STANDARDIZATION OF OPTIMUM TIME AND SPACING FOR TRANSPLANTING OF TRUE POTATO SEED SEEDLING AT KHUMALTAR CONDITION

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ABSTRACT

This experiment was conducted in two consecutive spring seasons of 2001 and 2002 at Khumaltar, Lalitpur (1350 m als.) under rice potato cropping pattern. The experiment was conducted using split plot design with three replications. The seedlings of TPS family HPS II/67 were evaluated on three different transplanting dates at 15 days interval and four inter row spacing. The highest plant population (60 cm x 15 cm) produced statistically highest tuber yield. In late transplanted seedling, short plant height and poor canopy cover (poor vegetative growth) occurred accompanied by lower tuber yield. In terms of tuber yield the first transplanting date 13 February and plant spacing of 60 cm x 15 cm were the most appropriate under mid hills, such as Kathmandu valley.

Key words: Planting date, seedling, spacing, tuber yield, true potato seed.

INTRODUCTION

The non-availability of relatively clean seed tubers especially in developing countries like Nepal did not allow the farmers to produce the potato at its highest yield potential. The cost of seed tubers accounts for 40-50 percent of production costs (Singh, 1994). Use of true potato seed (TPS) offers, perhaps, the greatest potential for reducing potato production cost, where healthy tuber seed is costly (Vander Zaag and Horton, 1983). However, the congeniality of this technology among the farmers of Nepal so far depends upon the proportion of available labour for raising the crop and assurance of water supply (Lama and Khatri, 1997). TPS can be used to produce either ware potatoes or seed potatoes (Sadik, 1983; Wiersema, 1983). Farmers can utilize TPS for potato production either by producing in-situ seedling tubers as seed for next season or transplanting the seedling raised in nursery beds for ware as well as seed potatoes in the same season. Agronomic and cultural practices for different agro-ecological zones have been perfected for raising the TPS nursery beds and propagating crops from seedlings (Kadian et al., 1988). In Nepal, major research emphasis in the past was given to the evaluation of TPS families suitable for different agro-ecological zones. But no information is available regarding appropriate time of seedling transplanting and optimum spacing combinations required for tuberlets production. Through transplanting, ware potato can be produced in the same year. Therefore, the present study was undertaken to standardize the appropriate time of planting and optimum combinations of spacing at mid hill condition.

MATERIALS AND METHODS

This study was undertaken during the spring season of 2001 and 2002 at Hattiban Research Farm of Potato Research Programme, Khumaltar, Lalitpur. Twelve treatment combinations comprising three dates of transplanting (13th Feb, 28th Feb, and 14th March) and four inter-row spacing (15, 20, 25 and 30 cm) were tried in split– plot design three replications. The plot size was 7.2 m2 (3 m x 2.4 m). True potato seed of family HPS II/67 was sown in aluminum tray using soil and well-decomposed farmyard manure (FYM) 1:1 ratio in the second week of

January. After 30 days of seed sowing the bare rooted seedling of 8-10 cm size were transplanted into the field on the side of the ridges. Only one seedling was transplanted per hill with a row spacing of 60 cm. At the time of transplanting, 50 kg N, 100 kg P_2O_5 and 60 kg K_2O and FYM 10 t/ha were applied in the plots. Remaining 50 kg N/ha was applied in first earthing up after 30 days of transplanting. The irrigation was given one day before sowing and immediately after transplanting. Subsequent irrigation were given at an interval of 3-4 days for first week and there after 10 days interval till dehaulming. All the other cultural practices were followed as recommended. The crop was dehaulmed at 90 days and harvested after 10 days of dehaulming. The data on percent seedling survival, plant height, canopy cover, marketable and total yield and number of tuber per plant were recorded and analyzed as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSIONS

The data on yield attributing characters like seedling survival, plant height, canopy cover, number of tuber per plant, grade wise yield per plot and total yield t/ha are presented in Tables 1, 2 and 3.

Seedling Survival

The over all performance of two years (mean) showed that the seedling transplanted at 27 February and 14 March survived better than those transplanted on 13 February (Table 1). Irrespective of planting dates, the inter- row spacing had not effect on seedling survival. The variation in seedling survival may be due to recovering capacity of transplanting shock and soil temperature. Singh (1994) has also reported similar findings.

Table 1. Effect of planting dates and spacing on plant survival (%), plant height (cm) and canopy cover (%) of seedling transplanted potato crops at Khumaltar, 2001-2002.

