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TRANSFER OF TRUE POTATO SEED TECHNOLOGY THROUGH ON-FARM PARTICIPATORY VERIFICATION DEMONSTRATON IN NEPAL

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ABSTRACT

TPS, an alternative technology for potato production was introduced to Nepal in 1985. From 1985 to 1993 major emphasis has been on the evaluation of TPS families suitable for different agro-ecoregions in Nepal. Transfer of technology was started in 1993-94 crop season through on-farm participatory technology verification demonstration (PVD), which was conducted, in different agro-ecozones (Terai, mid-hills and high-hills). Non-availability of good quality tuber seed and its movement to inaccessible areas have limited potato production in Nepal. TPS technology has helped to minimize these difficulties and farmers are enthusiastic about TPS indicating a rapid progress in its adoption by farmers in Nepal. The demand for TPS has increased in the last 3-4 years. The farmers bought 12kg of TPS in 1998/99 producing F_1C_1 tubers enough for planting 600 ha in the following season. Based on the past experiences gained through working with the farmers having varied socio-economic and cultural ethnicity while conducting PVD, a model was developed and adopted for transferring TPS technology in Nepal. The salient features of this model include a central training-cum-planning workshop, regional level training to field staffs, community based PVD in 'cluster' followed by field level training, field days and field visits at district and national level. The details of the mechanisms adopted for successful dissemination of TPS technology in the country are presented in this model. Location specific efficient and effective TPS technology was developed for potato production through participatory approach in Nepal.

Additional key words: *Solanum tuberosum*, technology transfer, seed quality.

INTRODUCTION

Preliminary work on True potato seed (TPS) was started as early as in 1978 (Shakya, 1978). TPS is a supplemental technology (Warrit and Pongphen, 1990; Rashid and *et.al.*, 1993; Altoverous *et al.*, 1994; Kadian and Upadhya 1994; Lama and Khatri, 1997) to the conventional potato production system. Because of inherent limitations of the conventional seed schemes potato seed sector posses multifaceted problems related to its quality, availability, price (Horton, 1987; Hyouk *et al.*, 1991; P.C. Gaur and S.K. Pandey, 1996) transportation, marketing and storage in other countries in tropical and sub-tropical region. In such circumstances TPS not only to assure the access of quality seed at cheaper price (Singh and Jee 1990) but also to support food security program by saving huge quantity of seed potatoes that can be consumed instead of planting in the soil.

However, research findings regarding performance of TPS were not sufficient to bring this technology under the commercial production system at farmers' level in Nepal. But in contrary, remarkable progress on generation and adoption of TPS technology in many developing countries like Vietnam, Bangladesh, India, Peru and Sri Lanka (Caligari, 1992) and Nepal (Lama *et al.*, 1998; Paudel, 1998) are the basis

to conduct on -farm technology verification study in Nepal. Furthermore, its importance is intensified by the availability of hybrid seed which possess more uniform yield parameters compared to open pollinated type (Lama and Khatri, 1997).

APPROACH ADOPTED

Transfer of TPS technology was carried out under farmers' participatory approach in five selected districts representing major agro-ecological zones of Nepal.

Technology Transfer Model

A technology transfer model was developed and adopted for effective transfer of TPS technology in terms of minimizing time, resources and reach higher number of beneficiaries (Fig.1).

Packaging of Technology

In-situ seedling tuber (F_1C_1) production: TPS progenies HPS-II/67 were used in this study. Three to five grams of TPS were sown at a spacing of 25cm row-row and 4cm seed-seed in 5 -15m^2 nursery bed of 25-30cm deep sub-soil and well rotten compost (1:1) substrate with recommended dose (100:80:60 N, P and K kg/ha) of chemical fertilizers as for ware potato production. After full emergence (25-30 days) 100 seedling/m2 was maintained in the nursery beds. Foliar application of 0.1% urea solution were sprayed every 7-10 days interval till 50-60 days. Three earthing-up were done depending on the nature of crop growth.

Seedling Transplanting: Nursery beds were established as for in-situ seedling tuber production. TPS was sown continuously in the rows of 25cm. Three to five leaf staged seedlings were transplanted in the side of 10-15cm high ridges with required amount of moisture supplied 8–24hr before transplanting seedlings. Other agronomic practices were followed as per normal tuber crop.

