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Potato growth as influenced by planting date, spacing and NPK levels under Godavari conditions

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Abstract

The field experiment was carried out during *rabi* season of 2018-19 and 2019-20 at College farm, COH, VR Gudem, West Godavari District of Andhra Pradesh. The data revealed that the highest germination and plant height, No. of branches plant⁻¹, No. of leaves plant⁻¹ and leaf area plant⁻¹ (at 30, 60 and 80 DAP) and total tuber yield were recorded in November 1st planting. Respect to spacings, significantly higher growth values were noticed at 75x20 cm except tuber yield. Among NPK levels, application of 160N:80P:200K kg ha⁻¹ was found to be superior in growth parameters as well as total tuber yield. In three way interaction of D₂S₂F₂ and D₂S₁F₂ were recorded the highest growth parameters and total tuber yield respectively. Plant spacing, NPK levels, their all the interaction effects were found to be non-significant on germination. Based on results, it may be concluded that D₂S₁F₂ combination may be considered as the best treatment in terms of tuber yield.

Keywords: Germination, planting date, plant spacing, NPK levels, potato, growth and tuber yield

Introduction

Potato (*Solanum tuberosum* L.) is the fourth most important staple food crop in the world after rice, wheat and maize. It belongs to Solanaceae family and native to South America. In the world, China ranks first in area, followed by Russian Federation, Ukraine and Poland. India ranks fifth in area in the world. In India, potato is cultivated in an area of 21.42 lakh hectares with an annual production of 513.10 lakh tones and productivity of 24.00 tones per hectare [1]. Nutritionally potato rich in starch, protein, sugars and minerals [2]. Potato is a weather sensitive crop. Its growth and production is influenced by climate and several other factors like use of improved varieties, good quality seed, planting time, spacing, nutrition, irrigation, weeds, incidence of pest and diseases. For best yields, potato crop needs long day conditions during growth and short day conditions during tuberization [3]. Earlier planting is not possible due to unfavorable weather conditions, particularly late rains.

Plant spacing also influences potato growth and yields, since it determines plant density. In general, closer spacing to certain extent will increase the yield of potato tubers. Under the wider spacing, the plant was more vigorous in terms of leaf size, which might be due to less competition for light, nutrients and moisture [4]. Fertilizer requirement of potato crop will vary with place, soil, variety and climatic conditions of the region. Low NPK fertilization leads to reduction in growth and yield in potato and also plants show nutrient deficiency symptoms. The balanced fertilizer application was increasing yield per unit area [5]. In view of importance of this crop, to develop suitable planting date, plant spacing and NPK levels, this present experiment was planned.

Material and Methods

A field experiment was conducted at College of Horticulture, VR Gudem, Dr. YSR Horticultural University, West Godavari District of Andhra Pradesh during winter season of 2018-19 and 2019-20 on "Growth of potato as influenced by planting date, spacing and NPK levels under Godavari conditions". There are 18 treatment combinations consisting of three factors *viz.*, planting dates (3 levels *viz.*, D₁: October 15th, D₂: November 1st and November 16th), plant spacings (2 levels *viz.*, S₁: 60 cm x 20 cm, S₂: 75 cm x 20 cm) with F₁: 120:60:150

kg ha⁻¹, F₂: 160:80:200 kg ha⁻¹ and F₃: 200:100:250 kg ha⁻¹). The treatments were laid in a factorial randomized block design (FRBD) replicated thrice under open field conditions with Kufri Surya variety. FYM @ 25 and full dose of SSP, 1/3rd dose of urea and MOP were applied in the last ploughing as basal dose. The remaining dose of Urea and MOP were

applied in two equal split doses, first dose at 30 DAP and final dose at 50 DAP. Following observations were recorded during course of study viz., Germination, plant height, no. of braches per plant, no. of leaves per plant, leaf area per plant and total tuber yield.

