

Appendix IV. Expenditure detail of PTM Project during 2003/04 (2060/61) and 2004/05 (2061/62)

Budget code	Budget heads	Budget Expanse of 2060/61	Budget released for 061/62	Budget Expanse of 2061/62	Total expanse of the Project	Balance
4090	Project Incentives	27,874.85	77,460.00	77,451.01	105,325.86	8.99
4100	Travel expense	2,496.00	1,050.00	1,050.00	3,546.00	0.00
4110	Vehicle fuel &Lubricants	5,235.08	9,232.00	9,230.57	14,465.65	1.43
4120	Wages to laborers	9,540.00	29,190.00	29,190.00	38,730.00	0.00
4130	Lab and Res. Supplies	0.00	26,970.00	26,961.80	26,961.80	8.20
4140	Farm supplies	7,980.00	42,300.00	41,532.00	49,512.00	768.00
4150	Books and Publications	0.00	6,090.00	6,088.00	6,088.00	2.00
4200	Rent and Utilities	0.00	0.00	0.00	0.00	0.00
4210	Communications	5,940.00	10,000.00	10,000.00	15,940.00	0.00
4220	Repair and maintenance	0.00	249,500.00	249,262.57	249,262.57	237.43
4230	Stationary &Office supp.	4,025.00	0.00	0.00	4,025.00	0.00
4260	Contingency	0.00	0.00	0.00	0.00	0.00
4340	Equipment and machi.	71,500.00	67,000.00	66,724.98	138,224.98	275.02
4360	Computer & accessories	7,580.00	10,000.00	9,965.36	17,545.36	34.64
	Total	**142,170.90**	**528,792.00**	**527,456.29**	**669,627.22**	**1,335.71**

Appendix V. List of germplasms maintained at NPRP, Tissue Culture Laboratory during 2003/2004 (2060/61)

S.N.	CIP Number	*Code Name*	Clones	Received Date	Source
1.	379420.1		27/15	31.10.1995	CIP, Peru
2.	379420.2		27/40	31.10.1995	CIP, Peru
3.	385524.9	058-1		April 2001	CIP, Peru
4.	385556.4	058-2		April 2001	CIP, Peru
5.	389746.2	058-3		April 2001	CIP, Peru
6.	391002.6	058-4		April 2001	CIP, Peru
7.	391011.17	058-5		April 2001	CIP, Peru
8.	391580.30	058-6		April 2001	CIP, Peru
9.	391696.96	058-7		April 2001	CIP, Peru
10.	392617.54	058-8		April 2001	CIP, Peru
11.	392633.54	058-9		April 2001	CIP, Peru
12.	392637.10	058-10		April 2001	CIP, Peru
13.	392657.8	058-11		April 2001	CIP, Peru
14.	392661.18	058-12		April 2001	CIP, Peru
15.	393077.159	058-13		April 2001	CIP, Peru
16.	393077.54	058-14		April 2001	CIP, Peru
17.	393085.5	058-15		April 2001	CIP, Peru
18.	393242.50	058-16		April 2001	CIP, Peru
19.	393280.57	058-17		April 2001	CIP, Peru
20.	393280.64	058-18		April 2001	CIP, Peru
21.	393280.82	058-19		April 2001	CIP, Peru
22.	393339.242	058-20		April 2001	CIP, Peru
23.	393349.68	058-21		April 2001	CIP, Peru
24.	393371.159	058-22		April 2001	CIP, Peru
25.	393371.58	058-23		April 2001	CIP, Peru
26.	393382.44	058-24		April 2001	CIP, Peru
27.	393385.39	058-25		April 2001	CIP, Peru
28.	393385.47	058-26		April 2001	CIP, Peru
29.		059-1	NY 123	20.05.2002	Chilli
30.		059-2	P 161-3	20.05.2002	Chilli
31.		059-3	L 235-4	20.05.2002	Chilli
32.		059-4	YAGANA	20.05.2002	Chilli
33.		059-5	Q 115-6	20.05.2002	Chilli
34.		059-6	Q 132-53	20.05.2002	Chilli
35.	800947		AL – 575	02.12.1998	CIP, Peru
36.	380013.12		Andinita	31.10.1995	CIP, Peru
37.	678009		BL - 1.10	01.05.1994	CIP, Peru
38.	800222		**BR - 63.65** (Molinera)	Aug. 1989	CIP, Peru
39.	-		BSU-PO3	1997	BSU, Phillipines
40.	381065.5		BW – 9	28.04.1992	CIP, Peru
41.	720117		Capiro	Sept. 1989	CIP, Peru
42.	-		**Cardinal**	12.06.1992	Cleaned in PRP
43.	720121		CEZ - 69-1	01.05.1994	CIP, Peru

