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Effect of Bio-fertilizers on Growth and Yield of Garlic (*Allium sativum* Linn.)

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A B S T R A C T

An investigation on the project entitled "Effect of bio-fertilizers on growth and yield of garlic (*Allium sativum Linn.*)" was taken up in the Horticultural Garden of Janta College, Bakewar, Etawah, U.P. which falls under sub-tropical climatic region during 2011-12 to work-out the optimum dose of the three bio-fertilizer and their combination on garlic variety-G1. Fourteen treatments namely, a control receiving FYM as basal dose @ 20 ton/ha + RDF (100:50:50) (T_0), Azotobactor 6 kg/ha (T_1), Azotobactor 8 kg/ha (T_2), PSB 6 kg/ha (T_3), PSB 8 kg/ha (T_4), VAM 6 kg/ha (T_5), VAM 8 kg/ha (T_6), Azotobactor 6 kg/ha + PSB 6 kg/ha+ VAM 6 kg/ha (T_7), Azotobactor 6 kg/ha + PSB 8 kg/ha+ VAM 8 kg/ha (T_8), Azotobactor 6 kg/ha+ PSB 6 kg/ha + VAM 8 kg/ha (T_9), Azotobactor 6 kg/ha+ PSB 8 kg/ha+ VAM 6 kg/ha (T_{10}), Azotobactor 8 kg/ha+ PSB 6 kg/ha+ VAM 6 kg/ha (T_{11}), Azotobactor 8 kg/ha+ PSB 8 kg/ha + VAM 8 kg/ha (T_{12}), Azotobactor 8 kg/ha + PSB 6 kg/ha+ VAM 8 kg/ha (T_{13}), Azotobactor 8 kg/ha+ PSB 8 kg/ha+ VAM 6 kg/ha (T_{14}) applied into soil prior to transplanting of seed cloves. The experiment was carried out in Randomized Block Design with 3 replications having plot size 3 sq.mt. The combination of treatments namely Azotobactor 8 kg/ha + PSB 8 kg/ha+ VAM 8 kg/ha (T_{12}) resulted the best optimal doze for garlic giving average plant height 79.83 cm, average number of leaves 9.86, average diameter of pseudo stem 1.13 cm, average weight of bulb 38.03 g and 5.96 kg average yield per plot are better for yield and profit at less cost.

Introduction

Garlic is the second most widely cultivated bulb crop, after onion, and has long been recognized as a valuable spice and condiment throughout India. In India garlic is grown an area of 274000 hectares with a production of 1271000 MT. Garlic possesses highly nutritive value and it has been considered as a rich source of carbohydrates, proteins and

phosphorus. Ascorbic acid content was also reported to be very high in green garlic (Pradhan *et al.,* 1977).Uninjured bulb contains a colourless, odourless water soluble amino acid called "Allin" which, after crushing converts into "Allicin" whose principal ingredient is odoriferous diallyldisulphide. Garlic contains 0-1% volatile oil, whose chief constituents are diallyldisulphide (60%), allyl alcohol (5.4%), dimethyl trisulphide (2-4%), methyl allyltrisulphide (1.5%), methyl allyldisulphide (1.2%) and diallyltrisulphide (1%) (Satish and Rajangam, 2011).Garlic has some antifungal, antimicrobial, insecticidal and other medicinal properties. It has hypoglycemic properties. Garlic therapy has also been suggested in flatulence, constipation, faulty digestion, inadequate food intake, leprosy, chronic coughs and many other diseases (Adegoke *et al*., 1998). It is grown widely in the country and the state of U.P. and to boost up it's per hectare yield the farmers resort to use of inorganic fertilizers containing N, P and K. But use of inorganic fertilizers to obtain higher yield with quality produce is not only costly but also a precursor of health hazards by polluting the environment, soil and water. This anxiety has now led them to devise ways and means to switch over the use of eco-friendly biofertilizers in crop production. *Azotobacter* and PSB fix atmospheric nitrogen and solubilise phosphorous to increase soil fertility and biological activities. Biofertilizers are products having living cells of different types of micro-organism, which have an ability to convert nutritionally important elements and also, bio-fertilizers are known to play principle role in expanding availability of N. and P. besides improving biological fixation of atmospheric nitrogen and build hormones and anti-metabolites (Bhat *et al*., 2013). Availability of nitrogen is important for growing plants. It is a main constituent of protein and nucleic acid molecules. It is also a part of chlorophyll molecules. Phosphorus is vital constituent of phospholipids, nucleic acids and several enzymes. It is also needed for the transfer of energy within the plant system and is involved in its various metabolic activities. Phosphorus has its beneficial effect on early root development, plant growth, yield and quality (Verma, 1993). Potassium plays anindispensable role in plant metabolism such as photosynthesis, translocation of food, regulation of plant pores, activation of plant catalyst and resistance against pests and diseases. Potassium improves colour, glossiness and dry matter accumulation besides improving keeping quality of the crop (Dorais *et al.,* 2001). Therefore, keeping in view the above facts in mind, an attempt has been made in the present investigation to study the effect of biofertilizers on growth and yield of garlic.

