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To study the effect of integrated nutrient management on growth and yield of potato

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Abstract

Field experiment was carried out at the Vegetable Research Farm, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during Rabi season of 2018-19 to study the effect of integrated nutrient management on growth and yield of potato. The experiment was consist of eight treatment viz. control (100% recommended dose off fertilizer), FYM @ 30 t/ha + bio – fertilizer (PSB), Poultry manure @ 5 t/ha + bio – fertilizer (PSB), Vermi – compost @ 7.5 t/ha + bio – fertilizer (PSB), FYM @ 10 t/ha + poultry manure 1.7 t/ha + vermi – compost 2.7 t/ha + bio – fertilizer (PSB), Recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB), Recommended dose of nitrogen (150 kg/ha) in which 33% RDN through inorganic and 67% RDN through FYM + bio – fertilizer (PSB), Farmer practices (through organic). The experiment was laid out in Randomized complete block design with three replication. The T₆ RDN (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio–fertilizer (PSB) were significantly superior over the other treatments for all growth, yield and nutrient uptake of parameters and economics of production. T₆ RDN (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) has resulted in higher plant height (49.14 cm), number of haulm and number of leaves (38.59 and 433.68, respectively), higher uptake of major nutrients viz., nitrogen, phosphorus and potassium (184.64, 34.85 and 185.51 kg ha⁻¹, respectively) in potato tuber. Yield studies characters viz., number of tuber (grade wise) hill⁻¹, Weight of tuber (gm hill⁻¹), and tuber yield (kg plot⁻¹) in 0-25g, 25-50g, 50-75g, and >75g (3.26, 2.24, 2.05, 2.04 and 23.17, 115.66, 138.93 and 184.88 and 2.50, 14.98, 18.99, 13.48) and yield of tuber (386.60 q ha⁻¹) was found T₆ RDN (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB).

Keywords: Integrated, nutrient, RDN, manure.

Introduction

Potato (*Solanum tuberosum* L.) popularly known as “The King of Vegetables” is a native of South America and occupies the largest area under any single vegetable crop in the world. Presently, developing countries of Asia accounts for more than 46% of global output. This spectacular growth in developing countries affirms its increasing importance as a source of food for growing populations, rural employment and income generation. Potato is an important food crop at global as well as the country level. Potato is a rich source of protein, least 12 essential vitamins such as (vitamin C, thiamine and folic acid), minerals and superior dietary fibre etc. It is an excellent source of carbohydrates with low fat contents which makes it a balance food. Due to high protein: calorie ratio (17g protein: 1000 kcal) and short vegetative cycle, potatoes yield substantially more edible energy, protein and dry matter per unit area per unit time (Shekhawat and Naik 1999) [8].

The trend of organic farming is getting momentum because people prefer to consume vegetable free from chemical residues. On the other hand, the ecological concerns regarding residual toxicity due to indiscriminate and excessive use of chemicals by means of fertilizers and pesticides and their harmful effects on soil health as well as on biodiversity indicates an urgent need for a shift to available organic resources as manure along with fertilizers. The organic manures not only supply the nutrients but also improve the physical environment for better plant and tuber growth. The manures are low analysis nutrient carriers yet play a significant role in the fertilizer economy.

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Application of FYM to soil have practiced for many centuries and its application to soil have increase crop yield, improved soil properties, increased soil fertility, increased soil organic matter, increased microbial activities and improved soil structure for sustainable agriculture (Ayyub *et al.*, 2011) [2]. FYM good source of plant nutrient like major nutrient 0.5% nitrogen, 0.2% phosphorus and 0.5% of potash.

Poultry manure used as an organic fertilizer, especially for soil low in nitrogen. Poultry manure contains significant amounts of N, P, K, S and other plant nutrients. Poultry manure rich of major and minor plant nutrient like 3% nitrogen, 2.63% phosphorus and 1.4% potash.

Vermi-compost is a rich mixture of major and minor plant nutrients. On an average Vermi-compost contains 2% nitrogen, 1% phosphorus, 1.5% potash.

Vermin -compost is a rich source of nutrients, vitamins, enzymes, antibiotics, plant growth hormones and a number of beneficial microorganisms. Using of vermin -compost is now a global movement for the second green revolution that emphasizes on composting. The use of vermin -compost has long been considered as an effective means of improving the structure and fertility of the soil (Haj *et al.*, 2011) [4].

