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Effect of integrated nutrients management on growth and yield of potato cv. Kufri Kyati

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Abstract

An experiment was conducted at Horticulture Research Farm, College of Horticulture, AAU, Anand during the three consecutive years 2020-21, 2021-22 and 2022-23 on Potato cv. Kufri Khyati. The experiment was laid out in Randomized Block Design with three replications and ten treatments viz., T₁: 100% RDF (220:110:220), T₂: 20 t FYM + 100% RDF (220:110:220), T₃: 75% RDF + 25% RDN through FYM, T₄: 75% RDF + 25% RDN through VC, T₅: 50% RDF + 50% RDN through FYM, T₆: 50% RDF + 50% RDN through VC, T₇: 50% RDF + 50% RDN through FYM + 1 L Bio NPK consortium/ha, T₈: 50% RDF + 50% RDN through VC + 1 L Bio NPK consortium/ha, T₉: 25% RDF + 50% RDN through FYM + 1 L Bio NPK consortium/ha + KMB 1 L/ha, T₁₀: 25% RDF + 50% RDN through VC + 1 L Bio NPK consortium + KMB 1 L/ha. The observations were recorded on different growth and yield attributes. The treatment T₂ [20 t FYM + 100% RDF (220:110:220)] recorded significantly, maximum plant height at 45 DAS (51.85 cm) and 60 DAS (64.10 cm), tuber weight per plant (487.13 g) and tuber yield (434.8 q/ha) in pooled analysis. Whereas, haulm yield (kg/ha) were found non-significant.

Keywords: INM, FYM, tuber yield, potato

Introduction

Potato (*Solanum tuberosum* L.) belongs to family Solanaceae. Potato is one of the major vegetable crops of the India and occupies an important position among food crops and provides staple food stuff for millions of people of many part of the world. It is grown as a cash crop and capable in producing more food per unit area and time than cereals in short span of life. India produces about 60.14 MT of potato from an area of 2.30 Mha with productivity of 26.14 metric tonnes (Anonymous, 2022-23^b)^[2]. Uttar Pradesh is the leading potato produce state and other important states are West Bengal, Bihar, Gujarat, Madhya Pradesh and Punjab. In Gujarat its production is 39.83 MT from an area of 131503 ha with productivity of 30.29 metric tonnes (Anonymous, 2022-23^a)^[1].

Continuous application of Inorganic fertilizer causes nutritional imbalance and adverse effects on physico-chemicals and biological properties of soil. On the other hand, the price of inorganic fertilizers has increased to an extent that those are out of reach of the small and marginal farmers. So it has become difficult for farmers to apply such expensive inputs for a crop of marginal returns. The use of bio fertilizers and organic manures in such situation is, therefore, a practically paying proposal. Thus, the integrated nutrient management could be a key factor for producing and maintain high level of tuber yield in sustain manner. Therefore, the present investigation was done to find out the effect of integrated nutrient management on growth and yield of potato.

Materials and Methods

The field experiment was laid out during the three consecutive years 2020-21, 2021-22 and 2022-23 at Horticultural Research Farm, College of Horticulture, Anand Agricultural University, Anand, Gujarat, India, during the *Rabi* season. The experiment was laid out with ten treatments i.e., T₁: 100% RDF (220:110:220), T₂: 20 t FYM + 100% RDF (220:110:220), T₃: 75% RDF + 25% RDN through FYM, T₄: 75% RDF + 25% RDN through VC, T₅: 50% RDF + 50% RDN through FYM, T₆: 50% RDF + 50% RDN through VC, T₇: 50% RDF + 50% RDN through FYM + 1 L Bio NPK consortium/ha, T₈: 50%

RDF + 50% RDN through VC + 1 L Bio NPK consortium/ha, T₉: 25% RDF + 50% RDN through FYM + 1 L Bio NPK consortium/ha + KMB 1 L/ha, T₁₀: 25% RDF + 50% RDN through VC + 1 L Bio NPK consortium + KMB 1 L/ha in a Randomized Block Design with three replications with plot size of 2.70 × 3.20 m. The experimented plot soil was light alluvial having sandy loam texture with pH of 7.11, organic carbon 0.65%, available N 240.00 kg/ha, available P₂O₅ 87.10 kg/ha, available K 241.00 kg/ha. Potato tuber of Kufri Kyati variety was planted at spacing of 45 × 20 cm. Application of 50% Nitrogen, 100% P₂O₅ and 50% K₂O was applied as basal application while 50% Nitrogen and 50% K₂O was applied 30 DAP and all organic manures and Bio NPK consortium was applied with organic manures as a basal, while KMB was applied at 45 DAP with irrigation.

