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Effect of Liquid Biofertilizer Application on Growth and Yield of Brinjal (*Solanum melongena* L.)

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ABSTRACT

An experiment was conducted at Ambach village of Pardi block of Valsad district of Gujarat to study the effect of liquid biofertilizers (LBF) application including *Azotobactor*, *Phosphorus solubilising bacteria* (PSB) and *Potash mobiliser bacteria* (KMB) on the growth and yield attributes of brinjal (*Solanum melongena* L.) variety Mukta round. Liquid biofertilizers developed by Navsari Agricultural University, Navsari applied through seedling treatment @ 30ml/10 l water prior to transplanting and with soil application @ 1l/ha after 35 days of transplanting as per treatments. The treatments were T_1: Control, T_2: 100 *per cent* RDF (200 kg N: 50 kg P_2O_5:50 kg K_2O /ha), T_3: Sole application of LBF i.e *Azotobactor,* PSB and KMB , T_4: 75*per cent* RDF (150 kg N: 37.5 kg P_2O_5: 37.5 kg K_2O/ha) + LBF and T_5: 50 *per cent* RDF (100 kg N: 25 kg P_2O_5: 25 kg K_2O /ha)+ LBF. An application of 100 *per cent* RDF *i.e.* T_2, through chemical fertilisers recorded 61.72 *per cent* more fruit yield than control with BCR 5.66 but it reduced 6.25 *per cent* organic carbon, increase salinity and alkalinity after harvest as compare to pre sown status, however 60.73 *per cent* more fruit yield over control with BCR 5.69 recorded with the application of 75 *per cent* RDF (150 kg N: 37.5 kg P_2O_5: 37.5 kg K_2O/ha) with LBF *i.e.* T_4 without deterioration in soil health. An application of LBF with reduction in RDF up to 25 *per cent* found more profitable than 100 *per cent* RDF.

Key Words: Liquid biofertiliser, *Azotobactor*, Growth hormones, Soil health, Organic carbon, BCR.

INTRODUCTION

Brinjal (*Solanum melongena* L.) is most adoptable vegetable in Valsad district with the production 54.33 Mt (Anon 2018). The soil of Valsad district is medium black, hilly laterite and coastal saline soils which are poor in fertility. The farmers use large quantity of chemical fertilizers with a view to boost the production. Sole application of costly chemical fertilizers decreases the profitability of brinjal cultivation, deteriorates environment and cause harmful impacts on soil microorganism. Chemical fertilizers have various adverse effects on soils *i.e.* depletes water holding capacity, soil fertility and disparity in soil nutrients, thus, it should be replaced with the natural and organic fertilizers which can play a key role of the conservation of the environment (Jangral and Lakra, 2014).

Eco-friendly liquid biofertilizer (LBF) formulation is a promising and updated technology can be a safe alternative to chemical fertilizers to minimize the ecological disturbance as they provide nutrients in addition to plant growth hormones, vitamins, amino acids etc. (Gurumurthy *et al,* 2019). Liquid biofertilizers (LBF) used in conjunction with chemical fertilizers improves crop productivity and nutrient use efficiency. Positive effect of LBF application on growth and yield of Brinjal also been reported (Saiyad, 2007). Thus, Gujarat Vidyapith, Krishi Vigyan Kendra- Valsad

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conducted experiment to study the effect of liquid biofertilizers (LBF) (*Azotobactor*, *Phosphorus solubilising bacteria* (PSB) and *Potash mobiliser bacteria* (KMB) application with chemical fertilizers on the growth and yield attributes of brinjal (*Solanum melongena* L.).

MATERIALS AND METHODS

An experiment was conducted with 10 replications during *Kharif* 2018-19 at Ambach village of Pardi block of Valsad district with Randomized block design. The brinjal variety Mukta round was transplanted with spacing 90 x 75 cm. Overall the soils of experimental plots was medium black, alkaline, with pH 8.12 , Electrical conductivity 0.34 dSm^{-1}, Organic carbon 0.48 *per cent*, Available nitrogen 137 kg/ha., Available phosphorus 32.8 kg/ha. and Available potash 315 kg/ha. The recommended dose of fertilizers (RDF) of brinjal crop was 200 kg N: 50 kg P_2O_5:50 kg K_2O/ha. NPK fertilizers were given in split doses as top dressing by ring placement. The treatments were T_1: Control, T_2: 100 *per cent* RDF (200 kg N: 50 kg P_2O_5:50 kg K_2O /ha), T_3: Sole application of LBF i.e *Azotobactor,* PSB and KMB , T_4: 75 *per cent* RDF (150 kg N: 37.5 kg P_2O_5: 37.5 kg K_2O/ha) + LBF and T_5: 50 *per cent* RDF (100 kg N: 25 kg P_2O_5: 25 kg K_2O /ha)+ LBF.