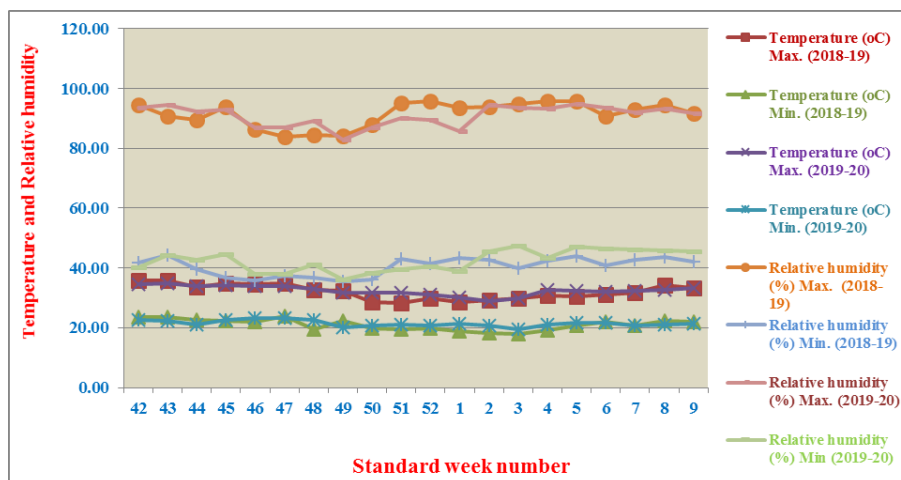


Fig 1: Weekly meteorological data during the crop growth period of October 15th to February 28 during 2018-19 and 2019-20.

Results and Discussion

Germination (%)

Germination was significantly highest in November 1st planting (D₂) and the lowest in October 15th planting (D₁). With respect to spacing and NPK levels both the effects were found non-significant (Table 1), however the superior germination was observed at a wider spacing of 75 x 20 cm

with low NPK level F₁ (120:60:150 kg ha⁻¹) and minimum in closer spacing with high NPK level F₃ (160:80:200 kg ha⁻¹). The highest germination in D₂ and D₃ plantings might be due to comparatively favourable temperatures (21-33 °C) and optimum moisture at the planting date with November 1st as these factors basically influence germination. Similar results were reported by Jamro *et al.* [6] in potato.

Table 1: Germination as influenced by planting dates, spacing and NPK levels in potato (two years pooled data).

Spacing (S)	NPK levels (F)	Planting dates (D)			
		D ₁ (October 15 th)	D ₂ (November 1 st)	D ₃ (November 16 th)	Mean
S ₁ (60 x 20 cm)	F ₁ (120:60:150 kg ha ⁻¹)	75.59	84.07	81.07	80.24
	F ₂ (160:80:200 kg ha ⁻¹)	74.53	83.52	80.56	79.53
	F ₃ (200:100:250 kg ha ⁻¹)	74.53	83.35	80.19	79.35
	Mean	74.88	83.65	80.60	79.71
S ₂ (75 x 20 cm)	F ₁ (120:60:150 kg ha ⁻¹)	75.80	84.50	81.92	80.74
	F ₂ (160:80:200 kg ha ⁻¹)	75.02	84.02	81.25	80.10
	F ₃ (200:100:250 kg ha ⁻¹)	74.80	83.77	81.12	79.90
	Mean	75.21	84.10	81.43	80.24
For Comparing planting dates (D) and fertilizer levels (F)					
F ₁ (NPK @ 120:60:150 kg ha ⁻¹)		75.70	84.28	81.50	80.49
F ₂ (NPK @ 160:80:200 kg ha ⁻¹)		74.78	83.77	80.90	79.82
F ₃ (NPK @ 200:100:250 kg ha ⁻¹)		74.66	83.56	80.65	79.63
Mean		75.05	83.87	81.02	79.98
Factor		S Em+ CD at 5%			
Planting dates (D)		0.87		2.50	
Spacing (S)		--		NS	
Fertilizer levels (F)		--		NS	
D x S		--		NS	
D x F		--		NS	
S x F		--		NS	
D x S x F		--		NS	

