Original Research Article

Effect of organic manures on yield, quality trait and economics of potato (*Solanum tuberosum* L.) under Indo Gangetic plain of Eastern Uttar Pradesh

Abstract

A field experiment was conducted during 2018-19 at Main Experiment Station Vegetable Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) with a view to find out the effect of different combination of organic manures on yield, tuber quality and net income of potato. The 7 treatment combinations consisted of T_1: Absolute Control, T_2: FYM 30t ha^{-1} + PSB, T_3: Poultry manure 5t ha^{-1} + PSB, T_4: Vermicompost 7.5t ha^{-1} + PSB, T_5: FYM 10t ha^{-1} + Poultry manure 1.7 t ha^{-1} + Vermicompost 2.5 t ha^{-1}, T_6: 67% N through Urea and 33% N through FYM + PSB, T_7: Farmer practices FYM 15t ha^{-1} + Vermicompost 1t ha^{-1} + PSB were tested in randomized block design with 3 replication on the basis of experiment result it was revealed that treatment T_6 shows better tuber yield (38.41 t ha^{-1}), tuber yield grade wise i.e. 0-25g (1.93 t ha^{-1}), 25-50g (11.52 t ha^{-1}), 50-75g (14.58 t ha^{-1}) and >75g (10.37 t ha^{-1}) respectively, grade size of tuber per hill 0-25 (0.300 kg), 25-50 (0.800 kg), 50-75 (1.2 kg) and > 75 (1.2 kg), dry matter (17.63%), protein content of tuber (3.0 %) and protein yield (1152.30 kg ha^{-1}). Higher values of economics *viz*., gross return (307280 ₹ ha^{-1}), net return (218331 ₹ ha^{-1}) and B:C

ratio (2.45) in potato were observed with the application of 67% N through Urea and 33% N through FYM + PSB except cost of cultivation.

Key Words: Potato, Poultry Manure, Protein, Tuber and Vermicompost.

Introduction

Potato (*Solanum tuberosum* L.) is an herbaceous annual plant and belongs to the family solanaceae. It is popularly known as ‘‘The King of Vegetable”. The edible part of the potato is modified underground. It originated in South America and brought to India in the 16th century by the Portuguese and occupies the largest area under any single vegetable crop in the world. It is called “poor man friend”. For vegetable purposes it is one of the most popular crops in the country. **(Ferdoushi *et al.*, 2010)**

India is the second largest producer of potato of world production (contributing 11%) after China with the production of 50.38 million tonnes from an area of 1.843 mha. The total area under potato cultivation is 19.30 mha and total production is 398.19 million tonnes with 20.50 tonnes productivity. Whereas in India, total area is 1.843 mha and production is 50.33 million tonnes with 27.31 tonnes ha^{-1} productivity. The contribution of U.P, alone in area, production and productivity is 0.614 million ha, 15.56 million tonnes 22.7 tonnes ha^{-1}**(Anonymous, 2020)** respectively. Potatoes are one of the most efficient food crops, which produce more dry matter, dietary fiber, quality protein, mineral & vitamin than wheat, maize & rice per unit area. Potatoes contain approximately 20.6% carbohydrate, 2.1% protein, 0.3% fat, 1.1% crude fiber and 0.9% ash, and contain a good amount of essential amino acids like leucine, tryptophan and isoleucine etc. **(Paul Khurana and Naik, 2003).**

Continuous Use of chemical fertilizers had increased the crop yield, but caused many environmental problems including soil, air and water pollution and finally human health hazards and making the crop productivity unsustainable **(Eid *et al.*, 2006).** Use of organic manure reduces the ill effect of chemical farming. Their use enriches soil organic carbon, supplies all required plant nutrients and improves physical, chemical and biological properties of soil. **Sarkar *et al.*, (2011).**

Organic manures (FYM, vermicompost, poultry manure and biofertilizer) is the source of primary, secondary and micronutrient to the plant growth and constant source of energy for heterotrophic microorganism, which help in increasing availability of nutrient, quality and quantity of crop produce **(Roy and Singh, 2014).** As a single source capable of supplying the required amount of plant nutrients, integrated use of all sources of plant nutrient is a must to supply balanced nutrition to the crop **(Banerjee *et al.*, 2016).**

Material and Methods

Soil of the Experimental Field

The experimental field is silt loam in texture, alkaline in reaction (pH 8.10), low in organic carbon (0.30%), low in available N (140 kg ha^{-1}), medium in available P (15.3 kg ha^{-1}), and high in available K (240 kg ha^{-1}).