Treatments	Seedling survival			Plant height			Canopy cover		
	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean
Planting date (PD)									
February, 13	57.43	66.93	62.18	41.83	45.01	43.42	65.55	70.17	67.86
February, 27	68.68	75.22	71.95	39.50	40.92	40.21	47.59	63.33	55.46
March, 14	73.95	76.11	75.03	30.50	30.42	30.46	44.51	46.33	45.42
F-test	NS	NS	NS	**	**	**	NS	*	**
LSD (0.05)				4.91	9.56	2.45		11.36	5.37
Spacing (SP) (cm)									
60 x 15	68.31	68.19	68.75	35.89	38.67	37.55	58.78	58.78	58.78
60 x 20	69.02	70.00	69.51	36.00	39.78	37.89	56.11	57.11	56.61
60 x 25	67.88	72.92	70.40	36.45	40.11	38.28	54.33	57.33	55.83
60 x 30	67.09	73.33	70.21	37.23	40.11	38.67	53.78	53.78	53.78
F-test	NS	NS	NS	NS	**	**	NS	*	**
LSD (0.05)					1.13	1.29		1.98	0.90
Interaction									
F- test									
Y x PD			NS			NS			NS
Y x SP			NS			NS			NS
PD x SP	NS	NS	NS	NS	NS	NS	NS	NS	NS
Y x PD x SP			NS			NS			NS

Note: LSD (Least significant difference), * Significant at 5% level, ** Significant at 1% level, Y (year).

Plant Height

In potato crop, plant height is an important character, which assists to enhance the interception of photosynthetically active radiation (Beukema and Vander Zaag, 1990). The earlier transplanted seedlings were significantly taller than later transplanted seedlings (Table 1). The 13 February transplanted seedlings had the tallest plant (43.42-cm). The shortest plants were found in the case of the 14 March transplanted seedlings (30.46 cm). The shorter height in case of late transplanted condition could be mainly due to short growing period for plant growth and early tuber initiation. Similar findings were reported by Bhatia *et al.* (1992). There was a significant effect of spacing for plant height, where 60 cm x 25 cm and 60 cm x 30 cm (row x plant) were taller than seedling transplanted at 60 cm x 15 cm and 60cm x 20 cm spacing. The reason for lower plant height in case of wider inter - row spacing was not clear but it could have been attributed in competition among plants to nutrients.

Canopy cover

Canopy cover indicates the size of photosynthetic system and is therefore an indication for radiation intercepted. Allen and Scott (1980) have shown that there is a close relationship between total light intercepted and tuber yield.

The over all two years mean data (Table 1) showed that the percent canopy covers by haulms were affected both by transplanting dates and spacing. The crop transplanted on 13th February had the highest percent of canopy cover (67.86) and it was statistically different to crops transplanted on 28th February and 14th March. The lowest percent canopy cover (45.42) was recorded by the 14

Table 2. Effect of planting dates and spacing on tuber number (pre plant), tuber weight (per plant) and total tuber yield (t/ha) of seedling transplanted potato crops at Khumaltar, 2001-2002.

Treatments	Tuber number plant^{-1}			Tuber weight plant^{-1}			Total tuber yield t/ha		
	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean
Planting date (PD)									
February, 13	19.27	12.46	15.87	296.86	331.71	314.29	23.25	25.69	24.47
February, 27	14.90	12.47	13.68	234.61	242.58	238.59	18.17	18.69	18.43
March, 14	11.48	11.89	11.69	175.24	197.14	186.19	13.42	15.10	14.26
F-test	NS	NS	NS	*	*	**	**	**	**
LSD (0.05)				73.30	104.50	25.58	5.78	8.03	2.09
Spacing (SP) (cm)									
60 x 15	13.11	11.11	12.11	201.26	217.10	209.18	22.19	24.28	23.24
60 x 20	14.47	12.91	13.69	230.99	264.89	247.94	19.50	21.83	20.67
60 x 25	15.87	12.82	14.35	252.55	278.24	265.40	17.10	18.29	17.69
60 x 30	17.41	12.24	14.82	257.48	268.35	262.91	14.32	14.90	14.61
F-test	**	**	**	*	**	**	**	**	**
LSD (0.05)	2.21	0.95	1.37	40.33	15.39	29.54	3.76	1.34	2.41
Interaction									
F-test									
Y x PD			NS			NS			NS
Y x SP			NS			NS			NS
PD x SP	NS	NS	NS	NS	NS	NS	NS	NS	NS
Y x PD x SP			NS			NS			NS

Note: LSD (Least significant difference), * Significant at 5% level, ** Significant at 1% level, Y (year).

March transplanted seedlings. The very low canopy cover in the later transplanting dates were mainly due to short growing period for canopy development. Short days and high temperature cause early tuber formation and limit size and length of the foliage (Burton, 1966). Irrespective of transplanting dates, the 60 cm x 15 cm spacing transplanted crop had highest percent canopy cover (58.78) and this was statistically different with seedling transplanted at other given spacing. The reason for lower percent of canopy cover was low haulms growth of seedlings can not cover wider space. Therefore, later transplanting and wider spacing for seedlings was not beneficial to canopy cover.

