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Influence of Biofertilizers on Uptake of NPK in Soils and Eggplant

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ABSTRACT

The study was conducted to improve the uptake of NPK by the plants by using Biofertilizers i.e., *Azatobacter chroccocum* for nitrogen fixation, *Psuedomonas* for phosphurus solubulisation and *Frauteria aurantia* for potash mobilisation. Biofertlizers were collected from plant pathology lab and pure cultures were isolated. Mass cultures of the microorganisms were obtained by culturing them in their respective broth media for 10 days at 28^0C. Mass production of the cultures was carried out in broth. The broth was mixed well and inoculated. While transplanting seed ling dip method was used at frequent intervals of time at 30DAT, 60DAT, 90DAT. Soil samples were collected before transplanting and available NPK in soil was estimated by using standard methods described by Jackson (1967). After harvesting plant samples and soil samples were prepared for different treatments and NPK uptake was evaluated. Results revealed that Biofertilizers along with 1/2 RDF of NPK has shown better uptake of fertilizers by the plants and availability of NPK in soil on par with RDF. Lowest uptake was recorded in control followed by the treatment were only Biofertilizers were used. Thus dosage of fertilizers can be reduced to half by using biofertilizers at frequent intervals and at optimum levels which are ecofriendly and reduces cultivation cost.

Introduction

The present farming system totally depends on use of agrochemicals including fertilizers, pesticides and growth regulators for enhancing crop productivity which gradually culminated in a situation where there is a need to reconsider the alternative to chemical agriculture developed in the western world. It is a well-documented fact that increased dependence on agrochemicals including fertilizers has led to several ill effects on the environment and human. Most biofertilizers consist of microbes that are involved in the decomposition of organic matter and the breakdown of minerals into a soluble form that is useful to plants. Biofertilizers contain specific strains of these naturally occurring organisms that have been cultivated in a lab environment to increase levels of major nutrients like nitrogen and phosphorus, while others help to fight off disease or provide beneficial trace elements in the soil. One of the main advantages of using biofertilizers is the diminished need to use other forms of fertilizer, many of which have negative effects in the environment. For example, synthetic nitrogen fertilizers are known to accumulate salts in the soil after prolonged use, making the soil less fertile over time. Concentrated applications of nitrogen and phosphates, whether from synthetic or organic sources, can run-off into waterways during heavy rains and disrupt the balance of aquatic ecosystems. Thus biofertilizers are effective in promoting healthy soil and plant life, the overall environment is healthier, as air and water quality are inextricably linked to soil quality

Azotobacter plays an important role in nitrogen cycle in nature by binding atmospheric nitrogen, which is in accessible to plants, and releasing it in the form of ammonium ions into the soil. Dhumal (1992) reported the application of *Azotobacter* as biofertilizer increased the average root length in vegetable crops. These results are in agreement with the findings of Abou-el-Seoud and Abdel-Megeed (2011). Principal mechanism in soil for mineral phosphate solubilization is lowering of soil pH by microbial production of organic acids and mineralization of organic P by acid phosphatases. Use of phosphorus solubilizing bacteria as inoculants increases P uptake. These bacteria also increase prospects of using phosphatic rocks in crop production. Greater efficiency of P solubilizing bacteria has been shown through co-inoculation with other beneficial bacteria and mycorrhiza. Ahmad Ali Khan *et al.,* (2009) reported that use of phosphorus solubilising bacteria enhances the availability of P to plants. *Frateuria aurantia* potash mobilising bacteria is capable of solubilizing the fixed form of potash into easily absorbable simpler form and mobilizing the solubilized potash into the plants (Chandra *et al.,* 2005).