S.N.	CIP Number	Code Name*	*Clones*	Received Date	Source
44.	676002		**CFJ - 69-1**	12.09.1990	CIP, Peru
45.	676003		**CFM - 69-1**	12.09.1990	CIP, Peru
46.	378711.7	CIP-11.7		31.10.1995	CIP, Peru
47.	676064		Cruza 118	01.05.1994	CIP, Peru
48.	575031		Cruza 27	01.05.1994	CIP, Peru
49.	800048		**Desiree**	Aug. 1989	CIP, Peru
50.	381263.2		F – 8	28.03.1990	CIP, Peru
51.	280054.23		G – 4	28.04.1992	CIP, Peru
52.	573079		I – 1035	28.03.1990	CIP, Peru
53.	575015		**I – 1124**	Aug. 1989	CIP, Peru
54.	575020		I – 1150	31.10.1995	CIP, Peru
55.	384638.10		Iniap Santa Rita	31.10.1995	CIP, Peru
56.	720123		**Janak Dev** (MEX 750821)	02.12.1998	CIP, Peru
57.	-		**Jumli Local**	19.3. 1999	Cleaned in PRP
58.	800972		Katcwekano	31.10.1995	CIP, Peru
59.	-		**Kathmandu Local**	05.02.1993	Cleaned in PRP
60.	378699.2		Kinigi	01.05.1994	CIP, Peru
61.	-		**Kufri Badshah**	19.3.1999	Cleaned in PRP
62.	800258		**Kufri Jyoti**	Aug. 1989	CIP, Peru
63.	676008		**Khumal Rato -2** (I-1039)	02.12.1998	CIP, Peru
64.	720088		**Khumal Seto-1** (A. Inta)	02.12.1998	CIP, Peru
65.	800265		**Kufri Sindhuri**	28.03.1990	CIP, Peru
66.	387205.5		LBr 20	31.08.1999	CIP, Peru
67.	387164.4		LBr 40	31.08.1999	CIP, Peru
68.	387170.9		LBr 43	31.08.1999	CIP, Peru
69.	387170.16		LBr 44	31.08.1999	CIP, Peru
70.	377957.5		LT – 5	28.03.1990	CIP, Peru
71.	720126		MEX 750838	02.12.1998	CIP, Peru
72.	IP 81001.1		MF I	09.05.2000	CIP, Peru
73.	IP 82010.2		MF II	Sept. 1989	CIP, Peru
74.	573272		Michoacan	28.03.1990	CIP, Peru
75.	800926.1		MS - 35.22 R	28.03.1990	CIP, Peru
76.	-		**NPI –106**	05.02.1993	Cleaned in PRP
77.	374080.5		**Perricholi**	02.12.1998	CIP, Peru
78.	800982		RW 8201.19	31.10.1995	CIP, Peru
79.	279139.5		Santa Ana	31.10.1995	CIP, Peru
80.	720136		Santa Cecilia	31.10.1995	CIP, Peru
81.	-		**Sarkari Seto**	Aug. 1989	Cleaned in SWZ
82.	720087		Serrana Inta	09.05.2000	CIP, Peru
83.	-		**Syang Dorje**	09.12.1992	Cleaned in SWZ
84.	-		**Tharu Local**	25.03.1994	Cleaned in PRP
85.	IP 84004.7		TPS – 7	08.05.1992	CIP, Peru
86.	IP 84008.13		TPS –13	09.05.2000	CIP, Peru
87.	IP 84007.67		TPS – 67	09.05.2000	CIP, Peru

Bold cultivars are recommended for commercial cultivation.

