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Evaluation of Biozyme Granule and Liquid Formulation Application on Tuber Yield and Related Characters in Potato

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ABSTRACT

The present investigation involves evaluation of biozyme application through granules and liquid formulation on yield and related characters of potato. It was observed that due to imbalanced nutrition and non-judicious use of fertilizers potato production is lower than potential one which further led to poor tuber size and number of tubers per plant which greatly hampers tuber yield and quality. To overcome this problem, an On Farm Trial (OFT) was conducted by K.V.K. S.A.S. Nagar (Mohali) in farmers' field during 2020-21 to evaluate the influence of application of biozyme granule and liquid formulation on tuber yield and related characters in Potato Var. *Kufri Pukhraj*. The treatment combinations comprised T_1 - FP: Farmers Practice (No treatment), T_2 -Application of 20 Kg biozyme granule at the time of planting and 20 kg at the time of earthing up along with application of biozyme liquid formulation @500 ml/ha at the time of tuber formation. T_3- Application of 40Kg biozyme granule at the time of planting and application of biozyme liquid formulation @500 ml/ha at the time of tuber formation. The results of the study revealed that yield of T_2 was found best performing (315 q/ha) followed by T_3 (295 q/ha) and T_1 (255 q/ha). It was noted that T_2 was earliest for first harvest (76 d) followed by T_3 (82 d) and T_1 (90 d). Yield increase of T_2 over control was found 23.53 per cent higher while it was higher by 15.69 per cent with T_3 over control. Benefit cost ratio for T_1, T_2 and T_3 was found to be 4.04, 4.58 and 4.33, respectively. The results led to a conclusion that for better growth and yield of potato, the crop may be supplemented with different formulations of biozyme in combination with the recommended dose of fertilizers.

Key Words: Biozyme, On farm trial, Potato, Tuber, Yield.

INTRODUCTION

Potato (*Solanum tuberosum*) is one of the most important crops from Solanum genus worldwide. It contribute substantially in providing food and nutritional security and contains high amount of dry matter, carbohydrates, mineral, edible protein, dietary fibre and vitamins. It contains 20.6% carbohydrates, 2.1% protein, 0.3% fat, 1.1% crude fibre and 0.9% ash. It also contains a good amount of essential amino acids like leucine, tryptophan and isoleucine etc. It is one of the most important and widely cultivatable crop in S.A.S. Nagar (Mohali) district of Punjab. It is grown in many parts of the district during *rabi* season and farmers fetches good returns from its sale. However, potato production in the district is below the potential level. This might be due to excessive use of inorganic fertilizers leading to poor soil health and other factors like cultural practices, nutrient management and climatic factors. Biozyme is an organic storehouse of naturally occurring nutrients derived from seaweed (*Aschophyllum nodosum*) which is known for its rich possession of vital nutritional elements. It is known to be rich in cytokinins like gibberellins, auxin precursors, polysaccharides, betaines, mannitol, organic acids, enzymes and hydrolyzed proteins all of which are very useful and diversely used in agriculture. *Aschophyllum nodosum* is large, brown algae of the Fucaceae family being the only species of the genus *Ascophyllum*. It

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contains both macronutrients (N, P and K) and micronutrients (Ca, Mg, S, Cu, Mn, Zn, Fe etc.). It contains nutrients in naturally chelated form which helps to improve cell division and cell enlargement resultant in to better chlorophyll content and thereby increases production. It also improves natural defense system of plant which makes crop healthy. In addition to this, organic substances produced by seaweed extract are biodegradable, non toxic, non polluting and eco friendly in nature. In order to improve production and quality of potato biozyme application in granular form and liquid formulation was applied in the crop. Therefore, an experiment on application of biozyme was conducted in district S.A.S. Nagar (Mohali) of Punjab to come up with best recommendations which can help farmers for better and profitable potato farming.

MATERIALS AND METHODS

Experimental site, treatments and design

Mohali district of Punjab falls under sub-mountainous zone (30.69°N latitude, 76.72°E longitude) having an average altitude of 316 m from the sea level. The present investigation was carried out at five locations of farmers' field during 2020-21 to evaluate application of biozyme granule and liquid formulation on tuber yield and related characters in Potato var. *Kufri Pukhraj*. The area under each trial was 0.4 ha. The soil of the experimental site was deep, loose and sandy loam. The trial was conducted in factorial randomized block design. It was observed that due to non-judicious use of fertilizers potato production is lower than potential which further leads to poor tuber size and and number of tubers/plant which greatly hampers tuber yield and quality. To overcome this problem, an On Farm Trial (OFT) was conducted by K.V.K. S.A.S. Nagar (Mohali) in farmers' field during 2020-21 to evaluate the influence of application of biozyme granule and liquid formulation on tuber yield and related characters in Potato Var. Kufri Pukhraj. The treatment combinations comprised T_1 - FP: Farmers Practice (No treatment), T_2 -Application of 20 Kg biozyme granule at the time of planting and 20 kg at the time of earthing up along with application of biozyme liquid formulation @500 ml/ha at the time of tuber formation. T_3- Application of 40 Kg biozyme granule at the time of planting and application of biozyme liquid formulation @500 ml/ha at the time of tuber formation. Observations were taken on various growth, yield and economic parameters. Selected farmers were trained on scientific cultivation of crop including method of raising crop, intercultural operations, nutrient management, water management, weed management and proper harvesting through on/off campus trainings. Crop was raised following recommended package of practices. The weather data of the experimental site for the growing period of the crop is given in Table 1.