Establishment of PTV demonstration: Five to seven PTV demonstrations were clustered in a selected site of respective Agriculture Service Center (ASC) command area to make follow up visits convenient. Such demonstration clusters were laid out in two to four locations in a district. Size of TVS demonstration plot varied from 5-15 m^2 depending on the location. For each demonstration, the cooperator farmer contributed the locally available inputs and labor required in conducting PTV demonstrations. Location specific need based component technologies were also evaluated as per farmers' opinion at the various stages of technology evaluation.

Seed quality evaluation demonstration (SQED): The objective of the SQED was to provide a plot to evaluate available planting materials of different sources under farmers' manage condition. Total of 12 SQED were laid out in PVD sites of three districts (Bara, Rupandehi and Sunsari) providing 30m^2 plot area for each treatment and crop was raised applying recommended practices.

Methods applied for technology transfer

Training

Training for support staffs: Two days regional level training was organized for field based staffs to support district level program implementation.

Training for farmers: Community based training were organized for a group of 10-20 farmers per cluster during the cropping season. For each TVS demonstration,

the group identified a co-operator farmer in conducting PTV demonstrations in the site.

Field days

Pre-harvest field days: It was organized in each cluster bringing member farmers and farmers from the neibouring villages. It provided an opportunity for discussion on the various aspects of the field operations at the demonstration site.

A MODEL ADOPTED FOR TRANSFER OF TPS TECHNOLOGY IN NEPAL

OBJECTIVE SETTING	ACTIVITIES	OUTPUT ASSESSMENT	STRATEGY DEVELOPMENT
(PHASE - I. SENSITIZATION)			
➢ To build up awareness on TPS technology	o Flow of information among providers and receivers o TPS distribution for preliminary testing	❖ Mixed feed back Improve technical capability	▪ Identify areas for technology transfer ▪ Develop linkages with partner R&D
(PHASE - II. TECHNOLOGY TRANSFER)			
➢ To transfer the technology through on farm verification demonstrations	o Setting program boundaries Coordination, planning and sharing of responsibility. o Implement program activities	❖ Identify and select new potential areas ❖ Modify technology as clients' need ❖ Participation increased ❖ Farmers' acceptance increased	▪ Area expansion ▪ Large plot demonstration ▪ Revise and verify component technologies to adapt locally ▪ Add component technologies in the verification demonstrations
(Phase - III Participatory technology verification and transfer)			
➢ To identify constraints for adoption ➢ To widen areas under the program.	o Program expansion in new areas o Follow up to old areas o Strengthen information delivery system	❖ Productivity increased ❖ Make assured supply of quality TPS. ❖ High cost benefit ratio	▪ Develop in country TPS production scheme. ▪ Feed back to research partners for technology development. ▪ Conduct impact study of TPS technology. ▪ Explore new areas for TPS utilization. ▪ Expand area under TPS by educating farmers through farmers' field school approach.
(PHASE-- IV. AREA ZOOMING)			
➢ To utilize TPS in blocks through group approach. ➢ To develop community resource centers. ➢ To coordinate for implementing model and methodology in the national policy guideline of agricultural extension program.	o Strengthen and mobilize users group. o Support to in country TPS production. o Lateral training. o Develop guideline for national extension policy.	❖ Training to extension staffs ❖ Develop policy and guideline for operating resource centers. ❖ Assist program implementation through national extension system. ❖ Group mobilization. ❖ Strengthen in country TPS production program. ❖ Incorporate approach model in the extension system.	▪ Model and methodology adopted by national agricultural extension program. ▪ HMG/Nepal approved TPS as priority alternative potato production technology.

Post-harvest field days: Post-harvest field days were organized at the time of the crop harvest. Farmers were invited as in pre-harvest field days but more visitors were involved. The discussions were mainly concentrated on yield parameters and over all aspect of the technology based on harvest data collected in the particular site.

Field visits/tour program

The field visit program was organized for participating farmers and non-participating farmers separately.

A. For participating farmers:

District field visits: It was organized to bring participating farmers from other locations of the districts to evaluate and monitor the technology in different socio-economic conditions, mainly to expose the participant farmers and develop a ground for the cooperation between the participating farmer's group for dissemination of technology at wider area in the district.

National level farmers' tour: The tour was composed of one representative from each demonstration locations of all the districts. It was organized to evaluate and synthesize the effectiveness of the technology in various sets of socio-cultural background and agro-ecological regions.

B. Non-participating farmers

Farmers from other potential areas in the districts took part in the field visit program. This was mainly to create awareness and sensitize the mass of farmers to increase the level of farmer's participation in production program.