Materials and Methods

Biofertilizers were obtained from plant pathology lab agriculture college Nagpur**.** Bacterial cultures were sub cultured in their respective media to know its purity, transparent pure colonies of *Azotobacte*r, shiny, white slimy colour of *Pseudomonas,* creamy, smooth, slimy, spreading colonies of *Frateuria* were transferred aseptically on to their respective media. Mass cultures of the micro-organisms were obtained by culturing them in their respective broth media for 10 days at 28^{0}C. Mass production of the cultures was carried out in broth. The broth was mixed well and counted for cfu per ml of inoculants and then used for further studies. After three days of incubation the total number of colonies were counted and calculated as follows.

$$\text{Organism of 1g of sample} = \frac{\text{No. of colonies}}{\text{Amount of diluted suspension} \times \text{Dilution factor}}$$

Initially soil samples were collected before transplanting and NPK analysis was done. Brinjal seeds were scarified and seedlings were raised in raised bed for 30days. For inoculation seed ling dip method was used. In seedling dip method seedlings raised were dipped in biofertlisers broth and left for 30min in shade conditions.

Thus seedlings were dipped in *Azatobacter, Psuedomoans, Frauteria* solutions according to the treatments one after the other. The control seedlings were left without any treatment. After 90days of crop period and harvesting, soil samples were collected for different treatments along with plant samples separately.

Analysis of NPK in soil and plant material

Available nitrogen in soil was estimated by using alkaline potassium permanganate method (Subbiah and Asija, 1956). Available phosphorus in soil was determined by using

Olsen's method (Jackson, 1967). Available potassium in soil was extracted by neutral ammonium acetate solution and potassium was determined by using flame photometer (Jackson, 1967). Available nitrogen in plant was estimated by Kjeldhal's method as determined by Piper (1996).

Plant extract was prepared by pre-digesting the plant samples with concentrated HNO_3 and then digesting the content with di-acid mixture (nitric acid and perchloric acid) in the ratio of 9:4 as described by Jackson (1967). This plant extract was analyzed for determination of following properties. Total phosphorus was determined by Vanado molybdate phosphoric yellow colour method as described by Jackson (1967). Total potassium was estimated by flame photometer method as described by Jackson (1967).

Statistical analysis

Standard method of analysis known as 'Analysis of variance' was applied for the standard analysis of the data, critical difference (CD) at 5 per cent level of significance as worked out and use for comparison of different treatment (Gomez and Gomez, 1984).

Results and Discussion

Analysis for nutrient uptake

The N uptake was recorded superior in Treatment T_6 (*Azotobacter* + PSB + KMB + 1/2 RDF) (Table 1). In respect to other treatments, the treatment T_5 (*Azotobacter* + PSB + KMB + RDF) was found significantly better. The P uptake was recorded superior in Treatment T_6 (*Azotobacter* + PSB + KMB + 1/2 RDF), (Table 1). In respect to other treatments, the treatment T_5 (*Azotobacter* + PSB + KMB + RDF) was found significantly better recording. The K uptake was recorded superior in Treatment T_6 (*Azotobacter* + PSB + KMB + 1/2 RDF) (Table 1). In respect to other treatments, the treatment T_5 (*Azotobacter* + PSB + KMB + RDF) was found significantly better recording. In all treatments NPK was recorded low in control and followed by the treatment were only Biofertilizers alone was used T_4 (*Azotobacter* + PSB + KMB).

Lin *et al.,* (2002) recorded increase in biomass 125 % which leads in increase in the uptake of K and P more than 150 % in tomato plant due to application of *B. mucilaginosus.* Nirmala Agrawal *et al.,* (2004) observed that due to application of biofertilizers in wheat crop there is an increase in N P K uptake.

The N uptake was recorded superior in Treatment T_6 (*Azotobacter* + PSB + KMB + 1/2 RDF) (Table 1).

In respect to other treatments, the treatment T_5 (*Azotobacter* + PSB + KMB + RDF) was found significantly better. The P uptake was recorded superior in Treatment T_6 (*Azotobacter* + PSB + KMB + 1/2 RDF), (Table 1).

In respect to other treatments, the treatment T_5 (*Azotobacter* + PSB + KMB + RDF) was found significantly better recording. The K uptake was recorded superior in Treatment T_6 (*Azotobacter* + PSB + KMB + 1/2 RDF) (Table 1).

In respect to other treatments, the treatment T_5 (*Azotobacter* + PSB + KMB + RDF) was found significantly better recording. In all treatments NPK was recorded low in control and followed by the treatment were only Biofertilizers alone was used T_4 (*Azotobacter* + PSB + KMB). Nirmala Agrawal *et al.,* (2004) observed that due to application of biofertilizers in wheat crop there is an increase in N P K uptake.