Material and Methods

Field experiment was carried out at the Vegetable Research Farm, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U. P.) during Rabi season of 2018-19 to study the effect of integrated nutrient management on growth and yield of potato. The experimental site falls under sub humid subtropical zone in indo-gangetic plains and situated at 26.47° N latitude, 82.12° E longitude and an altitude of 113 meters above mean sea level. The region receives a mean annual rainfall of about 1143 mm, out of which about 90 per cent is received from mid-June to end of September. However, occasional showers are also common during winter.

The experiment was consist of eight treatment viz. control (100% recommended dose off ertilizer), FYM @ 30 t/ha + bio – fertilizer (PSB), Poultry manure @ 5 t/ha + bio – fertilizer (PSB), Vermi – compost @ 7.5 t/ha + bio – fertilizer (PSB), FYM @ 10 t/ha + poultry manure 1.7 t/ha + vermi – compost 2.7 t/ha + bio – fertilizer (PSB), Recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB), Recommended dose of nitrogen (150 kg/ha) in which 33% RDN through inorganic and 67% RDN through FYM + bio – fertilizer (PSB), Farmer practices (through organic). The experiment was laid out in Randomized complete block design with three replication.

1. Growth analysis

Emergence per cent and plant population

With an object to see the effect of different treatments on emergence the observation was recorded after 30 days planting, when the emergence was completed.

Plant height (cm)

The height of the main stem from the ground level to the apical bud (leaf apex) was measured with the meter scale at 30, 60 and 90 days after planting.

2. Yield studies

Number of 0-25g, 25-50g, 50-75g & >75g tuber (grade wise) hill⁻¹

The plants selected for number of haulm hill⁻¹ were also used for this purpose each grade of tubers were separated and counted the number of tubers hill⁻¹.

Weight of 0-25g, 25-50g, 50-75g & >75g tubers grade (g hill⁻¹)

The same tuber grades for number of tubers g hill⁻¹ was used for this purpose. Average weight of each grade of tubers was calculated on the basis of tubers weighted of five hills.

Weight of 0-25g, 25-50g, 50-75g & >75g tubers grades (kg plot⁻¹)

Each plot was harvested separated and tuber weight of 0-25g, 25-50g, 50-75g & >75g grade recorded in kg plot⁻¹.

Tuber yield (q ha⁻¹)

After harvesting, the yield of total tubers plot⁻¹ were recorded in kilograms separately and converted into q ha⁻¹.

Result and Discussion

1. Growth studies

Growth was measured in terms of emergence percentage, plant height (cm), number haulms m⁻¹, Fresh weight of haulm gm⁻¹ and dry weight of haulm gm⁻¹.

Emergence percentage

Maximum emergence percent (94.40 %) was recorded under T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) which was closely followed by T₃ Poultry manure @ 5 t/ha + bio – fertilizer (PSB) (93.90) and minimum (91.30 %) under T₂ FYM @ 30 t/ha + bio – fertilizer (PSB).

Plant height (cm)

The plant height at 30 DAP was observed to be in the range of 18.55 – 24.00 cm. It was observed highest (24.00 cm) in T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) followed by T₇ recommended dose of nitrogen (150 kg/ha) 67% RDN through FYM and 33% RDN through inorganic + bio – fertilizer (PSB) (22.30 cm) and lowest plant height at 30 DAP was observed in T₁ control (18.55 cm). At 60 and 90 DAP, among the treatments significantly higher plant height was observed in T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) (47.09 cm and 49.14 cm, respectively). Similar trends were observed by Anchal, *et al.* (2008) [1] in tomato.

Number of haulms m⁻¹

Number of haulms at 30 DAP as influenced by integrated nutrient management show significant difference. However, T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) is recorded the highest number of haulms (8.01) followed by T₇ recommended dose of nitrogen (150 kg/ha) 67% RDN through FYM and 33% RDN through inorganic + bio – fertilizer (PSB) (7.75 cm). The highest numbers of haulms m⁻¹ was observed in T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) (36.37 and 38.59 at 60 and 90 DAP, respectively). Naidu *et al.* (1999) [6] also indicated the same trend in okra.

Fresh weight and dry weight

In both the cases the plant treated with, T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) recorded highest values for fresh weight and dry weight of haulms i.e., 383.79 and 38.45. The result confirms the finding of Khurana *et al.* (2003) [5]. Reported that dry weight of shoots plant⁻¹ with the application of FYM @ 10 t ha⁻¹ +100% RDF Raghav *et al.* (2008) [7].

2. Yield studies

Number of tubers (grade wise) hill⁻¹

Maximum number of tuber (grade wise) hill⁻¹ in 0-25g, 25-50g, 50-75g and >75g (3.26, 2.24, 2.05 and 2.04) was recorded under T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) which was followed by T₇ recommended dose of nitrogen (150 kg/ha) 67% RDN through FYM and 33% RDN through inorganic + bio – fertilizer (PSB) (3.20, 2.17, 2.01 and 1.98) The highest grade wise number of tuber plot⁻¹ was found in (10 t FYM ha⁻¹ with 100% RDF NPK) reported by Raghav *et al.* (2008) [7].