OBSERVATION AND OUTPUTS

In-situ F_1C_1 seedling tuber (ST) production

Average annual ST yield varies from 3.5 -4.0 kg/m^2 (Table 1). Mean yield over the years was 3.7 kg/m^2. Percent seed size distribution of <5 gm (58%) was higher followed by 5-20 gm (38%) and > 20 gm (4%). Mean ST weight was 7.5gm. ST yield in terms of number per meter square and per kilogram was 456 and 126 respectively ranging from 436 to 496 tuber/m2 and 3.5 to 3.8kg/m^2 (Table2).

Nursery raised transplanted seedling tuber (TST)

Two years (1995/96 and 1997/98) yield samples of recommended varieties are compared with nursery raised TST. The Table 3 shows annual average yield of TST ranged from 17- 23 t/ha with mean over the years of 20.0 t/ha. Mean yield of TST was 25% higher than yield obtained by general farmers (low level technology adoption group) where as there was no difference in yield between TST and non-SPG farmers (medium level technology adoption group). But the tuber yield obtained by SPG farmers (high level technology adoption group) was higher by 35% over yield of TST crop. It indicates that seedling as farmers adopting medium level of production technology can equally utilize seedling as basic standard clonal seed tuber. Similarly, seedlings can be cheaper planting materials in the areas where access to quality seed tuber remains constraints to increase productivity.

Yield performance of different planting materials

Comparative performance of various planting materials available to farmers such as basic seed (in-vitro origin), seedling tuber (TPS origin) and local (untagged) seed tubers were evaluated under farmer's managed condition. The result shows that yield of crop raised from TPS derived F_1C_1 of HPS-II/67 family was higher than crop raised from basic seed of variety Kufri sinduri, F_1C_2 of HPS-II/67 and local seed by 9, 22 and 45% respectively. But the yield of variety Desiree was higher by 9 percent than yield of F1C1 of HPS II/67 (Table 4).

Productivity decline by 5 t/ha in F_1C_2 compared to F_1C_1 of HPS- II/67 might be due to segregating population. Yield superiority of TPS derived-seedling tubers over commonly adapted cultivars is in conformity with findings of S.K. Bardhan Roy *et al.* (1995) in west Bengal, India. Yield of TPS derived F_1C_1 and F_1C_2 generation in this study are in conformity with the previous work (on-station, out-reach and FFT) as reported by various workers (Annual reports- NPDP/PRP; 1989,1990, 1991 and 1992).

Training

Total of 264 demonstrations were conducted in Nepal covering 20 districts during 3 years period. Number of field days and field tour (inter and intra- district) accomplished was 435 and 13 respectively. Similarly 818 persons were trained on TPS technology at various levels (table 5).

TPS utilization

Annual demand of TPS abruptly increased from 0–12 kg within a period of 3 years where as TPS utilization in technology transfer was reduced from 1kg in 1995/96 to 650gm in 1998/99 (Table 6). Area covered by TPS derived planting materials also increased from initial 7 ha. to 600 ha. with the production of 500mt of F1C1 generation.

Table 1. Three Years average yield of TPS derived seedling tubers in TVS demonstration (1995/96 - 1997/98)

Year	Number of PVSD	District	Average tuber yield number & weight (kg) per $5m^2$						Mean seedling tuber wt. (gm)	Seedling tuber yield		
			<5 gm		5-20 gm		>20 gm			number		weight
			#	wt	#	wt	#	wt		/m^2	/kg	kg/m^2
1995/96	86 (34)	Bara (14)	1753	4.0	941	10.0	133	4.0	6.0	565	157	3.6
		Shindhupalchok (5)	1705	8.0	861	11.0	49	3.0	8.0	523	118	4.3
		Rupandehi (15)	1108	3.0	1191	13.0	210	3.0	4.0	501	132	3.9
		Year mean	1522	5.0	998	11.0	131	4.0	6.0	530	184	4.0
1996/97	95 (30)	Bara (14)	1229	5.0	1015	10.0	0.0	0.0	7.0	448	150	3.0
		Shindhupalchok (8)	1305	4.0	885	10.0	0.0	0.0	6.0	438	156	2.8
		Rupandehi (8)	1551	7.0	470	12.0	117	5.0	11.0	427	89	4.8
		Year mean	1362	5.0	790	11.0	39	2.0	8.0	438	132	3.5
1997/98	91 (50)	Bara (19)	1121	5.0	902	9.0	0.0	0.0	7.0	405	144	2.8
		Shindhupalchok (20)	1229	5.0	943	14.0	152	7.0	11.0	465	89	5.2
		Rupandehi (21)	1165	5.0	935	10.0	84	2.0	8.0	437	128	3.4
		Year mean	1172	5.0	927	11.0	79	3.0	9.0	436	120	4.0
Total 272 (114)		**Grand Mean**	**1352**	**5.0**	**905**	**11.0**	**90.0**	**3.0**	**8.0**	**468**	**145**	**4.0**
		% distribution	**58**	**26**	**38**	**58**	**4.0**	**16**				

