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Effect of integrated nutrient management on marketable and non-marketable tuber yield of Potato (*Solanum tuberosum* L.)

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Abstract
The present investigation entitled "Effect of integrated nutrient management on Marketable and Non-marketable tuber yield of potato (*Solanum tuberosum* L.) " was carried out in Horticulture Research cum Instructional Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Sarkanda, Bilaspur (C.G.), during Rabi season of Nov 2018 to Mar 2019, The field experiment was laid out in randomized block design with 3 replications and 12 different treatment combinations viz. T1 (125% RDF (187:125:125 kg ha^{-1} NPK), T2 (100% RDF (150:100:100 kg ha^{-1} NPK), T3 (75% RDF + FYM @ 7.5 t ha^{-1} (25% N by FYM), T4 (50% RDF + FYM @ 15 t ha^{-1} (50% N by FYM), T5 (75% RDF + Vermicompost @ 3.75 t ha^{-1} (25% N by Vermicompost), T6 (50% RDF + Vermicompost @ 7.5 t ha^{-1} (50% N by Vermicompost), T7 (Tuber treatment with Trichoderma @ 20 g /k + soil incorporation of Trichoderma enriched FYM @ 15 t ha^{-1} SOIL, T8 (Tuber treatment with Pseudomonas @ 20 g /k + soil incorporation of Pseudomonas enriched FYM @ 15 t ha^{-1} soil, T9 (Tuber treatment with Pseudomonas followed by Trichoderma @ 20 g /k + soil incorporation of consortia of Pseudomonas & Trichoderma enriched FYM @ 15 t ha^{-1} soil, T10 (Tuber treatment with consortia of Azotobacter & PSB @20 g /k + soil incorporation of consortia of Azotobacter & PSB enriched FYM @ 15 t ha^{-1} soil, T11 (50% RDF only FYM @ 15 t ha^{-1} (50% N by FYM) and T12 (Local control), T6 (50% RDF + Vermicompost @ 7.5 t ha^{-1} (50% N by Vermicompost). Integrated use of synthetic fertilizers and organic manures showed the significant impact on growth and yield attributes of potato. It was observed that highest marketable tuber yield in the plots treated with T6- (50% RDF + Vermicompost @ 7.5 t ha^{-1} (50% N by Vermicompost) (25.99 t ha^{-1}) at the time of harvesting, respectively followed by T1 (125% RDF (187:125:125 kg ha^{-1} NPK) (25.19 t ha^{-1}) at the time of harvesting, respectively., It is evident from the data that the yield parameter of potato in terms of marketable and non-marketable tuber yield varied significantly due to integrated nutrient management, chemical fertilizers and organic manure, during at the time of harvesting given the table 1.

Keywords: azotobacter, ferttilizer, vermicompost, yield

Introduction

Potato (*Solanum tuberosum* L.) is one of the most important basic vegetable and staple food-crop of the world as well as Indian continents which belong to family solanaceae. Potato is world's fourth important food crop after wheat, rice and maize (Rana, M.K. 2008) [1]. More than a billion people worldwide eat potato, the potato is the third most important food crop in the world after rice and wheat in terms of human consumption, it is originated from Andes of Peru in South America.

It is introduced in India in early 17th centuries either by Portuguese or the Britishers which is grown throughout the country commercially from sea level to temperate region (upto 4000 MSL). Potato is one of the value added and exportable items.

The widely grown potato is an autotetraploid with 2n=48. The potato is unique and different from other crops in that sense the food material is stored in underground stem parts called tubers. Potato provides a source of low cost energy to the human diet and it is the rich source of starch, vitamin C and B and minerals (Kumar *et al*., 2013; Lokendrajit *et al*., 2013) [2]. It is a heavy feeder of plant nutrients having very high requirement of nitrogen, phosphorus, potassium and other nutrients. Potato is known as protective food because potato protein is rich in lysine which is one of the most important amino acid. The potato is a highly nutritious, easily digestible, wholesome food which contains 77.20 % water and the rest is dry matter. Average dry matter composition is 16.30% starch, 0.9% sugar (0.6 total sugar and 0.3 reducing sugar), 4.40% protein (2.8% crude and 1.60% true protein), 0.9% minerals, 0.59% fiber, 0.14% crude fat and considerable amount of vitamin A and C (Bose, 1993) [4].