Five plants per plot were selected randomly and tagged for recording various observations on growth and yield parameters. Plant height was measured by measuring scale from ground level to the apical bud at 45 and 60 DAP. Haulm yield was taken at a time of maturity upper oration of plant from soil was cut and weighted on physical balance and their average weight per plant was worked out and number of tubers per plant at harvest counted from tagged plants, while yield of tuber were recorded in kg per plot separately and converted into q/ha. The statistical analysis of data recorded in all observations was computed by methods of analysis of variance and treatments were compared with help of critical difference as suggested by Panse and Sukhatme (1989)^[8].

Results and Discussion

Growth parameters of potato

Plant height (cm) at 45 and 60 DAP

The data revealed that the plant height at 45 and 60 DAP was found significant in pooled analysis (Table 1). Maximum plant height at 45 DAP (51.85 cm) was recorded with the treatment T₂ [(20 t FYM + 100% RDF (220:110:220))] but it was at par with treatment T₁, T₄, T₃, T₅, T₆ and T₈. while, the highest plant height at 60 DAP (64.10 cm) was observed with T₂ [20 t FYM + 100% RDF (220:110:220)] and which was at par with treatment T₃, T₈, T₄, T₅, T₁ and T₆.

The increase in plant height by the use of FYM with integration of NPK might be due to the influence of nitrification inhibition properties of FYM in the soil. Besides, it may also be due to rapid elongation and multiplication of cell in the presence of adequate quantity of nitrogen. Nitrogen is one of the basic minerals associated with synthesis of protoplasm and primary synthesis of amino acid. It also increases meristematic activity at faster rate under higher fertility which caused better plant growth. It is also an established fact that plant supplied with abundant nitrogen and phosphorus would assimilate more photosynthates and better translocation of photosynthate which ultimately resulted higher vegetative growth in plant. Similar observations have also been noted by Kumar *et al.*

(2012)^[5], Muhammad *et al.* (2015)^[7] and Singh (2018)^[10].

Haulm yield (kg/ha)

The data pertaining to haulm yield influenced by different integrated nutrient management treatment during three consecutive years 2020-21, 2021-22, 2022-23 and in pooled data are presented in Table 2. The data show non-significant effect in all the years 2021-22, 2022-23 and in pooled result.

Yield parameters of potato

Number of tubers per plant

The data pertaining to number of tubers per plant influenced by different integrated nutrient management treatment during three consecutive years 2020-21, 2021-22, 2022-23 and in pooled data are presented in Table 2. The data found non-significant effect in all the three consecutive years and in pooled result.

Tuber weight per plant (g)

The data pertaining to tuber weight per plant is presented in Table 3. The result showed significant effect during 2020-21, 2021-22 and 2022-23 as well as in pooled analysis. Maximum tuber weight per plant (487.13 g) was recorded with treatment T₂ [20 t FYM + 100% RDF (220:110:220)] which was at par with treatment T₃, T₄, T₈, T₇ and T₆ in the pooled data.

This might be due to the usage of both organic and inorganic chemical fertilizers, as an organic fertilizer promoted aeration in the soil, focalized root advancement and boosted microbes and biological production in the rhizosphere which also increased the nutrient use efficiency through modification of soil physical condition and resulted in higher total uptake of nutrients because of better root penetration leading to better absorption of nutrients and moisture that ultimately increase tuber weight of plant. Similar result also found by Solanke *et al.* (2009)^[12] and Jaipaul *et al.* (2011)^[3].

Tuber yield (q/ha)

The data pertaining to tuber yield (q/ha) is presented in Table 3. The result showed significant effect during 2020-21, 2021-22 and 2022-23 as well as in pooled analysis. Maximum tuber yield (434.8 q/ha) was observed with treatment T₂ [20 t FYM + 100% RDF (220:110:220)] but it was at par with T₃ and T₄ in pooled analysis.

This could be ascribed to the use of organic manure and fertilizer, which altered the physical characteristics of the soil to enhance the efficiency of nutrient use and led to a larger total uptake of nutrients due to better root accessibility, which increased nutrient and moisture absorption in plant that lead to more photosynthates in plant Khurana *et al.* (2005)^[4]. Resulted increase tuber weight per plant and ultimately increased total yield of potato tuber. Similar observations have also been noted by Kushwah and Banafar (2003)^[6], Raghav and Chandra (2005)^[9] and Singh and Rai (2007)^[11] and Singh (2018)^[10].

