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EFFECT OF DIFFERENT LEVELS OF NITROGEN AND POTASH ON YIELD AND QUALITY OF CLONAL PROGENY OF TRUE POTATO SEED AT MANGALPUR, CHITWAN

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ABSTRACT

A study was conducted during the winter (October to February) of 2008/09 in the farmers' field to standardize the appropriate dose of nitrogen and potash for the higher productivity and profitability of TPS technology at Mangalpur, Chitwan. The planting material used for ware potato production was seed tuber of a first generation clonal progeny of hybrid TPS namely, HPS II/67. The treatment consisted of four levels of nitrogen (50, 100, 150 and 200 kg/ha) and four levels of potash (40, 70, 100 and 130 kg/ha). The treatment consisted of four levels of nitrogen (i.e. 50, 100, 150 and 200 kg N/ha) and four levels of potash (40, 70, 100 and 130 kg K_2O/ha). Nitrogen 50 kg/ha produced the lowest yield per plant. Similarly, potash 130 kg/ha produced significantly higher yield per plant which was at par with 100 kg K_2O/ha. The treatment combination of 150 kg N/ha and 100 kg K_2O/ha gave the highest tuber yield (30.42 and 29.18 mt/ha) respectively, and large sized tuber. The highest physiological weight loss was observed at nitrogen level 50 kg N/ha and potash 130 kg/ha. The dry matter percentage was recorded to be the highest with nitrogen level at 150 kg N/ha. On the contrary, the lowest level of potash produced the maximum dry matter. Therefore, the study showed that potato production through clonal progeny of HPS II/67 should be done with fertilization of 150 kg N/ha and 100 kg K_2O/ha to optimize yield at Mangalpur, Chitwan condition.

Key words: ware potato, standardize, clonal progeny, parameter

INTRODUCTION

The international community is facing a key challenge to ensure food security for present and future generations. The potato (*Solanum tuberosum* L.) will be an important part of efforts to meet those challenges (IYP, 2008). In Nepal, potato plays an important role in the food production and poverty alleviation. It occupies the 6th positions in area coverage, 4th in total production and 1st in the productivity (APP, 1995). According to ABPSD (2007/2008), the area under potato is 1, 56,737 ha and total production is 20,54,817 mt with an average productivity of 13.11 mt/ha which is very less as compared to developed countries. The major cause for this low productivity is poor quality tuber seed, non availability of good quality seed and lack of knowledge about modern crop cultivation methods. On the other hand tubers used or marketed as seed are usually the extra potatoes that remain after consumption (Thapa *et al.*, 1999).

Potatoes are rich in several micronutrients. It is a moderate source of iron, and its high vitamin C content promotes iron absorption (IYP, 2008). Thus, potato can make a major contribution in improving world health and productivity and meets the nutritional requirement of the fast growing population particularly in the developing country like Nepal (CIP, 1995).

True Potato Seed (TPS) has good prospects because it can reduce the cost of production and thus, farmers can become independent from conventional seed sources (Wiersema, 1986). The use of TPS is emerging as low cost technology to replace the traditional method of growing from seed tuber. But the lack of crop uniformity, longer crop duration and low yield are the major constraints to adopt this technology. Thus, the production of tuberlets from TPS in one year and its subsequent utilization for potato production in next year may be remedy for this problem. Use of TPS technology for potato production have several advantages of low disease transmission, resistance against several diseases, less bulky seed (150gm/ha), low incidence of viruses and mainly the low cost of true potato seeds than tubers. It can reduce the cost of production by 50 percent. In Nepal, major research emphasis in the past was given to the evaluation of TPS families suitable for different agro-ecological zones.

MATERIALS AND METHODS

The experiment was conducted during the winter (October to February) of 2008/09 in the farmers' field in the vicinity of the Institute of Agriculture and Animal Sciences (Mangalpur VDC, Ward No. 6) Chitwan. The experiment was laid out in a factorial RCBD with 16 treatments and 3 replications. The doses of nitrogen (50, 100, 150 and 200 kg N/ha) and potassium (40, 70, 100 and 130 kg K_2O/ha) were used as two different factors. The total experimental area was 427.85 m^2 (19.9 m x 21.5 m) with an individual plot size of 2.4m x 2.0m i.e. 4.80 m^2 where seedling tubers were planted in the raised method of planting at the crop geometry of (60 x 20) cm^2. Well decomposed farmyard manure (FYM) was applied @ of 20 mt/ha, 2 weeks before planting. Half dose of nitrogen, full doses of phosphorous and potash were incorporated into the soil at the time of tuber planting. The remaining amount of nitrogen was split into two equal parts and each part was top-dressed at 30 and 45 days after planting. Analysis of variance for all parameters was done using statistical analysis through MSTAT-C programme. All the analyzed data were subjected to DMRT for mean separation at 5% level of significance.

