Effect of biodynamic package with vermicompost on growth, yield, quality and economics of potato under Malwa conditions of Madhya Pradesh

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 Received: 10.10.2012/Accepted: 15.11.2022

ABSTRACT

A field experiment was conducted to assess the impact on growth, yield, quality and economics of potato at the research farm of College of Agriculture, Indore, Madhya Pradesh during rabi season 2021-2022 in RBD with 3 replications. Ten treatments viz T_0 (Control), T_1 [Biodynamic preparation 500 (BD 500) @ 2.5 g/l], T_2 (BD 500 @ 5.0 g/l), T_3 [Biodynamic preparation 501 (BD 501) @ 2.5 g/l], T_4 (BD 501 @ 5.0 g/l], T_5 (Vermicompost @ 2.5 tons/ha), T_6 (BD 500 @ 2.5 g + vermicompost @ 2.5 tonnes/ha), T_7 (BD 500 @ 5.0 g + vermicompost @ 2.5 tonnes/ha), T_8 (BD 501 @ 2.5 g + vermicompost @ 2.5 tonnes/ha) and T_9 (BD 501 @ 5.0 g + vermicompost @ 2.5 tonnes/ha) were used. The treatments T_9 (BD 501 @ 5.0 g + vermicompost @ 2.5 tonnes/ha) (53.83 g) and T_8 (BD 501 @ 2.5 g + vermicompost @ 2.5 tonnes/ha) (53.67 g) recorded higher fresh weight of leaves per plant as compared to T_0 (Control) (49.33 g). Diameter of tubers was highest in T_9 (8.42 cm) followed by T_8 (8.23 cm) and lowest in T_0 (6.33 cm). T_9 recorded highest net income and B-C ratio (Rs 5,75,070.67 and 1:3.72 respectively) followed by T_8 (Rs 5,06,428.33 and 1:3.71 respectively). Thus it can be concluded that the vermicompost and biodynamic approach are advantageous sources for sustainable agriculture specially for heavy feeder crops like potato.

Keyword: Biodynamic approach; biofertilizer; potato; yield; quality

INTRODUCTION

Potato (*Solanum tuberosum* L) is one of the most important food crops after wheat, maize and rice. It belongs to the family Solanaceae and is originated from South America having chromosome number 2n (4x) = 48 and is a self-pollinated crop. In India, area and production of potato are 2.20 Mha and 56.17 MT while in Madhya Pradesh area and production are 0.15 Mha and 3.67 MT respectively (Anon 2021). Madhya Pradesh is the 5th largest potato producing state at national level. It produces 33,05,474 MT potato from 90,557 ha land. Indore (20,910 ha) and Dewas (10,333 ha) account for 36 per cent area of potato in the state (Nahatkar et al 2021).

The biodynamic method is a new approach to agriculture, based on advanced knowledge of the working with soil, plants and animals which are considered to be the components of the environment. The biodynamic methods aim to produce well balanced plant growth and sustainable soil fertility by improving the soil structure and nutrient availability. A good range of preparations are available in biodynamic package which increase production and at the same time eliminate the use of agricultural chemicals.

Vermicompost enhances physical and chemical characteristics of soil in potato cultivation, provides excellent effect on overall plant growth and encourages the growth of new shoots/leaves and improves the quality and shelf-life of produce. Organic matter through the application of vermicompost increases the bio-availability of phosphorus in the soil effecting plant growth in potato cropping. Compost application also effects nitrogen mineralization in soil (Ansari 2008). Positive effect of vermicompost on photosynthetic pigments of vegetable crops is recommended and the increase in growth, yield and quality of vegetable crops with addition of

vermicompost as compared to using chemical fertilizers (Ahirwar and Hussain 2015). However, the available information on the role of the vermicompost together with a biodynamic approach in potato is meager. Therefore, an experiment was carried out to examine the effect of biodynamic package with vermicompost on growth and yield characteristics in potato.

MATERIAL and METHODS

The present experiment was laid out in the field of the research farm of Department of Horticulture, College of Agricultur, Rajmata Vijayarraje Scindia Krishi Vishwa Vidyalaya, Indore, Madhya Pradesh. Ten treatments viz T_0 (Control), T_1 [Biodynamic preparation 500 (BD 500) @ 2.5 g/l], T_2 (BD 500 @ 5.0 g/l), T_3 [Biodynamic preparation 501 (BD 501) @ 2.5 g/l], T_4 (BD 501 @ 5.0 g/l], T_5 (Vermicompost @ 2.5 tonnes/ha), T_6 (BD 500 @ 2.5 g + vermicompost @ 2.5 tonnes/ha), T_7 (BD 500 @ 5.0 g + vermicompost @ 2.5 tonnes/ha), T_8 (BD 501 @ 2.5 g + vermicompost @ 2.5 tonnes/ha) and T_9 (BD 501 @ 5.0 g + vermicompost @ 2.5 tonnes/ha) were used. The experiment was replicated thrice in randomized block design. Different doses of nutrients viz nitrogen, phosphorus and potash were given to all the treatments. The calculated quantities of fertilizers were applied in the plots as per required treatments. FYM (20 tonnes/ha), vermicompost (2.5 tonnes/ha), poultry manure (3 tonnes/ha), BD 500 and BD 501 were applied on the basis of treatments. Sampling was done at 30 days up to harvest for growth analysis. Five plants were randomly selected from each plot for data analysis.