The bioinoculant cultures (*Azotobacter chrochoccum* as Azotobactor, *Bacillus polymyxa* as PSB and *Bacillus circulans* as KMB) were developed by the Navsari Agricultural University, Navsari. For seedling treatment, seedlings were dipped in the culture of liquid biofertilizers @ 30 ml/10 l water for 10 to 15 min. Seedlings were then allowed to air dry prior to transplanting. After 35 days of transplanting, soil application of LBF @1 l/ ha was carried out. Mean data of plant height at 150 days after transplanting (DAT), number of fruits per plant, fruit yield per plant and fruit yield per treatment plot were recorded from each plot. Cost of cultivation per hectare, gross income, net profit and BCR of each treatment plot was calculated. Soil samples were collected after harvesting of crop electrical conductivity and pH of soil measured with a soil-to-water ratio of 1:2.5 at 25^0 C by *conductometric* method and *potentiometric* method respectively. Soil organic carbon was measured with Walkley and Black titration method. Extraction 0.5 M $NaHCO_3$ *pH* (8.5) *Colorimetric* method was used to test the soil available P, and soil available K was determined with Extraction:1 N H_4OAC *pH* (7.0) *Flame photometric* method. The other agronomic practices were followed uniformly during cropping season and need based protection measures were taken.

RESULTS AND DISCUSSION

Effect on growth and yield

The data (Table 1.) showed that maximum plant height (98.26 cm) at 150 DAT was recorded with T_4 i.e 75 *per cent* RDF + LBF followed by T_2: 100 *per cent* RDF (98.18 cm), T_5: 50 *per cent* RDF + LBF (92.13 cm) and T_3: Sole LBF application (84.06 cm), however, minimum plant height (71.44 cm) was recorded in control treatment (T_1). Highest number of fruits per plant was also recorded with T_4 (38.20) was 2.55 per cent higher than T_2 (37.25), which was decreased with T_5 (34.62), T_3 (31.26) and T_1 (25.13). Result proved that reduction in RDF upto 25 per cent may be compensated by the LBF application (Doifode and Nandkar, 2014). Plant height increased by the application LBF, attributed to the increased uptake of nutrients in the plants leading to enhanced chlorophyll content and carbohydrate synthesis and increased activity of hormones which in turn helped better proliferation of root growth and uptake of other nutrients to the greater extent. So that the enlargement in cell size and cell division, which might have helped in plant height and number of fruits per plant. Upadhya *et al* (2018).

Highest fruit yield per plant (1075.5 g) and fruit yield (39.04 t/ha) were recorded with T_2. Fruit yield data recorded with T_2 (39.04 t/ha), T_3 (29.30 t/ha), T_4 (38.80 t/ha) and T_5 (37.12 t/ha) were 61.72*per cent*, 21.38*per cent*, 60.73*per cent* and 53.77*per*

Table 1. Effect of LBF application on growth and yield of brinjal.

Sr. No.	Treatment	Plant height at 150 DAT(cm)	No. of fruits per plant	Fruits yield per plant(g)	Fruit Yield (t /ha)
1.	T_1	71.44	25.13	665.0	24.14
2.	T_2	98.18	37.25	1075.5	39.04
3.	T_3	84.06	31.26	807.2	29.30
4.	T_4	98.26	38.20	1068.9	38.80
5.	T_5	92.13	34.62	1022.6	37.12
CV%		0.645	2.062	0.061	1.838
CD @ 5%		0.521	0.623	0.514	0.561

cent respectively, higher than T_1 (24.14 t/ha). These results were in conformity with the Doifode and Nandkar, (2014) and Umalaxmi *et al* (2016). Such increase in yields due to liquid inoculums have been attributed to N_2-fixation, development of better root system, production of plant growth hormones, enhancement in uptake of NO_3^-, NH_4^+, $H_2PO_4^-$, K^+ and Fe^{++}, improvement of plant water status and increase in nitrate reductase activity. The increase in fruit yield also was attributed to the fact that phytohormones produced by the LBF stimulated root growth and induced changes in root development and root morphology, which in turn affected the assimilation of the nutrients Gurumurthy *et al* (2019), Aditya Kumar Singh and Kushwaha (2018).

Effect on soil fertility status

Data (Table.2) revealed that treatment T_2 *i.e* application of 100 per cent RDF increased the pH and EC value, 8.17 and 0.36 respectively, although 25 to 50 per cent reduction in RDF in combination with LBF decreased the pH and EC values, up to 8.09 and 0.29, respectively as compared to status of soil before crop sown. It indicated that the chemical fertilizers were responsible for the enhanced alkalinity and salinity of the soil. These findings were in close agreement with Jangral and Lakra (2014) and Doifode (2017). The post-harvest soil analysis has also found highest values of organic carbon *per cent* with T_5 (0.54) followed by T_4 (0.52), T_3 (0.51) and T_1(0.47). Sole and combined application of LBF improves the soil organic carbon

Table 2. Effect of LBF application on soil fertility status after harvest of brinjal.

