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A Study of Planting Method and Spacing on the Yield of Potato Using TPS

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Abstract: An experiment was carried out at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh to investigate the effect of planting method and spacing on the yield of potato using Cv. BARI TPS-2. The experiment consisted of (a) two planting methods viz., transplanting and direct sowing in the field, (b) two planting systems viz., single row and double row system and (c) three spacing viz., 50x5, 50x10 and 50x15 cm. The experiment was laid out in RCBD with 3 replications. Transplanting method produced the highest yield (46.09 t ha⁻¹) by increasing plant height, fresh and dry weight of foliage and number and weight of tubers per plant than the direct sowing method (32.00 t ha⁻¹). Double row system of planting and the plant spacing 50x5 cm produced the maximum yield 41.67 and 42.32 t ha⁻¹, respectively. Transplanting with double row system gave the highest yield (48.98 t ha). Whereas, the transplanting with 50x5 cm spacing produced the maximum yield (50.72 t ha⁻¹). The highest yield 44.19 t ha⁻¹ was produced by the combination of double row and 50x5 cm. The combination of planting method, planting system and spacing produced marked effect on all parameters studied, being the highest yield (52.62 t ha⁻¹) in the combination of transplanting, double row and 50x5 cm spacing.

Key words: Planting method, spacing, yield, potato, TPS

INTRODUCTION

Potato is a staple food crop in some countries and in others, as in Bangladesh, it is used as vegetable. In Bangladesh potato represents about 53% of the total edible vegetables. It plays an important role to mitigate the food and nutritional requirements of the fast growing population of developing countries of the world. Traditionally, potatoes are grown in Bangladesh using tubers as planting material. About 1 to 2 tonnes of seed tubers are needed to plant one hectare of land, which can be replaced by only 1-1.5 kg of TPS^[1]. The cost of seed tubers which accounts for 25 to 50% of the total cost of production is an unbearable burden on the poor farmers^[2]. In order to make the potato cultivation attractive to farmers and to make potatoes available to the consumers at a cheaper price, it is essential to reduce the cost of production. Among the various means to reduce production cost, the use of TPS has recently emerged as a new technology of great potentiality. TPS offer a good alternative to the use of traditional seed tubers due to low transmission of diseases, high multiplication rate and good tuber yield^[3]. There are opinions in favour of seedlings or direct sowing of seeds^[4-6]. An improper spacing may cause either too dense or too thin plant population resulting in the reduction of potato tuber yield. Optimum plant density ensures optimal growth of plants through efficient utilization of moisture, nutrients and

light^[7], which results a high yield, leading to a reduction in the cost of production per tonne of potato. In view of the above facts, a research programme was undertaken to standardize the method of raising potato crop using TPS for a high yield.

MATERIALS AND METHODS

The experiment was conducted at Horticulture Farm, Bangladesh Agricultural University, Mymensingh during the period from 30th October, 2001 to 19th March, 2002. The soil of the experimental area was silty loam in texture having pH 6.5. The seeds of a hybrid TPS variety, BARI TPS-2 were collected from Bangladesh Agricultural Development Corporation (BADC) Farm, Domar, Nilphamari. The experiment consisted of three factors viz., i) methods of planting (transplanting and direct sowing), ii) planting system (single and double row system) and iii) spacing (50x5, 50x10 and 50x15 cm). The three-factor experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. Each experimental plot size was 3x2.4 m² and, plot to plot and block to block distances were 50 and 75 cm, respectively. For transplanting method, five single ridges (3 m long) were prepared in 6 unit plots of each replication with 50 cm spacing between the ridges. Again four double ridges (3 m long) were prepared in 6 unit plots of each replication with 10 cm spacing between the two ridges of

a double ridge and 50 cm spacing between the two double ridges. The fertilizers were applied at the rate of 350 kg Urea/ha, 225 kg Triple Super Phosphate (TSP)/ha, 260 kg Muriate of Potash (MP)/ha, 125 kg Zypsum/ha, 14 kg Zinc Sulphate/ha and 6 kg Borax/ha. Cow-dung 15 ton/ha was applied to enrich the soil during land preparation. Full dose of TSP, Zypsum, Zinc Sulphate and Borax and half dose of urea and MP were applied at the time of final land preparation. The rest half dose of Urea and MP were applied as topdressing at 45 and 60 days after seed sowing/transplanting of seedlings. True potato seeds were sown in nursery beds for transplanting on 30th October, 2001. For the direct sowing method, seeds were sown in well-prepared plots on 2nd December, 2001. On the same day, 33 days old seedlings were transplanted in the relevant plots of the main fields. After seed sowing nursery beds (for transplanting) and well-prepared plots (for direct sowing) both were covered with freshly cut banana leaves. The cover was removed as soon as emergence of seedling was visible and light overhead irrigation was provided to the seedlings everyday with water can. Transplanting was done in the late afternoon, as the young seedlings are sensitive to scorching sunlight. Dithane M-45 was used at 15 days interval commencing at 40 days after sowing/transplanting @ 0.2% as preventive measure against late blight. Harvesting of the crops under the transplanting method was done after 93 days of transplanting of seedlings and 109 days of seed sowing in case of direct sowing in field method, at a stage when the plants showed the sign of maturity.