The data based on plants selected for observation were statically analyzed as described by (Fisher 1938). The harvested tubers were graded separately on the basis of their weight. Three grades A, B and C were made. The net return per hectare was worked out for all the treatments by subtracting the cost of cultivation from the gross return.

RESULTS and DISCUSSION

Growth and physiological parameters: The data given in Table 1 show that plant height varied from 26.05 to 28.83 cm, number of leaves per plant from 51.67 to 54.67, number of branches per plant from 18.46 to 21.95, leaf area from 22.00 to 23.93 cm^2 and dry weight of leaves per plant from 10.67 to 15.67 g in T_0 (Control) and T_9 (BD 501 @ 5.0 g + vermicompost @ 2.5 tonnes/ha) respectively. However, there were no statistical differences among all the treatments for these traits. Fresh weight of leaves per plant varied from 49.33 to 53.83 in T_0 and T_9 respectively. For fresh weight of leaves per plant, the treatments T_9 (53.83 g) and T_8 (BD 501 @ 2.5 g + vermicompost @ 2.5 tons/ha) (53.67 g) recorded higher values as compared to T_0 (49.33 g) where T_0 was at par with all other treatments except T_9 and T_8. The remarkable increase in plant growth due to NPK and vermicompost in the soil promotes growth by the accumulation of proteins, enzymes and amino acids which are responsible for cell division and cell elongation. The results obtained in the present study are supported by the findings of Singh et al (2015).

Yield and quality parameters: From the data given in Table 2 it can be inferred that weight of tubers per plant varied from 281.67 to 531.00 g, tuber yield per plot from 8.45 to 15.93 kg and tuber yield per hectare from 208.64 to 393.33 q in T_0 and T_9 respectively but differences among all the treatments were non-significant for these traits. Number of tubers per plant varied from 6.67 to 9.59 in T_0 and T_9 respectively but minimum number was recorded in T_0 (6.67) which was lower than all other treatments which were at par among themselves. Diameter of tubers was highest in T_9 (8.42 cm) followed by T_8 (8.23 cm) and lowest in T_0 (6.33 cm). T_6 (BD 500 @ 2.5 g + vermicompost @ 2.5 tonnes/ha) (6.29°Brix), T_7 (BD-500 @ 5.0 g + vermicompost @ 2.5 tonnes/ha) (6.34°Brix), T_8 (6.41°Brix) and T_9 (6.49°Brix) recorded higher TSS, all being at par and lowest was recorded in T_0 (4.20°Brix). High nutrient availability might have resulted in enhanced growth of tubers. The results obtained in the present study are supported by the findings of Alam et al (2007), Kumar et al (2012) and Chatterjee et al (2014). The increase in TSS of potato due to various organics has also been observed by Lakshmi et al (2011), Jariene et al (2015) and Ram et al (2017).

Economics of potato production: Data presented in Table 3 show that T_9 recorded highest net income of Rs 5,75,070.67 followed by T_8 (Rs 5,06,428.33) and minimum was recorded in T_0 (Rs 2,80,069.95). Similarly, T_9 recorded highest B-C ratio (1:3.72) followed by T_8 (1:3.71) and minimum was recorded in T_0 (1:3.04). This might be due to higher quality marketable tuber yield and good market price fetched. Similar results were also reported by Kumar et al (2008) and Sarkar et al (2022).

Table 1. Effect of biodynamic package with vermicompost on growth and physiological parameters of potato

Treatment	Plant height (cm)	Number of leaves/plant	Number of branches/plant	Leaf area (cm^2)	Fresh weight of leaves/plant (g)	Dry weight of leaves/plant (g)
T_0	26.05	51.67	18.46	22.00	49.33	10.67
T_1	27.21	52.67	20.11	22.42	50.33	12.37
T_2	27.27	53.17	20.22	22.67	50.67	12.74
T_3	27.47	53.33	20.53	22.83	51.00	12.75
T_4	27.68	53.50	20.71	22.93	51.33	12.77
T_5	26.93	52.33	19.89	22.33	50.17	11.67
T_6	28.54	54.27	21.67	23.75	53.00	14.83
T_7	28.57	54.33	21.73	23.83	53.33	15.00
T_8	28.71	54.50	21.88	23.92	53.67	15.50
T_9	28.83	54.67	21.95	23.93	53.83	15.67
SEm±	1.69	2.56	1.47	1.71	1.43	3.05
$CD_{0.05}$	NS	NS	NS	NS	4.14	NS