NS: Non-significant

2. Plant height (cm)

November 1st and October 15th plantings were noticed the highest and lowest plant height respectively at all growth stages (30, 60 and 80 DAP). Similarly, higher plant height was observed at a wider spacing of 75 x 20 cm as compared to closer spacing of 60 x 20 cm (Table 2). Among NPK

levels, F₂ level (160:80:200 kg ha⁻¹) recorded the maximum plant height (at 80 DAP) while minimum plant height was noticed with F₁ level (120:60:150 kg ha⁻¹). In two way interaction of D x S, D x F and S x F were found to be non-significant on plant height at all growth stages. Regarding to three way interaction of D x S x F, the highest plant height

values were found in the combination D₂ S₂ F₂: November 1st planting + 75 x 20 cm spacing + NPK @ 160:80:200 kg ha⁻¹ which was significantly superior to the rest of treatments except D₂ S₂ F₃: November 1st planting + 75 x 20 cm spacing

+ NPK @ 200:100:250 kg ha⁻¹ whereas the lowest plant height was noticed in D₁ S₁ F₁: October 15th planting + 60 x 20 cm spacing + NPK @ 120:60:150 kg ha⁻¹.

Table 2: Plant height at 30, 60 and 80 DAP as influenced by planting dates, spacing and NPK levels in potato (two years pooled data).

Spacing (S)	NPK levels (F)	Plant height (cm)											
		Planting dates (D)											
		At 30 DAP				60 DAP				80 DAP			
NPK kg ha ⁻¹	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	
S ₁ (60 x 20 cm)	F ₁ (120:60:150)	13.38	18.63	16.93	16.31	23.19	28.04	26.24	25.82	29.20	34.27	32.70	32.06
	F ₂ (160:80:200)	15.15	20.75	19.35	18.42	26.29	31.13	28.74	28.72	31.73	37.41	35.00	34.71
	F ₃ (200:100:250)	14.84	19.57	18.26	17.56	25.09	29.31	29.30	27.90	30.40	36.33	33.45	33.39
	Mean	14.46	19.65	18.18	18.91	24.86	29.49	28.09	27.48	30.44	36.00	33.72	33.39
S ₂ (75 x 20 cm)	F ₁ (120:60:150)	16.03	19.66	17.75	17.81	24.09	28.17	26.65	26.31	29.62	35.15	33.26	32.68
	F ₂ (160:80:200)	17.67	22.34	20.76	20.26	26.93	31.78	29.79	29.50	33.70	40.17	36.02	36.63
	F ₃ (200:100:250)	16.81	20.53	19.47	18.94	25.93	30.43	27.99	28.12	32.19	38.10	34.93	35.07
	Mean	16.84	20.84	19.33	20.09	25.65	30.13	28.15	27.98	31.84	37.81	34.74	34.79
For Comparing planting dates (D) and fertilizer levels (F)													
F ₁ (NPK @ 120:60:150 kg ha ⁻¹)		14.70	19.15	17.34	17.06	23.64	28.11	26.44	26.06	29.41	34.71	32.98	32.37
F ₂ (NPK @ 160:80:200 kg ha ⁻¹)		16.41	21.54	20.06	19.34	26.61	31.46	29.27	29.11	32.71	38.79	35.51	35.67
F ₃ (NPK @ 200:100:250 kg ha ⁻¹)		15.82	20.05	18.87	18.25	25.51	29.87	28.65	28.01	31.3	37.21	34.19	34.23
Mean		15.65	20.25	18.75	18.21	25.25	29.81	28.12	27.73	31.14	36.90	34.23	34.09
Factor		S Em+ CD at 5%				S Em+ CD at 5%				S Em+ CD at 5%			
Planting dates (D)		0.22		0.63		0.31		0.89		0.33		0.96	
Spacing (S)		0.18		0.51		0.25		0.72		0.27		0.78	
Fertilizer levels (F)		0.22		0.63		0.31		0.89		0.33		0.96	
D x S		--		NS		--		NS		--		NS	
D x F		--		NS		--		NS		--		NS	
S x F		--		NS		--		NS		--		NS	
D x S x F		0.53		1.53		0.76		2.18		0.82		2.35	

Planting dates (D): D₁ - October 15th, D₂ - November 1st, D₃ - November 16th; NS: Non-significant; DAP: Days after planting

3. Number branches (haulms) per plant

The number of branches or haulms per plant was maximum in November 1st planting followed by November 16th planting and minimum in October 15th planting at all growth stages (Table 3). Non-significant difference was observed on number branches per plant due to spacings, however, higher number of branches noticed at a spacing of 60 x 20 cm compared to spacing of 75 x 20 cm. Among NPK levels, application of

NPK @ 160:80:200 kg ha⁻¹ took more number of branches per plant while, NPK applied @ 120:60:150 kg ha⁻¹ took less number of haulms per plant. With regard to interactions, all the two interactions were found to be non-significant but three way interaction was found to be significant and Number of branches per plant was highest in D₂ S₂ F₂ and the lowest in D₁ S₂ F₁ combination at all growth stages (30, 60 and 80 DAP).