Appendix VI. Newly introduced clones in the laboratory, 2004/05

S. N.	Code Number	CIP Number	Cultivar Name	Received Date	Source	Remarks
1	061-1	390663.8		Sept. 20, 2004	CIP, Peru	
2	061-2	391004.18		" "	" "	
3	061-3	392745.7		" "	" "	
4	061-4	393077.159		" "	" "	Old clone
5	061-5	393085.5		" "	" "	Old clone
6	061-6	393248.55		" "	" "	
7	061-7	397016.7		" "	" "	
8	061-8	385499.11	E 86.011	" "	" "	
9	061-9	386612.5	E 86.604	" "	" "	
10	061-10	388676.1	Maria Bonita-INIA	" "	" "	
11	061-11	800928	MS 42.3	" "	" "	
12	061-12	388611.22	REICHE	" "	" "	
13	061-13	720110	Baronesa	Oct. 27, 2004	CIP, Peru	
14	061-4	800048	Desiree	" "	" "	Old clone
15	061-15	381379.9	Kisoro	" "	" "	Old clone
16	061-16	381400.22	LBr-19	" "	" "	
17	061-17	706661	LBr-27	" "	" "	
18	061-18	387015.3	LBr-35	" "	" "	
19	061-19	387132.2	LBr-37	" "	" "	
20	061-20	800926.1	MS 35.22R	" "	" "	Old clone
21	061-21	800934	MS 35.9	" "	" "	
22	061-22	-	Cardinal	Nov., 26, '04	SASA, UK	Old clone

Appendix VII. LOG FRAME, National Potato Research Programme, Khumaltar

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS (OVI)	MENS OF VERIFICATION (MOV)	IMPORTANT ASSUMPTIONS
GOAL: To improve livelihoods of Nepalese farmers through potato cultivation.	Food security and per capita income increased by 15 % at the end of 11th plan.	National Socio-economic survey report	Govt policy support for the establishment of potato based industries and minimization of potato import
PURPOSE: To increase the productivity of potato and farmers income.	• Productivity increased by 25 % with the adoption of ICM by the end of 11th five year plan	Agriculture statistics report from MOA & C	All the stake holders of potato perform integrated work for technology transfer, production, processing and marketing
OUTPUTS: 1. High yielding and economically important diseases and insect pest resistant 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 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 two TPS families released for commercial production by the end of 11th Plan. 2. Low cost and environment friendly management technology developed for economically important diseases and insect pests of potato by the end of 11th plan 3. Package of practices developed for conventional and TPS potato production and 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 2015. 5. Programme implemented to achieve the expected out puts by strengthening national and international linkages	- Report of variety release committee - PRP Annual reports/Project completion report - Germplasms and Scientist visit exchanged	Resource allocation for potato research improved as per it's importance to address the food security

ACTIVITIES	INPUTS (Budget for year 2061/62))		
1.1 Potato varieties of high yielding and resistant to major diseases developed for major three climatic regions of Nepal 1.2 High yielding TPS families identified for terai and mid hills 2.1 Economically important diseases (LB, Brown rot, Black scurf, wart and virus) management 2.2 Economically important insect pest (PTM and Red ant) management 3.1 Soil fertility studies on potato with respect to different agro climatic conditions. 3.2 Appropriate ICM technologies developed for each released potato varieties 3.3 Safe storage and value added processed products explored 4.1 Low cost bio technology developed for PBS production 4.2 PBS mini tubers produced as per farmer's demand come and distributed through NPDP/DOA 5.1 Organize working group meetings, workshops for coordination and multi location testing and technology development 5.2 Develop linkages specially with International Potato Center (CIP) Peru and other National Programs of the countries concerned.	Budget heads — Rs. 000' 40 Staff expenses 2689.0 41 Operational Expenses 2173.0 42 Admin Cost 713.0 43 Capital Item cost 135.0 Total Rs. 5710.0 Project wise budget for 2061/62 Project # — Rs. 000' 404 57 003 Variety Improv 452.0 404 61 001 LB-Management 112.0 404 54 002 TPS Evaluation 155.0 404 61 002 LC-ICM 124.0 404 57 002 Sustain PBS 117.0 404 60 001 BS Management 97.0 404 57 001 Soil Fertility 160.0 404 55 002 PBS Production 510.0 404 00 001 FMP 446.0 Total Operational 2173.0	Project monitoring and evaluation report	Project leader get empowered to perform their research projects effectively.