The land was brought to a fine tilth by repeated ploughing and harrowing. The clods were broken and debris was removed. The soil was levelled and beds were prepared. For cultivation of crop, recommended package of practices were followed. The seed tubers were planted during the month of September-October. The seed rate employed was 30-45 q/ha. The seeds were sown at a spacing of 60 cm between ridges × 20 cm between plants. Before fertilizer application, random soil samples were taken from the experimental site and were analyzed. 20 t of well rotten farmyard manure, 412.5 kg of urea, 387.5 kg of single superphosphate and 100 kg of muriate of potash was applied in one ha area. All the fertilizers were applied at the time of sowing except Nitrogen which is applied in two equal split doses (half during field preparation and half during earthing up). 2-3 hoeing were done for weed control. Earthing up was done about 25-30 d after planting. 7-8 irrigations were given to crop including one immediately after planting. The crop was harvested when tubers developed desirable marketable size.

Data collection

Five plants were selected at random from each plot for recording observations like Days taken to harvest, No of stem/plant, Plant height (cm), Tuber

diameter (cm), Individual tuber weight (g) and Yield (q/ha). Days taken for harvest were calculated as days from planting to first harvest. Based on the net plot yield, tuber yield per hectare was calculated and expressed in quintal (q) per hectare.

Economic analysis

The cost of cultivation and gross returns were worked out by using prevailing market prices of inputs and output during the period of investigation. Labour and power cost for different operations such as ploughing, weeding, irrigation, planting, bed preparation and harvesting etc. along with inputs such as seed and fertilizers were considered as per market price. Net returns were worked out using formula: Net Returns (Rs/ha) =Gross Returns (Rs/ha)-Cost of cultivation (Rs/ha). Benefit-cost ratio (BCR) was worked out by using the following formula. Benefit: Cost ratio (BCR) = Gross return (Rs/ha)/ Total cost of cultivation (Rs/ha).

Statistical analysis was done using standard procedure given by Panse and Sukhatme (1985).

Table 1. Weather Data of the district in growing season of crop.

Month	Average Temp °C (Max)	Average Temp °C (Min)	Average Rainfall (mm)
September 2020	38	21	121.1
October 2020	36	12	14.0
November 2020	8	33	08.90
December 2020	4	25	33.10
January 2021	4	24	40.00
February 2021	6	33	50.00

RESULTS AND DISCUSSION

Days taken to harvest

All treatments had significant effect on days taken to harvest (Table 2). Treatment T_2 was earliest maturing crop (76 d) followed by T_3 (82 d) and T_1 (90 d). It means treatment T_2 took minimum days to harvest as compared to other treatments which took more days. This might be due to genetic phenomenon, inherited characters and their early acclimatization to area of cultivation which further improved growth and developments. The early harvest in biozyme treated plants may be due to the fact that such plants were able to build suitable carbohydrate reserves early. The results are in close line with those of Deepika and Tiwari (2021).

Number of stem/plant

Treatments had significant effect on number of stem/plant. T_3 recorded maximum number of stem/plant (5.60) followed by T_2 (5.06) further followed by T_1 (4.70). Similar findings were reported by Bhaske *et al* 2017 and John (2017). This can be attributed to the fact that seaweed extract contains cytokinins which induced the physiological activities and due to this increase the chlorophyll content in the plant. This positively reflected on the activity of photosynthesis and the synthesized materials which positively reflected on shoot characteristics (John, 2017).

Plant height (cm)

All treatments had significant effect on plant height. T_3 recorded maximum plant height (45.5 cm) followed by T_2 (42.1 cm) further followed by T_1 (36.4 cm). The augmentation in plant height is the result of intensive cell division and cell enlargement which in turn is influenced by protein synthesis. Therefore, any variation in cell metabolism can consequently affect the plant height (Sharma *et al* 2016). Similar findings were reported by Kumar *et al* (2016) and Bhaske *et al* (2017).

Tuber diameter (cm)

All treatments had significant effect on Tuber diameter. Treatment T_2 was having maximum tuber diameter (7.2 cm) followed by T_3 (6.6) and T_1 (6.2). The increase in tuber diameter may be due to effect of gibberellins which affect cell elongation. Similar findings were reported by Sarhan (2011).