Table 3: Number of branches (haulms) plant⁻¹ at 30, 60 and 80 DAP as influenced by planting dates, spacing and NPK levels in potato (two years pooled data).

Spacing (S)	NPK levels (F)	Number of branches (haulms) plant ⁻¹											
		Planting dates (D)											
		At 30 DAP				60 DAP				80 DAP			
NPK kg ha ⁻¹	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	
S ₁ (60 x 20 cm)	F ₁ (120:60:150)	2.52	3.59	2.83	2.98	3.12	4.27	3.85	3.74	3.99	4.90	4.49	4.46
	F ₂ (160:80:200)	3.00	4.05	3.75	3.60	3.99	5.00	4.44	4.48	4.55	6.07	5.07	5.23
	F ₃ (200:100:250)	2.77	3.88	3.49	3.38	3.62	4.65	4.09	4.12	4.41	5.64	4.83	4.96
	Mean	2.76	3.84	3.36	3.32	3.58	4.64	4.13	4.11	4.32	5.54	4.80	4.88
S ₂ (75 x 20 cm)	F ₁ (120:60:150)	2.59	3.57	2.89	3.02	3.14	4.31	3.81	3.75	4.06	4.91	4.48	4.48
	F ₂ (160:80:200)	3.19	4.21	3.87	3.76	4.14	5.27	4.70	4.70	4.66	6.17	5.22	5.35
	F ₃ (200:100:250)	2.88	3.99	3.70	3.52	3.73	4.83	4.38	4.31	4.41	5.74	4.97	5.04
	Mean	2.89	3.92	3.49	3.43	3.67	4.80	4.30	4.26	4.38	5.61	4.89	4.96
For Comparing planting dates (D) and fertilizer levels (F)													
F ₁ (NPK @ 120:60:150 kg ha ⁻¹)		2.56	3.58	2.86	3.00	3.13	4.29	3.83	3.75	4.02	4.91	4.49	4.47
F ₂ (NPK @ 160:80:200 kg ha ⁻¹)		3.10	4.13	3.81	3.68	4.06	5.13	4.57	4.59	4.61	6.12	5.15	5.29
F ₃ (NPK @ 200:100:250 kg ha ⁻¹)		2.82	3.94	3.60	3.45	3.68	4.74	4.24	4.22	4.41	5.69	4.90	5.00
Mean		2.83	3.88	3.42	3.38	3.62	4.72	4.21	4.19	4.35	5.57	4.84	4.92
Factor		S Em+ CD at 5%				S Em+ CD at 5%				S Em+ CD at 5%			
Planting dates (D)		0.07		0.21		0.08		0.22		0.06		0.18	
Spacing (S)		--		NS		--		NS		--		NS	
Fertilizer levels (F)		0.07		0.21		0.08		0.22		0.06		0.18	
D x S		--		NS		--		NS		--		NS	
D x F		--		NS		--		NS		--		NS	
S x F		--		NS		--		NS		--		NS	
D x S x F		0.18		0.52		0.19		0.55		0.16		0.44	

Planting dates (D): D₁ - October 15th, D₂ - November 1st, D₃ - November 16th; NS: Non-significant; DAP: Days after planting

4. Number of leaves per plant

Pooled results revealed that the highest number of leaves per plant was recorded with November 1st planting which was significantly superior to the rest of planting dates at all growth stages (Table 4). The lowest number of leaves per plant was recorded with October 16th planting. Among spacings, the higher leaf number per plant was observed at a spacing of 75 x 20 cm when compared to 60 x 20 cm spacing. Significant effect of NPK levels was observed on number of leaves per

plant at all the growth stages and maximum and minimum number of leaves per plant were registered with application of NPK @ 160:80:200 kg ha⁻¹ and NPK @ 120:60:150 kg ha⁻¹, respectively. Regarding to two way interactions, D₂ S₂, D₂ F₂ and S₂ F₂ combinations recorded the highest number leaves per plant and same were lowest in D₁ S₁, D₁ F₁ and S₁ F₁ combinations at 80 DAP. Similarly in three way interaction of D₂S₂F₂ recorded the highest leaf number per plant and the same was lowest in D₁ S₁ F₁ combination.