Sr. No.	Treatment	pH (1:2.5) at 25^{0}C	EC (dSm^{-1})	Organic carbon (*per cent*)	Available Nitrogen (kg/ ha)	Available phosphorus (kg/ ha)	Available potash (kg/ ha)
1.	T_1	8.07	0.32	0.47	85.0	32.67	227.0
2.	T_2	8.17	0.36	0.46	140.0	42.19	350.0
3.	T_3	8.08	0.31	0.51	142.0	41.09	337.0
4.	T_4	8.10	0.30	0.52	154.0	44.92	354.0
5.	T_5	8.09	0.29	0.54	158.0	45.62	372.0
Initial		8.12	0.34	0.48	137.0	32.83	315.0
CV %		0.199	3.668	2.547	0.988	2.786	0.505
CD @ 5%		0.015	0.010	0.012	1.217	1.044	1.502

Table 3. Effect of LBF application on economic parameters of brinjal cultivation

Sr, No.	Treatment	Gross income (Rs./ ha)	Total cost of cultivation (Rs./ha)	Net profit (Rs. ha)	BCR
1.	T_1	3,13,820.0	68,857.3	2,44,962.7	4.56
2.	T_2	5,07,520.0	91,697.0	4,15,823.0	5.66
3.	T_3	3,80,900.0	69,307.3	3,11,592.7	5.50
4.	T_4	5,04,400.0	88,409.3	4,15,990.7	5.69
5.	T_5	4,82,560.0	87,175.1	3,95,384.9	5.54
CV %		0.504	0.804	0.591	0.790
CD @ 5%		2001.52	591.10	1911.98	0.038

*Selling price @ 13 Rs/kg

up to 12.50 *per cent*, however application of 100 per cent RDF reduced 4.17 *per cent* as compared to status of soil before crop sown. The data indicated that the chemical fertilizers were responsible for the reduction of organic carbon from soil, while the LBF improved it (Doifode, 2017).

Highest value of available nitrogen after harvest of brinjal was found with T_5 (158 kg/ha) followed by T_4 (154 kg/ha), T_3 (142 kg/ha), T_2 (140 kg/ha), and T_1 (85 kg/ha). Sole and integrated application of LBF i.e *Azotobactor, PSB* and *KMB* were increased the available nitrogen 3.65 to 15.33 per cent and sole chemical fertilizer application increased available nitrogen 2.19 per cent compare to status of soil before crop sown. Treatment T_5, *i.e.* 50 per cent RDF + LBF was recorded highest content of available phosphorus (45.62 kg/ha) and available potash (372 kg/ha) after harvest of brinjal. It was also observed that the application of LBF increased the available phosphorus 25.16 to 38.96 per cent and available potash 12.38 to 18.10 per cent as compared to pre sown soil status. *Azotobacter* fixing atmospheric nitrogen in soil, however phosphate solubilizing bacteria and potash mobilising bacteria increased phosphate and potash availability in soils which enhances the soil fertility. These findings are in close agreement with Doifode (2017).

Effect on economic parameters

Data pertaining to economics of brinjal cultivation (Table 3) noted the highest gross income (5,07,520 Rs./ha) with T_2 *i.e.* 100 per cent RDF having a maximum fruit yield, however , maximum net profit (4,15,990.7 Rs./ ha) and highest BCR(5.69) was recorded with T_4 *i.e.* 75 per cent RDF (150 kg N: 37.5 kg P_2O_5: 37.5 kg K_2O/ha) + LBF due to reduction in cost of cultivation. Data of experiment revealed that an application of LBF with reduction in RDF upto 25 per cent found more profitable than application of 100 per cent RDF. Singh *et al* (2015) and Mallick and Patnaik (2018) also studied that benefit cost ratio was appreciable when the crop was raised with combined application LBF and chemical fertilizers.

CONCLUSION

It was concluded that maximum yield of fruits obtained with the 100 per cent RDF (200 kg N: 50 kg P_2O_5:50 kg K_2O /ha) application although it reduce organic carbon content, increase pH and EC of soil and cost of cultivation. However an application of LBF with 25 percent reduction in RDF (150 kg N: 37.5 kg P_2O_5: 37.5 kg K_2O/ha) *i.e.* T_4 slightly lower yield, besides improve soil fertility and net profit with highest BCR. So, Integrated and judicious use of chemical fertilizers and biofertilizers is essential for soil fertility in the modern agriculture.