Weight of tubers (gm hill⁻¹)

Maximum weight of tuber (gm hill⁻¹) in 0-25g, 25-50g, 50-75g and >75g was recorded under T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) 23.17, 115.66, 138.93 and 184.88.

Tuber yield (Kg plot⁻¹)

Tuber yield kg plot⁻¹ in 0-25g, 25-50g, 50-75g and >75g was significantly affected due to different treatments tested during course of investigation. Scanning of data reveals that under T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB) recorded significantly higher (2.50, 14.98, 18.99 and 13.48) tuber yield (kg plot⁻¹).

Yield of tuber (q ha⁻¹)

The highest tuber yield per hectare (386.60 q ha⁻¹) was recorded with T₆ recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB). The lowest total tuber yield per hectare was recorded with T₁ (150 q ha⁻¹). Barman *et al.* (2018) [3] observed that possibility of improving, growth and tuber yield of potato by the use of integrated nutrient management.

Table 1: Emergence percentage of potato and plant height as influenced by integrated nutrient management practices

Treatments	Emergence 30 DAP	Plant height (cm)		
		30 DAP	60 DAP	90 DAP
T ₁ : Control	92.34	18.55	41.20	44.26
T ₂ : FYM @ 30 t/ha + bio – fertilizer (PSB)	91.30	20.87	42.78	45.07
T ₃ : Poultry manure @ 5 t/ha + bio – fertilizer (PSB)	93.90	21.59	43.11	45.60
T ₄ : Vermi – compost @ 7.5 t/ha + bio – fertilizer (PSB)	92.86	21.90	43.58	45.59
T ₅ : FYM @ 10 t/ha + poultry manure 1.7 t/ha + vermi – compost 2.7 t/ha + bio – fertilizer (PSB)	93.38	22.20	44.54	45.78
T ₆ : Recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB)	94.40	24.00	47.09	49.14
T ₇ : Recommended dose of nitrogen (150 kg/ha) 33% RDN through inorganic and 67% RDN through FYM + bio – fertilizer (PSB)	91.30	22.30	44.95	47.06
T ₈ : Farmer practices (through organic)	91.82	22.19	44.92	46.93
SEm±	0.71	0.93	0.88	0.49
CD 5%	NS	NS	1.88	1.47

Table 2: Number of haulm as influenced by integrated nutrient management practices in potato

Treatments	Number of haulm m ⁻¹		
	30 DAP	60 DAP	90 DAP
T ₁ : Control	7.60	33.29	34.08
T ₂ : FYM @ 30 t/ha + bio – fertilizer (PSB)	7.62	33.91	34.30
T ₃ : Poultry manure @ 5 t/ha + bio – fertilizer (PSB)	7.63	33.94	34.35
T ₄ : Vermi – compost @ 7.5 t/ha + bio – fertilizer (PSB)	7.67	33.98	34.39
T ₅ : FYM @ 10 t/ha + poultry manure 1.7 t/ha + vermi – compost 2.7 t/ha + bio – fertilizer (PSB)	7.69	34.89	35.30
T ₆ : Recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB)	8.01	36.37	38.59
T ₇ : Recommended dose of nitrogen (150 kg/ha) 33% RDN through inorganic and 67% nitrogen through FYM + bio – fertilizer (PSB)	7.78	34.84	36.69
T ₈ : Farmer practices (through organic)	7.75	34.54	36.62
SEm±	0.08	0.48	0.60
CD 5%	0.25	1.45	1.81

Table 3: Fresh weight of haulm and dry weight of haulm at successive stage of crop growth as influenced by integrated nutrient management in potato

Treatments	Fresh weight of haulm gm ⁻¹	Dry weight of haulm gm ⁻¹
T ₁ : Control	356.47	34.08
T ₂ : FYM @ 30 t/ha + bio – fertilizer (PSB)	359.40	34.30
T ₃ : Poultry manure @ 5 t/ha + bio – fertilizer (PSB)	361.30	34.35
T ₄ : Vermi – compost @ 7.5 t/ha + bio – fertilizer (PSB)	362.25	34.39
T ₅ : FYM @ 10 t/ha + poultry manure 1.7 t/ha + vermi – compost 2.7 t/ha + bio – fertilizer (PSB)	366.61	35.31
T ₆ : Recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB)	383.79	38.45
T ₇ : Recommended dose of nitrogen (150 kg/ha) 33% RDN through inorganic and 67% RDN through FYM + bio – fertilizer (PSB)	371.75	36.22
T ₈ : Farmer practices (through organic)	371.41	36.21
SEm±	3.83	0.52
CD 5%	11.60	1.57