T_0 (Control), T_1 [Biodynamic preparation 500 (BD 500) @ 2.5 g/l], T_2 (BD 500 @ 5.0 g/l), T_3 [Biodynamic preparation 501 (BD 501) @ 2.5 g/l], T_4 (BD 501 @ 5.0 g/l], T_5 (Vermicompost @ 2.5 tonnes/ha), T_6 (BD 500 @ 2.5 g + vermicompost @ 2.5 tonnes/ha), T_7 (BD 500 @ 5.0 g + vermicompost @ 2.5 tonnes/ha), T_8 (BD 501 @ 2.5 g + vermicompost @ 2.5 tonnes/ha), T_9 (BD 501 @ 5.0 g + vermicompost @ 2.5 tonnes/ha)

Table 2. Effect of biodynamic package with vermicompost on yield and quality parameters of potato

Treatment	Number of tubers/plant	Weight of tubers/plant (g)	Diameter of tubers (cm)	Tuber yield /plot (kg)	Tuber yield (q/ha)	TSS (^oBrix)
T_0	6.67	281.67	6.33	8.45	208.64	4.20
T_1	8.80	335.00	7.03	10.05	248.15	5.43
T_2	8.94	398.33	7.12	11.95	295.06	5.59
T_3	9.09	398.67	7.55	11.96	295.31	5.72
T_4	9.21	348.33	7.59	10.45	258.02	5.84
T_5	8.79	330.00	6.71	9.90	244.44	5.52
T_6	9.52	450.00	8.02	13.50	333.33	6.29
T_7	9.54	456.33	8.09	13.69	338.02	6.34
T_8	9.57	468.00	8.23	14.04	346.67	6.41
T_9	9.59	531.00	8.42	15.93	393.33	6.49
SEm±	0.53	88.32	0.04	2.65	65.42	0.13
$CD_{0.05}$	1.54	NS	0.12	NS	NS	0.39

T_0 (Control), T_1 [Biodynamic preparation 500 (BD 500) @ 2.5 g/l], T_2 (BD 500 @ 5.0 g/l), T_3 [Biodynamic preparation 501 (BD 501) @ 2.5 g/l], T_4 (BD 501 @ 5.0 g/l], T_5 (Vermicompost @ 2.5 tonnes/ha), T_6 (BD 500 @ 2.5 g + vermicompost @ 2.5 tonnes/ha), T_7 (BD 500 @ 5.0 g + vermicompost @ 2.5 tonnes/ha), T_8 (BD 501 @ 2.5 g + vermicompost @ 2.5 tonnes/ha), T_9 (BD 501 @ 5.0 g + vermicompost @ 2.5 tonnes/ha)

CONCLUSION

The study showed that the treatment BD 501 @ 5.0 g + vermicompost and BD 501 @ 2.5 g + vermicompost @ 2.5 tons/ha each gave higher fresh leaf weight per plant in comparison to all other treatments. The former treatment followed by the latter also resulted in higher diameter of tubers, net income and B-C ratio. Thus these treatments can be recommended for enhancing growth, yield and income of the farmers from potato.

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Table 3. Impact of biodynamic package with vermicompost on economics of potato

Treatment	Tuber yield (q/ha)	Gross income (Rs/ha)	Expenditure (Rs/ha)	Net income (Rs/ha)	B-C ratio
T_0	208.64	4,17,283.95	1,37,214.00	2,80,069.95	1:3.04
T_1	248.15	4,96,296.30	1,61,905.00	3,34,391.30	1:3.07
T_2	295.06	5,90,123.46	1,86,596.00	4,03,527.46	1:3.16
T_3	295.31	5,90,617.28	1,80,530.00	4,10,087.28	1:3.27
T_4	258.02	5,16,049.38	1,61,905.00	3,54,144.38	1:3.19
T_5	244.44	4,88,888.89	1,62,214.00	3,26,674.89	1:3.01
T_6	333.33	6,66,666.67	1,86,905.00	4,79,761.67	1:3.57
T_7	338.02	6,76,049.38	1,85,650.00	4,90,399.38	1:3.64
T_8	346.67	6,93,333.33	1,86,905.00	5,06,428.33	1:3.71
T_9	393.33	7,86,666.67	2,11,596.00	5,75,070.67	1:3.72

T_0 (Control), T_1 [Biodynamic preparation 500 (BD 500) @ 2.5 g/l], T_2 (BD 500 @ 5.0 g/l), T_3 [Biodynamic preparation 501 (BD 501) @ 2.5 g/l], T_4 (BD 501 @ 5.0 g/l], T_5 (Vermicompost @ 2.5 tonnes/ha), T_6 (BD 500 @ 2.5 g + vermicompost @ 2.5 tonnes/ha), T_7 (BD 500 @ 5.0 g + vermicompost @ 2.5 tonnes/ha), T_8 (BD 501 @ 2.5 g + vermicompost @ 2.5 tonnes/ha), T_9 (BD 501 @ 5.0 g + vermicompost @ 2.5 tonnes/ha)

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