Table.1 Analysis of uptake by eggplant as influenced by different treatments

S.no	Treatments	Nutrient uptake g plant^{-1} (%)		
		N	P	K
1	T_1 *Azotobacter* + ½ N + P +K	2.62	0.33	4.001
2	T_2 PSB + N + ½ P + K	2.47	0.35	4.02
3	T_3 KMB + N + P +1/2 K	2.40	0.34	4.026
4	T_4 *Azotobacter* + PSB + KMB	2.12	0.26	3.964
5	T_5 *Azotobacter* + PSB + KMB + RDF	2.86	0.53	4.030
6	T_6 *Azotobacter* + PSB + KMB + 1/2 RDF	3.33	0.56	4.059
7	T_7 RDF	2.80	0.51	3.955
8	T_8 Control	1.90	0.22	3.954
	F test	Sig.	Sig.	Sig.
	SE $\pm$ (m)	0.05	0.02	0.047
	CD (P=0.05)	0.143	0.06	0.069

Table.2 Effect of different treatments on available nutrients in soil

S. No	Treatments	Available nutrients in soil					
		N (mg kg^{-1})	% increase over intial	P (mg kg^{-1})	% increase over intial	K (g kg^{-1})	% increas e over intial
1	T_1 *Azotobacter* + ½ N + P +K	112.60	44.00	7.40	19.00	56.86	11
2	T_2 PSB + N + ½ P + K	104.30	34.00	7.80	25.00	61.60	20
3	T_3 KMB + N + P +1/2 K	102.00	31.00	7.10	14.00	62.56	21
4	T_4 *Azotobacter* + PSB + KMB	98.00	26.00	6.20	6.00	54.40	6
5	T_5 *Azotobacter* + PSB + KMB + RDF	127.00	63.00	10.10	62.00	64.80	27
6	T_6 *Azotobacter* + PSB + KMB + 1/2 RDF	120.00	54.00	9.30	50.00	63.26	23
7	T_7 RDF	114.00	46.00	9.00	45.00	63.13	23.7
8	T_8 Control	96.00	23.00	6.00	-3	49.56	-2
	F test	Sig.		Sig.		Sig.	
	SE $\pm$ (m)	1.802		0.17		0.53	
	CD (P=0.05)	5.409		0.542		2.21	
	Initial nutrient status	77.7		6.2		51	

Analysis for available nutrients in soil

The total Available N was recorded superior in Treatment T_5 (*Azotobacter* + PSB + KMB + RDF), 127.0 mg kg^{-1} (Table 2). In respect to other treatments, the treatment T_6 (*Azotobacter* + PSB + KMB + 1/2 RDF) was found significantly better followed by T_7 (RDF). The data presented in (Table 2) revealed that the total P present in soil after harvest was recorded superior in Treatment T_5 (*Azotobacter* + PSB + KMB + RDF). In respect to other treatments, the treatment T_6 (*Azotobacter* + PSB + KMB + 1/2 RDF), was found significantly better. The total K present was recorded superior in Treatment T_5 (*Azotobacter* + PSB + KMB +

RDF) (Table 2). In respect to other treatments, the treatment T_6 (*Azotobacter* + PSB + KMB + 1/2 RDF), was found significantly better recording. In all treatments NPK was recorded low in control and followed by the treatment were only Biofertilizers alone was used T_4 (*Azotobacter* + PSB + KMB). Abou-el-Seoud and Abdel-Megeed (2011) reported co-inoculation of PDB and KDB found increased P and K availability of maize plants grown on P and K limited soils.

An attempt was made to study the effect of biofertilizers in combination with the recommended dose of chemical fertilizers. The present study reveals that Biofertilizer application along with RDF shows a significant increase in the uptake of the nutrients by the plant and the available nutrient in the soil also increased significantly. Thus we can conclude that use of biofertilizers as a reliable tool to be incorporated into the present day intensive agricultural practices to supplement the nutrient requirements of plants. In all treatments NPK was recorded low both in soil and plant samples in control and followed by the treatment were only Biofertilizers alone was used T_4 (*Azotobacter* + PSB + KMB).

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