Table 4: Number of leaves plant⁻¹ at 30, 60 and 80 DAP as influenced by planting dates, spacing and NPK levels in potato (two years pooled data).

Spacing (S)	NPK levels (F)	Number leaves plant ⁻¹											
		Planting dates (D)											
		At 30 DAP				60 DAP				80 DAP			
NPK kg ha ⁻¹	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	
S ₁ (60 x 20 cm)	F ₁ (120:60:150)	29.04	41.20	36.63	35.62	66.47	87.88	82.21	78.85	80.69	113.30	97.79	97.26
	F ₂ (160:80:200)	32.44	46.92	40.43	39.93	74.21	101.2	94.18	89.86	89.56	129.54	109.47	109.52
	F ₃ (200:100:250)	30.86	43.82	38.88	37.85	67.69	96.6	87.42	83.90	85.57	123.12	103.12	103.93
	Mean	30.78	43.98	38.65	37.80	69.46	95.23	87.94	84.21	85.27	121.99	103.46	103.57
S ₂ (75 x 20 cm)	F ₁ (120:60:150)	31.02	44.67	41.08	38.92	70.54	91.19	88.69	83.47	84.92	116.27	100.29	100.49
	F ₂ (160:80:200)	35.61	53.67	45.50	44.93	81.00	105.77	98.86	95.21	98.17	144.62	122.42	121.74
	F ₃ (200:100:250)	34.17	51.23	43.97	43.13	75.67	99.59	96.02	90.43	91.05	135.18	119.09	115.10
	Mean	33.60	49.86	43.52	42.33	75.74	98.85	94.52	89.70	91.38	132.02	113.93	112.44
For Comparing planting dates (D) and fertilizer levels (F)													
F ₁ (NPK @ 120:60:150 kg ha ⁻¹)		30.03	42.94	38.86	37.27	68.51	89.54	85.45	81.17	82.81	114.78	99.04	98.87
F ₂ (NPK @ 160:80:200 kg ha ⁻¹)		34.03	50.29	42.97	42.43	77.60	103.48	96.52	92.53	93.86	137.08	115.95	115.63
F ₃ (NPK @ 200:100:250 kg ha ⁻¹)		32.52	47.53	41.43	40.49	71.68	98.10	91.72	87.17	88.31	129.15	111.10	109.52
Mean		32.19	46.92	41.08	40.06	72.60	97.04	91.23	86.96	88.33	127.00	108.70	108.01
Factor		S Em+ CD at 5%				S Em+ CD at 5%				S Em+ CD at 5%			
Planting dates (D)		0.40		1.16		0.77		2.20		0.60		1.72	
Spacing (S)		0.33		0.95		0.63		1.80		0.49		1.40	
Fertilizer levels (F)		0.40		1.16		0.77		2.20		0.60		1.72	
D x S		0.57		1.64		--		NS		0.84		2.43	
D x F		--		NS		--		NS		1.03		2.97	
S x F		--		NS		--		NS		0.84		2.43	
D x S x F		0.99		2.84		1.88		5.39		1.46		4.20	

Planting dates (D): D₁ - October 15th, D₂ - November 1st, D₃ - November 16th; NS: Non-significant; DAP: Days after planting

5. Leaf area per plant (cm²)

Among planting dates, D₂ planting recorded maximum leaf area per plant followed by D₃ planting and same was minimum in D₁ planting at all growth stages (30, 60 and 80 DAP). Similarly, the higher and lower leaf area per plant was observed at S₂ and S₁ spacings respectively (Table 5). Among the levels of NPK, medium level F₂ recorded the maximum leaf area per plant and the same was minimum in low level F₁.