Potato is high yielding and more nutrient required crop. The growth, development and yield of potato are mainly governed by nutrient availability through major nutrients. Nitrogen, phosphorus and potassium are major nutrients required for cultivation of potato. Nitrogen is a constituent of protoplasm and it is helpful for chlorophyll synthesis. Phosphorus increases the growth of shoots, roots and tuber formation in potato. Whereas, potassium help to provide resistance against diseases and pests. There are many sources of nitrogen, phosphorus and potassium through organic fertilizers.

Material and Methods

A field experiment was conducted at the Horticulture Research cum Instructional Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Sarkanda, Bilaspur (C.G.), during Rabi season of 2018, to study "Effect of integrated nutrient management on Marketable and Non-marketable tuber yield of potato (*Solanum tuberosum* L.)" The details of the materials used and methods adopted during the course of investigation are described in this chapter.

The experiment consisted of the following treatments involving organics viz., Farmyard manure, vermicompost and biofertilizers (applied before planting) in different percentage to substitute the recommended dose of fertilizer on nitrogen basis. The recommended fertilizer dose for potato is 150:100:100 kg NPK ha^{-1}. Observations were recorded on marketable and Non-marketable tuber yield (t ha^{-1}). Marketable and Non-marketable tuber yield tubers like rotted, insect and intercultural operational damaged and greening due to exposure in sun light etc. were firstly separated, counted and respective tubers were also weighed and finally converted on hectare basis by using constant factor with (net plot yield x 10000m2 /3.96 m2 area of net plot).

Results and Discussion

The data on marketable and non-marketable tuber yield (t ha^{-1}) as influenced by integrated nutrient management practices are presented in Table-1 and Fig. 1

A grade tuber yield (t ha^{-1})

The data on a grade tuber yield per plot showed significant difference among the treatments. The data on the A grade tuber yield per plot as influenced by effect of integrated nutrient management is significant. However, T6 (50% RDF + Vermicompost @ 7.5 t ha^{-1} (50% N by Vermicompost) recorded the highest A grade tuber yield per plot (4.88 kg) followed by T1 - 125% RDF (187:125:125 kg ha-1 NPK) (4.73 kg). And the lowest A grade tuber yield per plot was observed in T12 (local control) (2.10 kg), followed by T9- (Tuber treatment with Pseudomonas followed by Trichoderma @ 20 g /k + soil incorporation of consortia of Pseudomonas & Trichoderma enriched FYM @ 15 t ha^{-1} soil) (2.33 kg).

B grade tuber yield (t ha^{-1})

The data on B grade tuber yield per plot showed significant difference among the treatments. The data on the A grade tuber yield per plot as influenced by effect of integrated nutrient management is significant. However, T6 (50% RDF + Vermicompost @ 7.5 t ha^{-1} (50% N by Vermicompost) recorded the highest B grade tuber yield per plot (3.79 kg) followed by T1 - 125% RDF (187:125:125 kg ha^{-1} NPK) (3.68 kg). And the lowest B grade tuber yield per plot was observed in T12 (local control) (1.63 kg), followed by T9- (Tuber treatment with Pseudomonas followed by Trichoderma @ 20 g /k + soil incorporation of consortia of Pseudomonas & Trichoderma enriched FYM @ 15 t ha^{-1} soil) (1.81 kg).

C grade tuber yield (t ha^{-1})

The data on C grade tuber yield per plot showed significant difference among the treatments. The data on the A grade tuber yield per plot as influenced by effect of integrated nutrient management is significant. However, T6 (50% RDF + Vermicompost @ 7.5 t ha^{-1} (50% N by Vermicompost) recorded the highest C grade tuber yield per plot (1.63 kg) followed by T1 - 125% RDF (187:125:125 kg ha^{-1} NPK) (1.58 kg). And the lowest C grade tuber yield per plot was observed in T12 (local control) (0.70 kg), followed by T9- (Tuber treatment with Pseudomonas followed by Trichoderma @ 20 g /k + soil incorporation of consortia of Pseudomonas & Trichoderma enriched FYM @ 15 t ha^{-1} soil) (0.78 kg).

Total marketable tuber yield (t ha^{-1})

The data on total marketable tuber yield (t/ha) showed significant difference among the treatments. The data on total marketable tuber yield (t/ha) as influenced by effect of integrated nutrient management is significant. However, T6 (50% RDF + Vermicompost @ 7.5 t ha^{-1} (50% N by Vermicompost) recorded the highest total marketable tuber yield (t/ha) (25.99 t/ha) followed by T1 - 125% RDF (187:125:125 kg ha^{-1} NPK) (25.19 t/ha). And the lowest total marketable tuber yield (t/ha) was observed in T12 (local control) (11.20 t/ha), followed by T9- (Tuber treatment with Pseudomonas followed by Trichoderma @ 20 g /k + soil incorporation of consortia of Pseudomonas & Trichoderma enriched FYM @ 15 t ha^{-1} soil) (12.40 t/ha).