RESULTS AND DISCUSSION

Yield and yield parameters

Number of tubers per plant

The data regarding number of tubers per plant revealed that differences were highly significant to different levels of nitrogen while effect of levels of potash was found to be non significant (Table 1). The numbers of tuber per plant are most important components of yield. Increase in the number of tubers per plant was recorded with increasing levels of nitrogen and decrease in the case where potash is increased. The highest number of tubers (7.44) per plant was observed when seedling tubers were planted at 200 kg N/ha which was at par with 150 kg N/ha while the lowest number of tubers (6.33) per plant was obtained at 50 kg N/ha which was at par with 100 kg N/ha. The highest number of tubers (7.08) per plant was found at 70 kg K_2O/ha while the lowest number of tubers (6.69) per plant at 130 kg K_2O/ha. Belanger *et al*. (2002) also found the number of tubers per plant increased from (6.5) with no nitrogen applied to (6.9) with 100 kg N/ha, followed by a decrease to (6.7) with 250 kg N/ha.

Tuber yield per plant

Weight of tubers per plant was highly significant to different levels of nitrogen and potash (Table 1). It shows that the tuber weight increases as we increase the level of nitrogen from 50-200 kg N/ha and potash from 40-130 kg K_2O/ha. The highest tuber weight (0.43 kg) per plant was recorded at the nitrogen level 200 kg N/ha which was at par with 150 kg N/ha while the lowest tuber weight (0.33 kg) was in the nitrogen level 50 kg N/ha. The highest tuber weight (0.41 kg) per plant was recorded at potash level 130 kg K_2O/ha while the lowest was in the potash level 30 kg K_2O/ha. The increase in yield of tuber could be attributed to the increase in plant height and number of leaves per plant which increases the photosynthetic surface and lead to more synthesis and translocation of photosynthates to the tubers. This agrees with the findings of Barevadia *et al*. (1978).

Table 1: Effect of different levels of nitrogen and potash on yield and yield parameters of potato at Mangalpur, Chitwan (2008/2009)

Treatments	Yield and Yield Parameters					
	Number of tuber/plant	Tuber yield/plant	Tuber yield/plot by size (kg)			Tuber yield (mt/ha)
			<25 g	25-50 g	>50 g	
Level of nitrogen (kg/ha) (Fa)						
N_1 (50)	6.33[b]	0.33[c]	1.18	2.33	8.38[c]	24.70[c]
N_2 (100)	6.67[b]	0.36[b]	1.09	2.17	10.10[b]	27.04[b]
N_3 (150)	7.38[a]	0.42[a]	1.13	2.37	10.75[ab]	30.42[a]
N_4 (200)	7.44[a]	0.43[a]	1.12	2.60	11.96[a]	30.93[a]
$LSD_{0.05}$	0.69**	0.03**	NS	NS	1.24**	2.27**
Level of potash (kg/ha) (Fb)						
K_1 (40)	6.96	0.36[c]	1.52[a]	2.70[a]	9.10[c]	26.36[c]
K_2 (70)	7.08	0.37[bc]	1.24[b]	2.56[a]	9.04[c]	27.60[b]
K_3 (100)	7.07	0.39[ab]	1.03[c]	2.29[ab]	10.84[b]	29.18[a]
K_4 (130)	6.69	0.41[a]	0.74[d]	1.93[b]	12.22[a]	29.95[a]
SEM±	0.24	0.01	0.07	0.14	0.43	0.78
$LSD_{0.05}$	NS	0.03**	0.19**	0.40**	1.24**	2. 27*
CV%	12.04	6.47	20.44	20.11	14.45	9.64

Figures followed by same letters across the column are not significant (P<0.05) by DMRT

Tuber yield (kg) per plot by size

The effect of level of nitrogen in the production of small size tubers (<25 g) and medium size tuber (25-50 g) per plot by size were found to be non significant while larger size tubers (>50 g) was found to be highly significant (Table 1). However, small size tubers (<25 g) was found high at lower nitrogen level 50 kg N/ha and in case of medium size tubers (25-50 g) was found to be higher at 200 kg N/ha. On the other hand large size tubers (>50 g) was found to be the highest (11.96 kg) per plot at 200 kg N/ha which was at par with 150 kg N/ha.