In two way interaction of D₂S₂ found superior in leaf area per plant at 80 DAP whereas D₂F₂ combination recorded the highest leaf area at 30 and 60 DAP while, S₂F₂ combination noticed maximum leaf area at 30 DAP. With respect to three way interaction, the treatment combination of D₂ S₂ F₂ and D₁S₁F₁ was recorded the maximum and minimum leaf area per plant, respectively at all growth stages.

Table 5: Leaf area plant⁻¹ at 30, 60 and 80 DAP as influenced by planting dates, spacing and NPK levels in potato (two years pooled data).

Spacing (S)	NPK levels (F)	Leaf area plant ⁻¹ (cm ²)											
		Planting dates (D)											
		At 30 DAP				60 DAP				80 DAP			
NPK kg ha ⁻¹	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	D ₁	D ₂	D ₃	Mean	
S ₁ (60 x 20 cm)	F ₁ (120:60:150)	268.17	652.72	512.49	477.79	884.46	1518.54	1313.38	1238.79	1530.98	2227.35	1977.21	1911.85
	F ₂ (160:80:200)	351.95	867.97	687.49	635.80	1138.08	1951.93	1576.48	1555.49	1906.40	2537.85	2371.42	2271.89
	F ₃ (200:100:250)	358.59	806.07	651.48	605.38	1049.43	1846.19	1543.65	1479.76	1864.00	2403.16	2284.83	2184.00
	Mean	326.23	775.59	617.15	572.99	1023.99	1772.22	1477.84	1424.68	1767.13	2389.45	2211.15	2122.58
S ₂ (75 x 20 cm)	F ₁ (120:60:150)	368.24	737.64	601.36	569.08	963.09	1713.94	1408.76	1361.93	1725.50	2368.19	2152.75	2082.15
	F ₂ (160:80:200)	548.29	967.71	822.15	779.38	1227.00	2120.56	1834.54	1727.37	2047.17	2890.45	2623.75	2520.46
	F ₃ (200:100:250)	470.29	901.36	738.57	703.41	1175.63	2044.89	1790.90	1670.47	1869.75	2718.37	2486.32	2358.15
	Mean	462.27	868.90	720.69	683.96	1121.91	1959.80	1678.07	1586.59	1880.81	2659.01	2420.94	2320.25
For Comparing planting dates (D) and fertilizer levels (F)													
F ₁ (NPK @ 120:60:150 kg ha ⁻¹)		318.20	695.18	556.92	523.43	923.77	1616.24	1361.07	1300.36	1628.24	2297.77	2064.98	1997.00
F ₂ (NPK @ 160:80:200 kg ha ⁻¹)		450.12	917.84	754.82	707.59	1182.54	2036.25	1705.51	1641.43	1976.79	2714.15	2497.59	2396.17
F ₃ (NPK @ 200:100:250 kg ha ⁻¹)		414.44	853.71	695.03	654.39	1112.53	1945.54	1667.28	1575.12	1866.88	2560.77	2385.58	2271.07
Mean		394.25	822.24	668.92	628.47	1072.95	1866.01	1577.95	1505.64	1823.97	2524.23	2316.05	2221.42
Factor		S Em+ CD at 5%				S Em+ CD at 5%				S Em+ CD at 5%			
Planting dates (D)		6.44		18.51		15.73		45.22		17.70		50.88	
Spacing (S)		5.26		15.11		12.84		36.92		14.45		41.54	
Fertilizer levels (F)		6.44		18.51		15.73		45.22		17.70		50.88	

D x S	--	NS	--	NS	25.03	71.95
D x F	11.15	32.06	27.24	78.32	--	NS
S x F	9.11	26.18	--	NS	--	NS
D x S x F	15.77	45.32	38.53	110.70	43.35	124.56

Planting dates (D): D₁ - October 15th, D₂ - November 1st, D₃ - November 16th; NS: Non-significant; DAP: Days after planting