Tuber Yield

Significantly higher tuber yield was obtained when seedlings were transplanted earlier. Seedling transplanted on 13 February produced the highest tuber yield (24.47 t/ha) (Table 2) The lowest tuber yield (14.26 t/ha) was produced by the last transplanting (14 March). Results indicated that TPS seedling transplanting on later date produced significantly lower tuber yield and this could be mainly due to low canopy cover and plant height (Table 1). Irrespective of planting dates, the higher plant population (60 cm x 15 cm) spacing gave statistically higher tuber yield (Table 2). The seedlings transplanted at 60 cm x 15 cm spacing gave 11.45 percent more yield over the ones transplanted at 60 cm x 20 cm and 37.13 percent more than 60 cm x 30 cm spacing. Midmore (1983) reported that closer spacing hasten tuber initiation, yields were always greater than at wider spacing, which achieved higher canopy cover, and intercepted more radiation than wider spaced plants. Kadian *et al.* (1988) and Singh (1994) also obtained higher yield at higher plant population at close spacing. There was no significant effect of transplanting dates on number of tubers per plant. However, number of tuber, was influenced by spacing.

Table 3. Effect of planting dates and spacing on marketable tuber yield (fraction > 20 g), and non-marketable tuber yield (fraction <20 g) of seedling transplanted potato crops at Khumaltar, 2001-2002.

Treatments	Marketable yield			% proportion			Non marketable			% proportion		
	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean
Planting date	15.25	17.22	16.24	65.59	67.03	66.35	8.00	8.47	8.24	34.41	32.97	33.65
February, 13	12.11	11.31	11.71	66.67	60.48	63.53	6.06	7.39	6.73	33.33	39.52	36.47
February, 27	9.06	8.00	8.53	67.49	52.99	59.79	4.36	7.10	5.73	32.51	47.01	40.21
March, 14	*	*	*				**	NS	**			
F-test												
LSD (0.05)	2.33	4.59	3.14				3.35		2.66			
Spacing (cm)												
60 x 15	14.53	14.22	14.38	64.46	58.58	61.86	7.67	10.06	8.86	34.54	41.42	38.14
60 x 20	13.40	13.76	13.58	68.73	63.04	65.73	6.10	8.07	7.08	31.27	36.96	34.27
60 x 25	11.07	11.35	11.21	64.74	62.03	63.34	6.03	6.94	6.49	35.26	37.97	36.66
60 x 30	9.51	9.38	9.44	66.44	62.91	64.64	4.81	5.53	5.17	33.56	37.09	35.36
F-test	**	**	**				*	*	**	NS	NS	NS
LSD (0.05)	1.68	0.69	1.07				1.76	1.24	1.10			
Interaction												
F-test												
Y x PD			NS						NS			
Y x SP			NS						NS			
PD x SP	NS	NS	NS				NS	NS	NS			
Y x PD x SP			NS						NS			

Note: LSD (Least significant difference), * Significant at 5% level, ** Significant at 1% level, Y (year).

The wider spacing (60 cm x 30 cm) produced higher number of tuber per plant (14.82) and this was at par with the 60 cm x 25 cm spacing. Singh (1994) and Upadhaya *et al.* (1990) also obtained higher tuber per plant at wider spacing.

Grade wise yield

As regards the production of grades of tubers, the 13 February transplanting was most effective Marketable size (fraction > 20 g) tuber yield was found to be affected both by transplanting dates and spacing (Table 3). The 13 February transplanted seedlings had the highest marketable tuber yield (16.24 t/ha). The last transplanting (14 March) produced the lowest marketable tuber yield (8.53 t/ha) and this was at par with the 28 February transplanting. Unmarketable size (fraction <20 g) tuber yield was also affected by planting dates. Regarding the ratio of tuber size, the 13 February transplanted seedlings produced higher ratio of marketable size tubers (66.35%) and least by 14 March transplanted seedlings (59.79%). Irrespective of transplanting dates the 60 cm x 15 cm spacing produced higher marketable size tuber (14.38 t/ha) and this yield was at par with the 60 cm x 20 cm spacing. The 60 cm x 20 cm spacing gave higher proportion of marketable size tubers (65.73%) as compare to other spacing. In spacing combinations more than 60 percent tubers were of marketable size that corroborate with the findings of Singh (1990).

The tuber yield of seed'ing-transplanted potato was affected by transplanting dates. The first transplanting date 13 February was better than later two dates (28 February and 14 March) that produced low yields. The tuber yields was also significantly high in the case of high plant population per unit area.

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