Highly significant variation due to different levels of potash in the total tuber yield per plot in small (<25 g), medium (25-50 g) and larger (>50 g) sizes of tubers were recorded (Table 2). Increasing levels of potash decreased the yield of small grade tubers (<50 g) and increased the proportion of large size tubers. Potash level 40 kg K_2O/ha produced the highest yield (1.52 kg) of small size and (2.70 kg) of medium size tubers but potash level 130 kg K_2O/ha produced the lowest yield (0.74 kg) of small and (1.93 kg) of medium size tubers per plot. In case of large size tubers (>50 g), potash level 130 kg K_2O/ha produced the highest tuber yield (12.22 kg) per plot while the lowest (9.10 kg) at 40 kg K_2O/ha. The significant effect on tuber yield due to potassium application might be attributed by higher availability of applied potassium which plays an important role in starch synthesis and translocation of photosynthates from leaves to tubers (Mengel, 1997).

Tuber yield (mt/ha)

The tuber yield was found to be highly significant at different levels of nitrogen application (Table 1). There was significant increment in yield with increase in level of nitrogen upto certain critical level beyond which there was no significant response to the level of nitrogen. The highest total tuber yield (30.93 mt/ha) was recorded at the highest nitrogen level 200 kg N/ha which was at par with nitrogen level 150 kg N/ha (30.42 mt/ha). The lowest tuber yield (24.70 mt/ha) was recorded in the nitrogen level 50 kg N/ha. The nitrogen level at 150 kg N/ha was optimum level for the higher productivity of potato. Higher nitrogen means greater vegetativeness and therefore more assimilate production by the green leaves that would translate into higher yield (Errebhi *et al.*, 1998).

Different levels of potash also significantly increased the tuber yield (Table 2). Similar to nitrogen, tuber yield increased with increase in the level of potash up to certain critical level (100 K_2O/ha) beyond which potash was not effective. The maximum tuber yield (29.95 mt/ha) was obtained at highest level of potash 130 kg K_2O/ha which was at par with 100 kg K_2O/ha. The minimum tuber yield (26.36 mt/ha) was obtained at the lowest level of potash 40 kg K_2O/ha which was at par with 70 kg K_2O/ha. Increased yield of tubers with increasing dose of potash up to 150 kg K_2O/ha. Increase in total yield due to K fertilization is due to the stimulating effect of potassium on photosynthesis, phloem loading and translocation, as well as

synthesis of large molecular weight substances within storage organs, contributing to the rapid bulking of the tubers (Singh, 1999).

Post-harvest parameters
Dry matter percentage of tuber

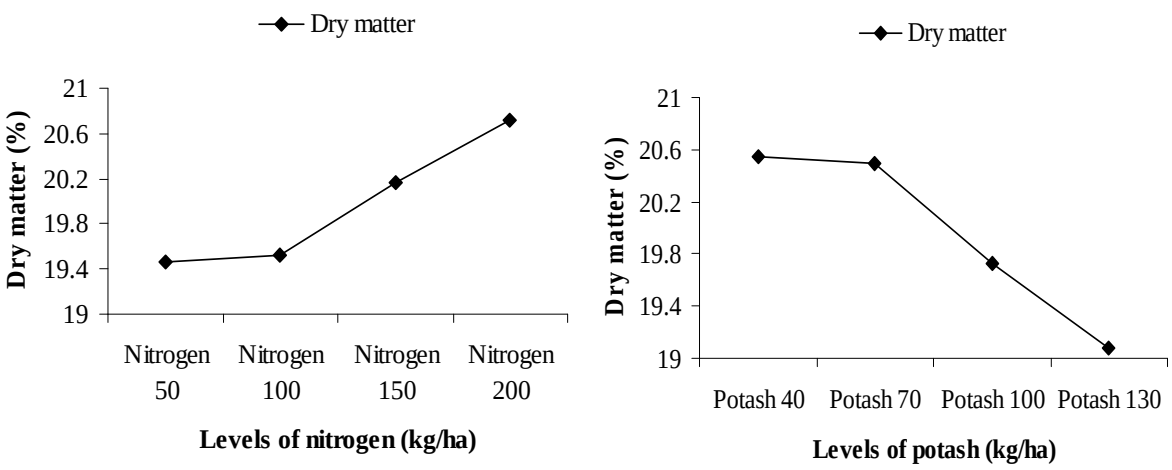

Figure 1: Dry matter percentage of seedling tuber at different levels of nitrogen and potash after harvesting.