Table 1: Effect of integrated nutrient management on plant height at 45 and 60 DAP

Treatment	Plant height (cm) at 45 DAP				Plant height (cm) at 60 DAP			
	2020-21	2021-22	2022-23	Pooled	2020-21	2021-22	2022-23	Pooled
T ₁ : 100% RDF (220:110:220)	50.86 ^a	49.16	50.30 ^a	50.11 ^{ab}	58.86 ^a	60.16 ^a	59.10	59.37 ^{ab}
T ₂ : 20 t FYM + 100% RDF (220:110:220)	52.00 ^a	51.20	52.36 ^a	51.85 ^a	63.00 ^a	65.10 ^a	64.20	64.10 ^a
T ₃ : 75% RDF + 25% RDN through FYM	48.06 ^{ab}	48.26	48.33 ^{ab}	48.22 ^{ab}	60.06 ^a	64.16 ^a	64.06	62.76 ^{ab}
T ₄ : 75% RDF + 25% RDN through VC	48.80 ^{ab}	49.40	48.90 ^a	49.03 ^{ab}	57.80 ^a	61.20 ^a	61.10	60.03 ^{ab}
T ₅ : 50% RDF + 50% RDN through FYM	45.06 ^{abc}	46.36	46.40 ^{ab}	45.94 ^{ab}	59.06 ^a	60.16 ^a	60.06	59.76 ^{ab}
T ₆ : 50% RDF + 50% RDN through VC	46.00 ^{abc}	45.60	45.63 ^{abc}	45.74 ^{ab}	58.00 ^a	61.00 ^a	55.70	58.23 ^{ab}
T ₇ : 50% RDF + 50% RDN through FYM + 1 L Bio NPK Consortium/ha	46.80 ^{ab}	47.20	47.23 ^{ab}	47.07 ^b	56.80 ^a	58.70 ^a	58.60	58.03 ^b
T ₈ : 50% RDF + 50% RDN through VC + 1 L Bio NPK Consortium/ha	44.00 ^{abc}	45.10	45.13 ^{abc}	44.74 ^{ab}	59.00 ^a	62.30 ^a	62.20	61.16 ^{ab}
T ₉ : 25% RDF + 50% RDN through FYM + 1 L Bio NPK Consortium/ha + KMB 1 L/ha	38.86 ^{bc}	39.56	39.60 ^{bc}	39.34 ^c	42.86 ^b	47.06 ^b	46.96	45.63 ^c
T ₁₀ : 25% RDF + 50% RDN through VC + 1 L Bio NPK Consortium + KMB 1 L/ha	35.93 ^c	36.43	37.43 ^c	36.60 ^c	43.93 ^b	46.43 ^b	46.30	45.55 ^c
S.Em (T)	3.09	1.41	2.72	1.49	3.09	3.09	4.19	1.78
S.Em (Y X T)	-	-	-	2.97	-	-	-	3.50
F Test (T)	Sig.	NS	Sig.	Sig.	Sig.	Sig.	NS	Sig.
F (Y X T)	-	-	-	NS	-	-	-	NS
C V%	11.72	10.11	10.21	11.22	9.56	9.12	12.56	10.53

Note: Treatment means with the letter/letters in common are not significant by Duncan’s New Multiple Range Test at 5% level of significance

Table 2: Effect of integrated nutrient management on haulm yield and number of tuber per plant

Treatment	Haulm yield (kg/ha)				Number of tubers per plant			
	2020-21	2021-22	2022-23	Pooled	2020-21	2021-22	2022-23	Pooled
T ₁ : 100% RDF (220:110:220)	925.9 ^{abcd}	1203.7	1192.3	1107.3	5.86	6.06	6.06	6.00
T ₂ : 20 t FYM + 100% RDF (220:110:220)	1350.3 ^a	1145.8	1192.0	1229.3	6.00	6.80	6.66	6.48
T ₃ : 75% RDF + 25% RDN through FYM	1157.4 ^{ab}	1300.1	1307.6	1255.0	6.06	5.73	5.66	5.82
T ₄ : 75% RDF + 25% RDN through VC	1157.4 ^{ab}	1184.4	1199.6	1180.4	5.80	5.66	5.53	5.66
T ₅ : 50% RDF + 50% RDN through FYM	1041.6 ^{bc}	1192.1	1199.6	1144.4	5.40	5.66	5.66	5.57
T ₆ : 50% RDF + 50% RDN through VC	1080.2 ^{bc}	1145.8	1157.3	1127.8	5.66	5.80	5.80	5.75
T ₇ : 50% RDF + 50% RDN through FYM + 1 L Bio NPK Consortium/ha	1157.4 ^{ab}	1103.3	1130.3	1130.3	5.80	5.86	5.86	5.84
T ₈ : 50% RDF + 50% RDN through VC + 1 L Bio NPK Consortium/ha	1080.2 ^{bc}	1246.1	1246.0	1190.7	5.66	5.73	5.60	5.66
T ₉ : 25% RDF + 50% RDN through FYM + 1 L Bio NPK Consortium/ha + KMB 1 L/ha	848.7 ^{cd}	1327.1	1281.0	1152.3	5.20	5.53	5.53	5.42
T ₁₀ : 25% RDF + 50% RDN through VC + 1 L Bio NPK Consortium + KMB 1 L/ha	733.0 ^d	1250.0	1204.0	1062.3	4.93	5.66	5.66	5.42
S.Em (T)	77.05	98.57	101.70	58.25	0.41	0.48	0.43	0.28
S.Em (Y X T)	-	-	-	93.08	-	-	-	0.44
F Test (T)	Sig.	NS	NS	NS	NS	NS	NS	NS
F (Y X T)	-	-	-	NS	-	-	-	NS
C V%	12.67	14.11	14.55	13.92	12.44	14.25	12.69	13.17