RESULTS AND DISCUSSION

Planting methods significantly influenced of all growth parameters and per hectare yield of potato (Table 1). Transplanting method has to better vegetative growth, which have encouraged better physiological activities in plants to attain highest height (88.04 cm), maximum fresh and dry weight of foliage per plant (76.19 and 7.60 g), highest number and weight of tubers per plant (14.66 and 176.14 g). The higher cumulative effects of growth parameters ultimately resulted transplant TPS to produce highest yield of tuber per hectare (46.09 t). The values of these characters were found to be lowest under direct sowing in field method (Table 1). This result is in agreement with the findings of Begum^[6]. The highest plant height (78.88 cm), fresh and dry weight of foliage (64.34 and 6.72 g), number and weight of tubers per plant (16.98 and 183.41 g) were obtained in plants raised by single row system compared to plants of double row system. But the maximum yield (41.67 t) of tubers in double row system

was due to presence of more number of plants per unit area. Spacing showed significant effects on all the parameters studied except fresh weight of foliage per plant (Table 1). The tallest plant (77.79 cm), highest dry weight (6.50 g), maximum number and weight of tubers per plant (17.42 and 204.85 g) were found in the widest spacing (50x15 cm). This might be due to the fact that wider spacing results in less competition among the plants for light, nutrients, water and other resources. On the other hand, closer spacing (50x5 cm) gave the highest yield (42.32 t) than the wider spacing. This is due to the compensation effect of plants per hectare than the wider spacing, which results higher yield of tuber per hectare. This result supports that of Sultana and Siddique^[8], Singh *et al.*^[9] and Islam *et al.*^[10].

The interaction effect of planting method and system found to be statistically significant (Table 2). Maximum plant height (88.63 cm), fresh and dry weight of foliage per plant (80.20 and 7.88 g), number and height of tubers per plant (17.26 and 215.86 g) were obtained from transplanting method with single row system. But the highest tuber yield 48.98 t ha⁻¹ was found from transplanting with double row system because of double row system accommodate more number of plants that of single row. The interaction effect of planting method and spacing was significantly influenced by all the parameters under studied (Table 1). Plants raised by transplanting method at 50x15 cm spacing produced tallest plant (88.68 cm), maximum fresh and dry weight of foliage per plant (77.69 and 7.77 g) and highest number and weight of tubers per plant (17.71 and 236.43 g). It is logical because transplanting method with widest spacing might have encouraged better growth of plant which have positive impact on number and yield of tubers per plant. But greater number of plants in the closest spacing (50x5 cm) and favourable growth condition due to transplanting combinedly yielded the highest production (50.72 t ha⁻¹). In relation to interaction effect, plants grown under single row with widest spacing (50x15 cm) gave tallest plant (80.33 cm), the maximum fresh and dry weight of foliage per plant (66.42 and 7.16 g) and highest number and weight of tubers per plant (20.05 and 246.78 g). But double row system with closest spacing (50x5 cm) provided highest number of plants than other treatment combinations leading highest tuber yield (44.19 t ha⁻¹).

In case of the interaction effect of planting method, planting system and spacing the highest plant height (90.72 cm), fresh and dry weight of foliage per plant (82.83 and 8.08 g), number and weight of tubers per plant (20.09 and 286.43 g) was obtained from the treatment combination of transplanting with single row system and 50x15 cm spacing (Table 3). The yield of potato tubers per

Table 1: Main effect of planting method, planting system and spacing on the growth and yield contributing characters of potato using TPS

Treatments	Plant height at 90 DAS/P (cm)	Fresh weight of foliage/ plant at harvest (g)	Dry weight of foliage/ plant at harvest (g)	No. of potato tubers/ plant at harvest	Weight of potato tubers/ plant at harvest (g)	Yield of potato tubers/ha (t)
Factor-A (Planting method)						
A ₁ (Transplanting)	88.04	76.19	7.60	14.66	176.14	46.09
A ₂ (Direct sowing)	65.61	45.14	5.02	13.69	124.31	32.00
LSD 0.05	-	-	-	-	-	-
LSD 0.01	0.98	3.12	0.25	0.82	4.53	0.73
Factor-B (Planting system)						
B ₁ (Single row)	78.88	64.34	6.72	16.98	183.41	36.43
B ₂ (Double row)	74.77	56.99	5.90	11.37	170.03	41.67
LSD 0.05	-	-	-	-	-	-
LSD 0.01	0.98	3.12	0.25	0.82	4.53	0.73
Factor-C (Spacing)						
C ₁ (50x5 cm)	75.67	59.98	6.10	9.78	87.75	42.32
C ₂ (50x10 cm)	77.02	60.45	6.33	15.34	158.06	38.79
C ₃ (50x15 cm)	77.79	61.56	6.50	17.42	204.85	36.05
LSD 0.05	-	-	-	-	-	-
LSD 0.01	1.19	-	0.31	1.16	5.55	0.89
CV (%)	1.36	5.47	4.26	6.18	3.21	1.98