Land preparation:

Land preparation was started after harvesting of the Kharif crop. One ploughing was done by disc plough followed by two ploughing by tractor drawn cultivator and planking was done invariably after each ploughing to get the fine seed bed. The clods were broken and planked to level the field properly so as to facilitate the layout and sowing operation. Layout was carefully done as per technical programme of the experiment.

Layout and Design of the Experiment:

The experiment was laid out in randomized block design with three replications. The total numbers of unit plots were 21. The size of a unit plot was 4.8 m X 4.0 m. The width of the main irrigation channel is 1.5 m and the width of the sub-irrigation channel is 1.0 m.

Treatments of the Investigation:

The experiment consisted of organic manure viz. farmyard manure, poultry manure, and vermicompost alone and with combination of biofertilizer (phosphorus solubilizing bacteria) were applied to potato as per the treatments details. The treatments used for the experiment were as follows: T_1: Absolute Control, T_2: FYM 30t ha^{-1} + PSB, T_3: Poultry manure 5t ha^{-1} + PSB, T_4: Vermicompost 7.5t ha^{-1} + PSB, T_5: FYM 10 t ha^{-1} + Poultry manure 1.7 t ha^{-1} + Vermicompost 2.5 t ha^{-1}, T_6: 67% N through Urea and 33% N through FYM + PSB, T_7: Farmer practices FYM 15 t ha^{-1} + Vermicompost 1 t ha^{-1} + PSB.

Preparation of Seed materials:

Potato tubers were taken out from cold storage and kept in the shed for 7 days before planting to accelerate the sprouting. The seeds were treated with bio-fertilizer (PSB) to use in respective treatments for sowing (seeds are inoculated with PSB through jiggery). This solution was poured on sprouted tubers kept on a polythene sheet. These treated tubers were mixed thoroughly by hand and dried in shade before planting.

Planting of seed Tubers:

The seed tubers were planted on 16 November 2018 in rows in furrows made with the help of the country plough. The unit plot size was 4.8 m X 4.0 m and the seed tubers were planted in furrows at a distance of 60 cm from row to row and 20 cm from tuber to tuber. The depth of the planting was approximately 7 cm. Immediate after planting the seed tubers were covered with soil.

Intercultural Operations:

Earthing and weeding operations were done at 30 and 35 DAP (Days after planting), using spade manually so that the furrow turns into ridges. The first irrigation was given at 2-3 DAP and then the irrigations were given at an interval of 8-10 days. All 4-5 irrigations were given to the crop during the crop growth period. Cutting of whole plants (aerial vegetative part of potato plant) from ground level of the tubers. Haulm cutting was done manually prior to 10-15 days before harvesting of potato tubers.

Protein content in tuber

The total nitrogen of the samples was determined by the Kjeldahl apparatus as described by Jackson (1973). Then the percentage of protein in tuber was calculated by multiplying the factor 6.25. The protein yield (kg ha^{-1}) was obtained by the following formula:

Protein yield (kg ha^{-1}) = Protein content (%) x Yield (kg ha^{-1}) / 100

Result and Discussion

Yield

Among the different treatments combination data revealed that maximum tuber yield (38.41 t ha^{-1}), yield of tuber in each grade is 0-25g (1.93 t ha^{-1}), 25-50g (11.52 t ha^{-1}), 50-75g (14.58 t ha^{-1}) and >75g (10.37 t ha^{-1}) and weight of each grade per hill is 0-25 (0.300 kg), 25-50 (0.800 kg), 50-75 (1.2 kg) and >75 (1.2 kg) recorded in treatment T_6[67% N through Urea and 33% N through FYM + PSB]. Similar finding were reported by **Jaipaul *et al.,* (2011), Ahmed *et al.,* (2019) and Choudhary *et al.,* (2010)**

Table-1: Effect of different combinations of organic manure on tuber yield (t ha^{-1}), tuber yield (t ha^{-1}) grade wise, weight of each grade tuber/hill.