Note: Treatment means with the letter/letters in common are not significant by Duncan’s New Multiple Range Test at 5% level of significance

Table 3: Effect of integrated nutrient management on tuber weight per plant and tuber yield

Treatment	Tuber weight per plant (g)				Tuber yield (q/ha)			
	2020-21	2021-22	2022-23	Pooled	2020-21	2021-22	2022-23	Pooled
T ₁ : 100% RDF (220:110:220)	435.46 ^{ab}	426.86	432.20	431.51 ^{bcd}	332.9 ^{abc}	320.2 ^{bc}	369.9 ^a	341.0 ^d
T ₂ : 20 t FYM + 100% RDF (220:110:220)	488.93 ^a	493.06	479.40	487.13 ^a	423.6 ^a	432.1 ^a	448.6 ^a	434.8 ^a
T ₃ : 75% RDF + 25% RDN through FYM	456.40 ^{ab}	486.06	474.06	472.17 ^{ab}	395.4 ^{ab}	421.3 ^a	424.3 ^a	413.7 ^{ab}
T ₄ : 75% RDF + 25% RDN through VC	462.13 ^a	459.86	466.20	462.73 ^{abc}	384.6 ^{ab}	393.5 ^{ab}	414.3 ^a	397.5 ^{abc}
T ₅ : 50% RDF + 50% RDN through FYM	432.20 ^{ab}	416.66	417.33	422.06 ^{cd}	320.6 ^{bc}	368.8 ^{ab}	380.4 ^a	356.6 ^{cd}
T ₆ : 50% RDF + 50% RDN through VC	439.46 ^{ab}	449.86	439.20	442.84 ^{abc}	321.3 ^{bc}	367.2 ^{ab}	381.9 ^a	356.8 ^{cd}
T ₇ : 50% RDF + 50% RDN through FYM + 1 L Bio NPK Consortium/ha	446.53 ^{ab}	440.53	448.20	445.08 ^{abc}	366.5 ^{ab}	376.1 ^{ab}	371.9 ^a	371.5 ^{bcd}
T ₈ : 50% RDF + 50% RDN through VC + 1 L Bio NPK Consortium/ha	452.33 ^{ab}	473.80	456.13	460.75 ^{abc}	378.8 ^{ab}	365.3 ^{ab}	391.5 ^a	378.6 ^{bcd}
T ₉ : 25% RDF + 50% RDN through FYM + 1 L Bio NPK Consortium/ha + KMB 1 L/ha	346.86 ^c	357.00	357.66	353.84 ^e	262.7 ^c	277.39 ^c	279.3 ^b	273.1 ^e
T ₁₀ : 25% RDF + 50% RDN through VC + 1 L Bio NPK Consortium + KMB 1 L/ha	369.26 ^{bc}	399.333	400.000	389.533 ^{de}	332.9 ^c	320.22 ^c	369.9 ^b	341.0 ^e
S.Em (T)	26.27	33.08	28.55	14.96	26.74	25.56	27.96	15.45
S.Em (Y X T)	-	-	-	29.43	-	-	-	26.77
F Test (T)	Sig.	NS	NS	Sig.	79.44	75.93	83.06	43.82
F (Y X T)	-	-	-	NS	-	-	-	NS
C V%	10.51	13.01	11.32	11.67	13.47	12.38	12.98	12.94

Note: Treatment means with the letter/letters in common are not significant by Duncan’s New Multiple Range Test at 5% level of significance

Conclusion

From the three years of field study, it can be concluded that application of 20 t FYM + 100% RDF (220:110:220) or 75% RDF + 25% RDN through FYM or 75% RDF + 25% RDN through Vermicompost recorded maximum plant height at 45 and 60 DAP, tuber weight per plant and tuber yield in potato cv, Kufri Kyati.

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Conflict of Interest

None.

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