Table 1: Effect of integrated nutrient management on Marketable and Non-marketable tuber yield (t/ha^{-1})

Trt. No.	Treatment Details	Marketable tuber yield (t/ha^{-1})				NM yield (t/ha^{-1})	Total tuber yield (t/ha)
		A Grade (>75 g)	B Grade (51-75 g)	C Grade (20-50 g)	Total Marketable yield (A+B+C)	(<25 g)	
T_1	125% RDF (187:125:125 kg ha^{-1} NPK)	11.93	9.28	3.98	25.19	1.33	26.52
T_2	100% RDF (150:100:100 kg ha^{-1} NPK)	9.85	7.66	3.28	20.79	1.09	21.89
T_3	75% RDF + FYM @ 7.5 t ha^{-1}(25% N by FYM)	9.66	7.51	3.22	20.39	1.07	21.46
T_4	50% RDF + FYM @ 15 t ha^{-1}(50% N by FYM)	10.45	8.13	3.48	22.07	1.16	23.23
T_5	75% RDF + Vermicompost @ 3.75 t $ha-^{1}$ (25% N by Vermicompost)	10.00	7.78	3.33	21.11	1.11	22.22
T_6	50% RDF + Vermicompost @ 7.5 t ha^{-1} (50% N by Vermicompost)	12.31	9.57	4.10	25.99	1.37	27.36
T_7	Tuber treatment with Trichoderma @ 20 g /k + soil incorporation of Trichoderma enriched FYM @ 15 t ha^{-1} soil	8.52	6.63	2.84	17.99	0.95	18.94
T_8	Tuber treatment with Pseudomonas @ 20 g /k + soil incorporation of Pseudomonas enriched FYM @ 15 t ha^{-1} soil	7.31	5.69	2.44	15.43	0.81	16.25
T_9	Tuber treatment with Pseudomonas followed by Trichoderma @ 20 g /k + soil incorporation of consortia of Pseudomonas & Trichoderma enriched FYM @ 15 t ha^{-1} soil	5.87	4.57	1.96	12.39	0.65	13.05
T_{10}	Tuber treatment with consortia of Azotobacter & PSB @20 g /k + soil incorporation of consortia of Azotobacter & PSB enriched FYM @ 15 t ha^{-1} soil	10.98	8.54	3.66	23.19	1.22	24.41
T_{11}	50% RDF only FYM @ 15 t ha^{-1} (50% N by FYM)	6.63	5.16	2.21	13.99	0.74	14.73

T_{12}	Local control	5.30	4.12	1.77	11.20	0.59	11.78
	Sem (±)	1.05	0.82	0.36		0.18	
	CD (5%) =	3.08	2.40	1.03		0.34	
	CV (%) =	20.06	20.60	20.60		20.60	

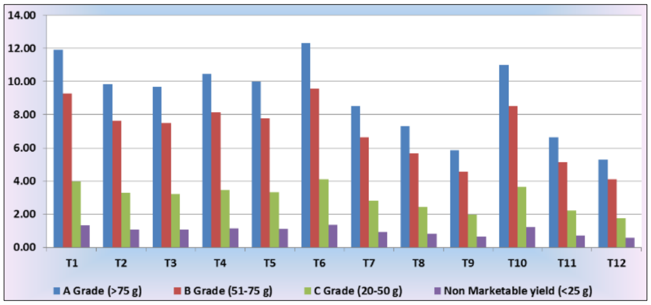

Fig 1: Effect of integrated nutrient management on Marketable and Non-marketable tuber yield per plot (kg)

Conclusion

Highest marketable tuber yield in the plots treated with T6- (50% RDF + Vermicompost @ 7.5 t ha-1 (50% N by Vermicompost) (25.99 t ha-1) at the time of harvesting, respectively followed by T1 (125% RDF (187:125:125 kg ha-1 NPK) (25.19 t ha-1) at the time of harvesting, respectively., It is evident from the data that the yield parameter of potato in terms of marketable and non-marketable tuber yield varied significantly due to integrated nutrient management, chemical fertilizers and organic manure, during at the time of harvesting.

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