Treatments	Tuber yield (t ha^{-1})	Tuber yield grade wise (t ha^{-1})				Weight (kg) of tuber grade /hill			
		0-25	25-50	50-75	>75	0-25	25-50	50-75	>75
T_1	10.25	0.93	3.95	4.38	3.95	0.240	0.300	0.320	0.640
T_2	27.80	1.43	8.35	10.55	7.47	0.170	0.630	0.700	0.900
T_3	29.62	1.50	8.87	11.26	7.99	0.200	0.735	0.900	0.865

T_4	29.01	1.45	8.70	11.05	7.81	0.200	0.730	0.900	0.848
T_5	30.58	1.54	9.18	10.98	8.87	0.250	0.700	1.100	0.950
T_6	38.41	1.93	11.52	14.58	10.37	0.300	0.800	1.200	1.200
T_7	26.28	1.52	9.07	9.53	3.56	0.250	0.700	0.800	0.450
SEm±	1.32	0.07	0.40	0.51	0.35	0.0025	0.0031	0.0138	0.0096
C.D. at 5%	2.90	0.15	0.88	1.12	0.77	0.0078	0.0095	0.0423	0.0294

Quality Traits:

Dry matter, Protein content in tuber (%) and Protein Yield (kg ha^{-1}):

Maximum dry matter (17.63%), protein content (3.0 %) and protein yield (1152.30 kg ha^{-1}) were found in the treatment T_6[67% N through Urea and 33% N through FYM + PSB] while minimum content of dry matter (17.37%) and protein content (2.68 %) were recorded in the treatment T_1[Absolute Control]. These result are accordance with the finding of **Kumar *et al.*, (2011) and Islam and Nahar (2012).**

Table-2: Effect of different treatments on dry matter, protein content in tuber (%) and protein yield (kg ha^{-1})

Treatments	Dry matter (%)	Protein Content (%)	Protein Yield (kg ha^{-1})
T_1	17.37	2.68	274.70
T_2	17.53	2.81	781.18
T_3	17.53	2.87	850.09
T_4	17.53	2.81	815.18
T_5	17.57	2.87	877..64
T_6	17.63	3.0	1152.30
T_7	17.46	2.76	725.32
SEm±	0.05	0.01	0.03
C.D. at 5%	0.11	0.02	0.07

Economics

The higher gross return (₹ 307280), net return (₹ 218331) were obtained with treatment T_6 [67% N through Urea and 33% N through FYM + PSB] while B:C ratio 2.47 under treatment T_3 [Poultry manure 5 t ha^{-1} + PSB]. The application of organic manures with inorganic

nitrogen fertilizer provide higher gross return, net return as compared to application of organic manures alone. Similar findings were reported by **Verma *et al.*, (2011), Raghav *et al.*, (2008) and Lal and Khurana (2007)**

Table-3: Effect of different treatments combination of organic manure on economics of potato.

Treatments	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
T_1	80398	102500	22102	0.27
T_2	99398	278000	178602	1.79
T_3	85148	296200	211052	2.47
T_4	118898	290100	171202	1.43
T_5	101173	305800	204627	2.02
T_6	88949	307280	218331	2.45
T_7	95398	262800	167402	1.75

Conclusion

On the basis of the result it may be concluded that integrated nutrient management (67% N through Urea and 33% N through FYM + PSB) was found to have better treatment on yield, quality and economics. So farmers should be suggested for better yield, quality and profit in potato cultivation by using balanced use of organic manure along with inorganic fertilizers so that soil health can also be sustained by balanced fertilization.

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