Table 2: Interaction effect of planting method, planting system and spacing on the growth and yield contributing characters of potato using TPS

Treatments	Plant height at 90 DAS/P (cm)	Fresh weight of foliage/ plant at harvest (g)	Dry weight of foliage/ plant at harvest (g)	No. of potato tubers/ plant at harvest	Weight of potato tubers/ plant at harvest (g)	Yield of potato tubers/ha (t)
AxB						
A ₁ B ₁	88.63	80.20	7.88	17.26	215.86	43.22
A ₁ B ₂	87.45	72.17	7.32	12.06	136.41	48.98
A ₂ B ₁	62.08	48.49	5.56	16.71	150.96	29.65
A ₂ B ₂	69.13	41.80	4.48	10.68	97.65	34.36
LSD 0.05	1.02	3.25	0.26	0.86	4.72	0.76
LSD 0.01	1.38	4.41	0.36	1.16	6.41	1.03
AxC						
A ₁ C ₁	86.99	74.75	7.47	10.37	105.32	50.72
A ₁ C ₂	88.44	76.13	7.55	15.90	186.67	45.53
A ₁ C ₃	88.68	77.69	7.77	17.71	236.43	42.04
A ₂ C ₁	67.13	46.15	5.18	9.18	70.19	33.92
A ₂ C ₂	65.35	47.00	5.45	14.78	129.45	32.04
A ₂ C ₃	64.34	42.28	4.43	17.11	173.28	30.05
LSD 0.05	1.25	3.98	0.32	1.05	5.78	0.93
LSD 0.01	1.69	5.40	0.44	1.43	7.85	1.26
BxC						
B ₁ C ₁	77.64	63.67	6.77	11.67	108.46	40.44
B ₁ C ₂	78.69	62.95	6.23	19.25	195.00	36.23
B ₁ C ₃	80.33	66.42	7.16	20.05	246.78	32.63
B ₂ C ₁	75.25	57.23	5.88	7.89	67.05	44.19
B ₂ C ₂	75.35	56.71	5.84	11.43	121.12	41.35
B ₂ C ₃	73.02	57.02	5.97	14.78	162.92	39.46
LSD 0.05	1.25	3.98	0.32	1.05	5.78	0.93
LSD 0.01	1.69	5.40	0.44	1.43	7.85	1.26
CV (%)	1.36	5.47	4.26	6.18	3.21	1.98

Table 3: Interaction effect of planting method, planting system and spacing on the growth and yield contributing characters of potato using TPS

Treatments	Plant height at 90 DAS/P (cm)	Fresh weight of foliage/ plant at harvest (g)	Dry weight of foliage/ plant at harvest (g)	No. of potato tubers/ plant at harvest	Weight of potato tubers/ plant at harvest (g)	Yield of potato tubers/ha (t)
AxBxC						
A ₁ B ₁ C ₁	87.45	77.33	7.66	12.17	130.83	48.82
A ₁ B ₁ C ₂	88.73	80.43	7.89	19.63	230.33	42.27
A ₁ B ₁ C ₃	90.72	82.83	8.08	20.09	286.43	38.57
A ₁ B ₂ C ₁	86.17	72.17	7.29	8.58	79.80	52.62
A ₁ B ₂ C ₂	88.63	71.82	7.22	12.17	143.00	48.79
A ₁ B ₂ C ₃	86.54	72.54	7.46	15.43	186.43	45.51
A ₂ B ₁ C ₁	64.33	50.00	5.89	11.17	86.08	32.07
A ₂ B ₁ C ₂	61.97	52.40	6.43	18.87	159.67	30.18
A ₂ B ₁ C ₃	59.95	43.07	4.49	19.99	207.14	26.69
A ₂ B ₂ C ₁	69.93	42.30	4.47	7.20	54.30	35.77
A ₂ B ₂ C ₂	68.74	41.60	4.47	10.70	99.23	33.91
A ₂ B ₂ C ₃	68.73	41.50	4.38	14.14	139.42	33.41
LSD 0.05	1.76	5.62	0.45	1.48	8.17	1.31
LSD 0.01	2.39	7.64	0.62	2.02	11.1	1.78
CV (%)	1.36	5.47	4.26	6.18	3.21	1.98

DAS/P = Days after sowing/transplanting

hectare ranged from 26.69 to 52.62 t. The highest yield of potato tubers 52.62 t ha⁻¹ was obtained from transplanting method, double row system and 50x5 cm spacing followed by the same spacing with transplanting and single system (48.82 t ha⁻¹) and the lowest (26.69 t ha⁻¹) was from direct sowing in field method, single row system and 50x15 cm spacing.

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