Materials and Methods

The experiment was conducted at on the experimental farm of Department of Horticulture of Janta College, Bakewar, Etawah, during rabi season of the year 2011-2012. Etawah falls in the southwestern portion of Uttar Pradesh, between the parallels of 26.21° and 27.1° North latitude and 78.45° and 79.45° East longitude, at the elevation of 150.06 m above the mean sea levelin the gangetic plane of central U.P. Average rainfall of Etawah ranges from 805 mm. per annum. The soil of the experimental field was sandy loam, pH 6.6 and loam in texture, normal in reaction with medium in respect to nitrogen, phosphorus and potassium. The experiment consisting of 15 treatments viz., two levels of Azotobactor (6 and 8 kg), two level of P.S.B. (6 and 8 kg) and two levels of VAM (6 and 8 kg), Eight combinations of Azotobactor, PSB and VAM with doses and one is absolute control (N:P:K =100:50:50) was laid out in simple RBD with three replications.

Results and Discussion

Application of 3 biofertilizers, viz., Azotobactor, PSB and VAM each @ 6 kg and 8 kg per hectare applied separately or in combination was either at par with control or were very less effective. The plant height was observed to be significantly affected by the treatment. The height noted in control plants was 73.36 cm, whereas it was noted significantly maximum observed in T12 (79.83 cm.) (Gaiki *et al.*, 2006, Talware *et al.*, 2012 and Singh *et al.*, 2017). In rest of the treatments it ranged between 73.83 cm. to 78.93 cm. Average no. of leaves as recorded in control was 6.30. It was significantly enhanced up to 9.86 in T12 (Talware *et al.*, 2012and Singh *et al.*, 2017). In rest of treatments it ranged between 6.40 to 9.56. Average diameter of pseudostem in control plants was recorded minimum (0.66 cm). It was significantly increased to the maximum in T12 (1.13 cm) (Bhandari *et al.*, 2014 and Das *et al.*, 2014). The Average diameter of pseudostem in other treatments ranged from 0.70 cm to 1.00 cm. Average weight of bulb (g) was significantly influenced to the maximum in T12 (38.03g) whereas bulb of control treatment weighed 27.30g (Gowda *et al.*, 2007, Bhandari *et al.*, 2014 and Das *et al.*, 2014). The Average diameter of pseudostem in other treatments ranged from 28.86 gto 37.03 g. Average bulb yield /plot was recorded 5.09 kg in control whereas in T12 it was 5.96 kg. In other treatments it was recorded to vary between 5.14 kg/plot to 5.71 kg/ha (Singh *et. al.*, 2008, Yogita *et al.*, 2012, and Das *et al.*, 2014) (Table 1).

Table.1 Summarized pooled data on various yield parameters recorded at the time of harvesting

Treatments	Growth Parameters			Yield Parameters	
	Plant height (cm)	No. of leaves	Diameter of pseudo-stem(cm)	Wt. of bulb/plant (g)	Yield per plot (kg)
T_0	73.36	6.30	0.66	27.30	5.09
T_1	74.46	6.76	0.76	29.40	5.21
T_2	75.90	7.46	0.83	30.73	5.35
T_3	73.83	6.40	0.70	28.86	5.14
T_4	75.53	6.93	0.83	30.13	5.28
T_5	74.16	6.46	0.76	29.13	5.15
T_6	74.70	6.93	0.80	29.80	5.21
T_7	78.20	8.36	0.96	33.03	5.45
T_8	78.93	9.56	1.00	37.03	5.71
T_9	76.13	7.80	0.76	31.16	5.30
T_{10}	78.10	8.90	0.93	35.73	5.66
T_{11}	76.60	7.96	0.80	31.56	5.36
T_{12}	79.83	9.86	1.13	38.03	5.96
T_{13}	77.83	8.53	0.90	32.43	5.56
T_{14}	77.23	8.10	0.83	32.03	5.43
CD	0.47	0.54	0.21	0.81	0.07

Data on economics of various treatments revealed that the plot treated with the combination of 3 biofertilizers each @ 8kg /ha (T_{12}) was found to be the best amongst all.

The combination of Azotobactor @ 6kg/ha, PSB and VAM each @ 8kg/ha (T_8) stand with net profit of 4.304 lakh and C:B ratio 1: 3.06, was found to be the next best followed by the combination of Azotobactor @ 6kg/ha, PSB @8kg/ha and VAM @ 6kg/ha (T_{10}) gave net profit of 4.257 lakh with C:B ratio of 1: 3.03 . T_{12} accounted for a net profit of nearly Rs 4.551 lakh and a widest cost: benefit ratio 1: 3.23.

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