Individual tuber weight (g)

All treatments had significant effect on individual tuber weight. Treatment T_2 was having maximum tuber weight (106.0 g) followed by T_3 (98.0 g) and

Table 2. Growth, yield and yield contributing characters as influenced by different treatments in potato.

Treatment	Days taken to harvest	No of stem/ plant	Plant height (cm)	Tuber diameter (cm)	Individual tuber weight (g)	Yield (q/ ha)	% increase over check
T1	90	4.70	36.40	6.20	90.0	255	--
T2	76	5.06	42.10	7.20	106.0	315	23.53
T3	82	5.60	45.50	6.60	98.0	295	15.69
SE	0.67	0.09	1.10	0.21	1.70	4.19	--
CD (5%)	2.69	0.35	4.42	0.84	6.85	16.91	--

T_1 (90.0 g). The increase in individual tuber weight was attributed to the effect of liquid seaweed extract which consequently resulted in improved plant physiological activities such as photosynthesis and plant nutrition (Sethi and Adhikary, 2008). Similar findings were reported by Sarhan (2011).

Yield

All treatments had significant effect on yield/ha. Among all treatments T_2 was having highest yield (315 q/ha) followed by T_3 (295 q/ha) and T_1 (255 q/ ha). The higher yield of T_2 was primarily attributed due to more tuber diameter and individual tuber weight. It was noticed that, the treatment which performed better in a unit area is likely to perform better on large scale as the yield per hectare was calculated by multiplying yield per plot with hectare factor. Biozyme application increased yield because it regulates physiological processes and it also contains macro and micro nutrients and other growth stimulants. Similar findings were reported by (Sau *et al*, 2016; Hussein *et al*, 2016; Bhaske *et al*, 2017; Sahana *et al*, 2019). Increase in nitrogen contents was observed in potato tubers treated with seaweed extract. Seaweed extract also increases phosphorus contents in the tuber which had a stimulatory effect on root mass in the potato plant thereby increasing nutrient uptake and tuber yield (John, 2017).

Per cent increase over check

The percentage increase over check of treatment T_2 was found to be 23.53 per cent whereas it was found 15.69 per cent under T_3 over check. This might also due to biozyme which leads to efficient absorption of nutrients and other elements which raise the production and translocation of dry matter from source to sink.

Economics

The economic analysis describes the methods used in analyzing the economic behaviour and the application of the results obtained to solve the economic problems. The input and output prices of commodities prevailed during the year of demonstration were taken for calculating cost of cultivation, net returns and benefit cost ratio. Net profit /ha also depends upon the availability of labour and a suitable market for the disposal of produce. Results of the present investigation (Table 3) revealed that among varieties T_2 gave net return of Rs. 4,92,500 /ha with B: C ratio of 4.58 whereas T_3 gave net return of Rs. 4,53,750 /ha with B: C ratio of 4.33 and T_1 gave net return of Rs. 3,83,750/- with B: C ratio of 4.04. The total cost of production was maximum for T_2 (Rs. 107532 /-) followed by T_3 (Rs. 1,04,792 /-) and T_1 (94,987/-). Gross return was found to be maximum for T_2 (Rs.6,00,032/-) followed by T_3 (Rs.5,58,542/-) and T_1 (4,78,737/-). The cost benefit ratio of any crop is an important factor that is responsible for the growing of crop by a particular farmer. For the adoption of any horticultural practice which is being adopted by a grower it must positively influence the cost benefit ratio. In general farmers follow those practices which ensure decrease in cost of cultivation and

Table 3. Economic returns from different treatments in potato.

Treatment	Cost of cultivation (Rs/ha)	Gross Return (Rs/ha)	Net return (Rs/ha)	BC Ratio
T1	94,987/-	4,78,737/-	3,83,750/-	4.04
T2	1,07,532/-	6,00,032/-	4,92,500/-	4.58
T3	1,04,792/-	5,58,542/-	4,53,750/-	4.33

thereby lead to increase in profitability. The results were in line with results of (Sau *et al,* 2016, Bhaske *et al* , 2017 ; Nayak *et al,* 2020) who also studied economics of biozyme application in various crops.

CONCLUSION

The results of the experiment revealed that Yield of T_2 was found to be the best (315 q/ha) followed by T_3 (295 q/ha) and T_1 (255 q/ha). Yield increase of T_2 over control was found to be 23.53 per cent while yield increase of T_3 over control was found to be 15.69 per cent. Benefit cost ratio for T_1, T_2 and T_3 was found to be 4.04, 4.58 and 4.33, respectively. It can be concluded that application of 20 Kg biozyme granule at the time of planting and 20 kg at the time of earthing up along with application of biozyme liquid formulation @500 ml/ha at the time of tuber formation along with recommended doses of fertilizers is best for crop growth, yield and economics.

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