Table 4: Number of tuber at harvest as influenced by integrated nutrient management practices in potato

Treatments	Number of tuber (grade wise) hill ⁻¹			
	0-25g	25-50g	50-75g	>75g
T ₁ : Control	3.04	2.09	1.90	1.89
T ₂ : FYM @ 30 t/ha + bio – fertilizer (PSB)	3.10	2.11	1.95	1.92
T ₃ : Poultry manure @ 5 t/ha + bio – fertilizer (PSB)	3.11	2.12	1.96	1.96
T ₄ : Vermi – compost @ 7.5 t/ha + bio – fertilizer (PSB)	3.11	2.12	1.97	1.96
T ₅ : FYM @ 10 t/ha + poultry manure 1.7 t/ha + vermi– compost 2.7 t/ha + bio – fertilizer (PSB)	3.11	2.15	1.98	1.97
T ₆ : Recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB)	3.26	2.24	2.05	2.04
T ₇ : Recommended dose of nitrogen (150 kg/ha) 33% RDN through inorganic and 67% RDN through FYM + bio – fertilizer (PSB)	3.20	2.17	2.01	1.98
T ₈ : Farmer practices (through organic)	3.12	2.16	1.99	1.98
SEm±	0.01	0.01	0.01	0.01
CD 5%	0.04	0.04	0.03	0.03

Table 5: Weight of tubers at harvest as influenced by integrated nutrient management practices in potato

Treatments	Weight of tubers grade (g hill ⁻¹)			
	0-25g	25-50g	50-75g	>75g
T ₁ : Control	9.35	46.77	56.19	76.80
T ₂ : FYM @ 30 t/ha + bio – fertilizer (PSB)	15.75	78.74	94.52	125.90
T ₃ : Poultry manure @ 5 t/ha + bio – fertilizer (PSB)	16.37	81.81	98.28	130.81
T ₄ : Vermi – compost @ 7.5 t/ha + bio – fertilizer (PSB)	17.55	87.76	105.42	140.32
T ₅ : FYM @ 10 t/ha + poultry manure 1.7 t/ha + vermi– compost 2.7 t/ha + bio – fertilizer (PSB)	17.92	89.58	107.58	143.26
T ₆ : Recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB)	23.17	115.66	138.93	184.88
T ₇ : Recommended dose of nitrogen (150 kg/ha) 33% RDN through inorganic and 67% RDN through FYM + bio – fertilizer (PSB)	19.47	97.35	116.92	155.62
T ₈ : Farmer practices (through organic)	18.49	92.45	111.06	147.83
SEm±	0.53	2.68	3.22	4.57
CD 5%	1.60	8.12	9.76	13.85

Table 6: Weight of potato tuber grade (kg plot⁻¹) and tuber yield (q ha⁻¹) as influenced by integrated nutrient management practices

Treatments	Wt. tuber grade kg plot ⁻¹				Tuber yield (q ha ⁻¹)
	0-25g	25-50g	50-75g	>75g	
T ₁ : Control	1.16	6.07	7.34	5.63	150.00
T ₂ : FYM @ 30 t/ha + bio – fertilizer (PSB)	1.78	10.22	12.93	8.98	262.53
T ₃ : Poultry manure @ 5 t/ha + bio – fertilizer (PSB)	1.86	10.93	13.80	9.75	280.50
T ₄ : Vermi – compost @ 7.5 t/ha + bio – fertilizer (PSB)	1.99	11.36	14.36	10.17	292.60
T ₅ : FYM @ 10 t/ha + poultry manure 1.7 t/ha + vermi– compost 2.7 t/ha + bio – fertilizer (PSB)	2.02	11.64	14.71	10.43	298.66
T ₆ : Recommended dose of nitrogen (150 kg/ha) 67% RDN through inorganic and 33% RDN through FYM + bio – fertilizer (PSB)	2.50	14.98	18.99	13.48	386.60
T ₇ : Recommended dose of nitrogen (150 kg/ha) 33% RDN through inorganic and 67% RDN through FYM + bio – fertilizer (PSB)	2.16	12.68	16.03	11.29	324.53
T ₈ : Farmer practices (through organic)	2.05	12.00	15.18	11.70	308.26
SEm±	0.07	0.31	0.37	0.29	2.70
CD 5 %	0.22	0.93	1.11	0.86	8.20

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