Figures in parenthesis are number of samples (taken within the limit of 2 SD)

Table 2. Average seedling tuber yield over the years

Districts	Seedling Tuber (F_1C_1) yield									District mean			Seedling tuber yield tons/ha
	Year												
	1995/96			1996/97			1997/98						
	#		wt.	#		wt.	#		wt.	#		wt.	
	/ m^2	/ kg	kg/m^2	/ m^2	/ kg	kg/ m^2	/ m^2	/ kg	kg/ m^2	/ m^2	/ kg	kg/ m^2	
Bara	465	157	3.6	448	145	3.0	405	144	2.8	439	148	3.0	30.0
Shindhupalchok	523	118	4.3	438	152	2.8	465	89	5.2	475	109	4.0	40.0
Rupandehi	502	132	3.9	427	87	5.0	437	128	3.4	455	120	4.0	40.0
Grand Mean	496	136	3.8	438	128	3.5	436	120	4.0	456	126	3.7	36.7

Table 3. Yield comparison of crop raised from transplanted seedling and conventional seed tubers with various level of technology adoption during 1997/98.

Year		Mean yield of tuber from different level of technology adoption ∞			F_1C_1 (Transplanted)
		Farmers of SPG *	Non- SPG farmer **	General growers ***	
1995/96 t/ha.	Yield	30.0	23.0	15.0	17.0
	sample size	(150)	(78)	(64)	(23)
1997/98 t/ha.	Yield	24.0	17.0	15.0	23.0
	sample size	306	62	72	72
Mean yield t/ha		27	20	15	20
Yield difference (%) to F_1C_1		35	0.0	-25	

∞ Annual report, PRP, NARC, 1997/98
Figures in parenthesis are number of samples

* SPG farmers = Organized seed grower groups and apply improved technology in potato farming.
** Non-SPG farmers = Potato growers of the same community but not a group member.
*** General farmers = Represents general potato cultivation practice by the majority

Table 4. Average of mean yield (t/ha) of on -farm seed quality evaluation of different planting materials over the years (12 locations of plot size 30 m^2)

Year	Tuber yield of various sources and generation of planting materials				
	TPS F_1C_1	TPS F_1C_2	Basic seed -3		Local seed
	HPS-II/67	HPS-II/67	Kufri sinduri	Desiree	
1996/97	21	17	19	21	11
1997/98	22	16	20	27	12
Mean	22	17	20	24	12
% change over F_1C_1		22	9	-9	45

Table 5. Number of TVS demonstration, field days and field tour organized (1995/96 to 1997/98).

Year	Number of demonstrations	Number of field days organized	Number of field tours organized	Persons trained
1995/96	60	120	none	170
1996/97	95	150	5	316
1997/98	109	165	8	332
Total	264	435	13	818

Table 6. TPS utilization, production and area over the years

Year	TPS utilized (kg) in		F_1C_1 Production (ton)		Area covered (ha)
	Technology transfer	Private	Seedling tuber	Transplanted seedling tuber	
1995/96	1.00	0.00	0.5	10	
1996/97	0.750	0.600	4.0	35	7
1997/98	0.600	2.00	5.5	100	30
1998/99	0.650	12.00	160.0	500	75
					600

In Nepalese condition farmers can utilize TPS for potato production either by producing in-situ seedling tubers as seed for next season or transplanting the seedlings raised in nursery beds for ware as well as seed potatoes in the same season. The result shows that yield performance of TPS derived planting materials (seedlings or seedling tubers) is higher compared to other conventional planting materials. The high yielding potential of TPS derived planting materials if incorporated in the present conventional seed system productivity of potato can be raise significantly in the country. The future potential of TPS depends on development of suitable TPS families to different growing environment of the country and continued support by trained technical facilitators at all levels.

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