6. Total tuber yield (t ha⁻¹)

The plants of November 1st planting produced maximum total tuber yield ha⁻¹ followed by November 16th planting and minimum yield was observed in October 15th planting (Table 6). Among spacings, the higher yield ha⁻¹ observed at 60 x 20 cm spacing followed by 75 x 20 cm. Application of NPK @ 160:80:200 kg ha⁻¹ gave the highest yield ha⁻¹, whereas, the lowest yield was from NPK @ 120:60:150 kg ha⁻¹. Among interaction means, all the two way interactions were found to be non-significant but three way interactions was found significant. D₂S₁F₂ combination was found to record the superior total tuber yield whereas the least yield was recorded under D₁S₂F₁ combination. All the growth parameters and tuber yield were significantly maximum in November 1st planting followed by November 16th planting may be due to congenial temperatures (21-32 °C) that prevailed during vegetative growth period resulting in greater photosynthetic

activity and higher mobilization of assimilates. While, higher temperatures (> 32 °C) during the vegetative phase of potato from October 15th planting might have resulted in reduction in growth and yield of potato plant. Mamun *et al.* [7], Thongam *et al.* [8], Dash *et al.* [9] and Patel *et al.* [10] also reported similar findings in potato. Wider spacing (75 x 20 cm) showed maximum growth characters which might be due to better availability of nutrients water and sun light since plants at wider spacing. These results are in conformity with the findings of Almeida *et al.* [11] and Lehar *et al.* [12] in potato. Medium NPK level (F₂: 160:80:200 kg ha⁻¹) recorded higher growth and yield might be due to the enhanced availability of nutrients to the crop, which may have resulted in increased photosynthetic efficiency of the plant and increased metabolic activities of the plant with increase in NPK dose up to certain level (F₂). Similar results were also reported by Sandhu *et al.* [13] and Banjare *et al.* [14] in potato.

Table 6: Total tuber yield as influenced by planting dates, spacing and NPK levels in potato (two years pooled data).

Spacing (S)	NPK levels (F)	Planting dates (D)			
		D ₁ (October 15 th)	D ₂ (November 1 st)	D ₃ (November 16 th)	Mean
S ₁ (60 x 20 cm)	F ₁ (120:60:150 kg ha ⁻¹)	14.80	17.96	16.03	16.26
	F ₂ (160:80:200 kg ha ⁻¹)	17.11	21.33	19.69	19.38
	F ₃ (200:100:250 kg ha ⁻¹)	15.88	19.37	18.07	17.77
	Mean	15.93	19.55	17.93	17.80
S ₂ (75 x 20 cm)	F ₁ (120:60:150 kg ha ⁻¹)	13.71	16.70	15.03	15.14
	F ₂ (160:80:200 kg ha ⁻¹)	16.24	19.56	18.48	18.09
	F ₃ (200:100:250 kg ha ⁻¹)	14.81	17.81	16.81	16.48
	Mean	14.92	18.02	16.77	16.57
For Comparing planting dates (D) and fertilizer levels (F)					
F ₁ (NPK @ 120:60:150 kg ha ⁻¹)		14.25	17.33	15.53	15.70
F ₂ (NPK @ 160:80:200 kg ha ⁻¹)		16.68	20.44	19.09	18.74
F ₃ (NPK @ 200:100:250 kg ha ⁻¹)		15.34	18.59	17.44	17.12
Mean		15.42	18.79	17.35	17.19
Factor		S Em+ CD at 5%			
Planting dates (D)		0.12		0.35	
Spacing (S)		0.10		0.29	
Fertilizer levels (F)		0.12		0.35	
D x S		--			
D x F		--			
S x F		--			
D x S x F		0.30		0.85	

NS: Non-significant

Conclusions

1. On the basis of the results emerged out from the present investigation, it may be concluded that planting of potato from November 1st (D₂) to 16th (D₃) at a spacing of 60 cm x 20 cm (S₁) with NPK dose @ 160:80:200 kg ha⁻¹ (F₂) may be considered as the best treatment in terms of growth and tuber yield (21.33 t ha⁻¹).
2. The next best treatment combination D₂ S₂ F₂ (November 1st planting at a spacing of 75 x 20 cm with NPK @ 160:80:200 kg ha⁻¹) was recorded the maximum tuber yield (19.56 t ha⁻¹).
3. It is worth to mention that yield per hectare was at the highest with 60 x 20 cm spacing due to more number of plants per unit area and thus the combination of D₂ S₁ F₂ was excelling over D₂ S₂ F₂.

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