Statistically, highly significant variation on dry matter content of potato tuber due to different level of nitrogen and potash was obtained (Figure 1). Tuber dry matter content increased with the increasing levels of nitrogen fertilizer. The highest dry matter content of tuber (20.72%) was obtained at 200 kg N/ha which was at par with 150 kg N/ha while there was less dry matter content of tuber (19.47%) at 50 kg N/ha which was at par with 100 kg N/ha. In contrast to nitrogen, increasing level of potash decreased the dry matter content of potato tuber. Potash level 40 kg K_2O/ha showed the highest dry matter content of the potato tuber (20.55%) which was at par with 70 kg K_2O/ha and 100 kg K_2O/ha. The lowest dry matter content of potato tuber (19.08%) was obtained at potash level 130 kg K_2O/ha which was at par with 100 kg K_2O/ha. Chaurasia and Singh (1993) reported that total dry weight of tubers increased with increasing levels of N and recorded the maximum at 150 kg N/ha. Potash promotes on production of large sized potato tubers by increasing water accumulation in tubers resulting in a lowering of dry matter content (Perrenoud, 1993). Maity and Arora's (1980) finding showed that application of 50 kg K_2O/ha produced significantly higher dry matter than 100 and 150 kg K_2O/ha.

Percentage weight loss of tuber

The effect of levels of nitrogen and potash was found non significant on cumulative physiological weight loss of potato tubers during their storage for 30, 60 and 90 days after storage (Table 2). The potato tuber is composed mainly of water (75-80%). Shriveling due to water loss is one of the serious problems encountered during storage (Rama *et al.*, 1990). Though non significant, as potassium application increased, there was also a corresponding increase in water accumulation in the tuber that was why the physiological weight loss during the storage also increased. Also the sprouts of tubers during the storage favored the physiological weight loss during the storage.

Table 2: Effect of different levels of nitrogen and potash on per cent cumulative physiological weight loss of potato at Mangalpur, Chitwan (2008/2009)

Treatments	Per cent cumulative physiological weight loss		
	30 DAS	60 DAS	90 DAS
Level of nitrogen (kg/ha) (Fa)			
N_1 (50)	5.18	9.07	11.83
N_2 (100)	4.67	8.77	11.50
N_3 (150)	4.93	8.38	11.19
N_4 (200)	4.62	8.53	11.07
$LSD_{0.05}$	NS	NS	NS
Level of potash (kg/ha) (Fb)			
K_1 (40)	4.78	8.61	11.24
K_2 (70)	4.80	8.61	11.25
K_3 (100)	4.74	8.60	11.42
K_4 (130)	5.07	8.93	11.67
Mean	4.84	8.69	11.39
SEM±	0.16	0.22	0.22
$LSD_{0.05}$	NS	NS	NS
CV%	11.70	8.78	6.79

Figures followed by same letters across the column are not significant (P<0.05) by DMRT

CONCLUSIONS

Nitrogen level at 150 kg N/ha and potash level 100 kg K_2O/ha were significantly superior to other levels in tuber weight and tuber numbers. The higher tuber yield per plant and number was obtained from the crop planted at nitrogen level of 150 and 200 kg N/ha which differed significantly with other levels. Similarly, potash 130 kg/ha produced significantly higher yield per plant which was at par with 100 kg K_2O/ha. The number and weight of tuber per plot also showed the similar type of trend that increase in the level of nitrogen and potash increased the weight of tuber significantly. The maximum yield among the treatment combination was observed at 150 kg N/ha and 100 kg K_2O/ha. The highest physiological weight loss (11.83%) was observed at nitrogen level 50 kg N/ha while (11.67%) at 130 kg K_2O/ha. The dry matter percentage was recorded to be the highest with nitrogen level at 150 kg N/ha. On the contrary, the lowest level of potash produced the maximum dry matter. In other words, 150 kg N/ha and 100 kg K_2O/ha are the best combination level for the higher productivity for ware potato production from clonal progeny of TPS hybrid under Mangalpur VDC, Chitwan, Nepal.

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