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Effect of biofertilizers and micronutrients on growth and yield of garlic (*Allium sativum* L.) var. 'G-282'

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Abstract

A field experiment was conducted to study the "Effect of biofertilizes and micronutrients on growth and yield of Garlic (*Alium sativum* L.) var G-282" during *rabi* season 2012-13 at the Department of Vegetable science, College of Horticulture and Forestry, Jhalawar. The experiment consist of 12 treatment *viz.*, three biofertilizers (control, PSB, *Azotobacter*) in combination with four micronutrients (control, ZnSO4 @ 0.4%, Boric acid @ 0.2% and CuSO4 @ 0.05%) was laid out in simple RBD with three replications. The treatment T5 (PSB + ZnSO4 @0.4%) was recorded maximum plant height at 60 days and 130 days after sowing (48.83 cm and 77.30 cm), number of leaves/plant at 60 days and 130 days after sowing (7.5 and 14.80), leaf length (39.27 cm) and neck thickness (0.92 cm), total chlorophyll both at 60 and 90 DAS (0.43 and 0.78 mg/g) then over control. The yield characters of bulb like maximum fresh weight of bulb (34.37 g), diameter of bulb (5.49 cm), number of cloves per bulb (30.67), fresh weight of 50 cloves (86.67 g), dry weight of 50 cloves (42.50 g), yield per plot (5.15 kg plot-1) and yield of bulb per hectare (229.03 q ha-1) other then rest treatments.

Key words: *Growth, Yield, Biofertilizers, Micronutrients, Garlic.*

Introduction

Garlic is the second most important bulb crop after onion. It is an important spice crop belonging to family alliaceae and botanically known as *Allium sativum* L. The economic yield is obtained from its underground bulb, which consists of bulblets, popularly called as cloves. A fresh bulb contains about (62.8%) moisture, (6.3%) fat, (0.8%) fiber and is a good source of carbohydrates, vita.- C, Selenium, Phosphorous and Manganese. It is specially rich in protein, carbohydrate and ascorbic acid. About 142 calories of energy is obtained from 100 gm of garlic.

Biofertilizers are live carrier based microbial preparation used in agriculture as low input resources to enhance the availability of plant nutrients or promote the growth by way of synthesizing growth factors. They are low cost effective, inexpensive and eco-friendly sources of nutrient. Micronutrient i.e. zinc play a vital role in the metabolic activities of plant. The principle functions of zinc in plant are as metal activator of enzymes like dehydrogenase (pyridine nucleotide, glucose-6 phosphodiesterase, carbonic anhydrase etc.). It is involved in the synthesis of tryptophane, a precursor of IAA, it is associated with water uptake and water retention in plant bodies (Noggle and Fritz, 1980). PSB might have increased the amount of available phosphorus in the root zone for the growth and development of plants. In addition to phosphate solubilization these microbes can mineralize organic phosphorus into a soluble form. These reactions take place in the rhizosphere and the microorganism render more phosphorus into soil solubilization required for their smooth growth and metabolism. The surplus is available for plants to be absorbed. It also produce fungistatic and growth promoting substances, like auxins, gibberlines, cytokines etc. which influence the plant growth parameters by enhancing cell division, cell elongation and thus increasing the metabolic activity (Bhattacharya and Jain 2000 and Gurmani *et al.*, 2012).

Material and Methods

An experiment was conducted at the Department of Vegetable Science, College of Horticulture and Forestry, Jhalawar. Jhalawar is situated between 23045' 20" and 24052' 17" North latitudes and 75027' 35" and 76056'46" East longitudes covering an area of 6322.35

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Km2. Jhalawar district falls under sub-humid South Eastern Plains under agro-climatic zone V. The climate of Jhalawar is typically sub-humid and characterized by extremes of temperature both in summer and winter with high rainfall and moderate relative humidity. the soil of the experimental field was black cotton, pH 6.9, clay, and loam in texture, normal in reaction with medium in respect to nitrogen, phosphorus and potassium.

The experiment consist of 12 treatment viz., three biofertilizers (control, PSB, *Azotobacter*) in combination with four level of micronutrients (control, ZnSO4 @ 0.4%, Boric acid @ 0.2% and CuSO4 @ 0.05%) was laid out in simple RBD with three replications. The treatments were T0- control (applied RDF NP &K), T1- control + ZnSO4, T2- control + Boric acid, T3- control + CuSO4, T4- control + PSB, T5- PSB + ZnSO4, T6- PSB + Boric acid, T7- PSB + CuSO4, T8- Control + *Azotobacte*r, T9- *Azotobacter* + ZnSO4, T10- *Azotobacter* + Boric acid, T11- *Azotobacter* + CuSO4. Plot of 1.5 × 1.5 m size were prepared. The distance between plant to plant as well as row to row was kept at 15 × 10 cm. Thus 150 plants were accommodated in each plot. Ten plants were randomly selected from each plot and tagged. The following observations were recorded on these plants. Plant height (cm), number of leaves per plant, leaf length (cm), neck thickness (cm), chlorophyll content (mg/g leaves), fresh weight of bulb (g), diameter of bulb (cm), number of cloves per bulb, fresh weight of 50 cloves (g), dry weight of 50 cloves (g), bulb yield per plot (kg plot-1) and bulb yield per hectors (q ha-1).

Results and Discussion

Plant growth characteristics

The results of present *investigation* showed that inoculation of biofertilizers and foliar application of micronutrients significantly increased *the plant height, number of leaves per plant,* leaf length and neck thickness compared to control.*(Table-1). The maximum value of growth parameters i.e.* plant height at 60 DAS (48.83 cm) and 130 DAS (77.30 cm), number of leaves per plant both at 60 DAS and 130 DAS (7.5 and 14.80), leaf length at 130 DAS (39.27 cm), neck thickness (0.92 cm) and total *chlorophyll content both at 60 and 90 DAS (0.43 and 0.78 mg/g in leaves), was recorded under treatment T5 (PSB +* ZnSO4*) as compared to control. These results are in conformity with the findings of* Sharangi *et al*. (2003) in garlic, Singh and Singh (2004) in cauliflower, Abd-El-Moneem *et al.* (2005) in garlic, Rohidas *et al*. (2010) in garlic, Abd-El-Samad *et al.* (2011) in tomato, Verma and Yadav (2011) in cauliflower and Gurmani *et al*. (2012) in tomato.

The increase in plant growth parameters may be due to inoculation of biofertilizers and foliar spray of micronutrients. PSB might have increased the amount of available phosphorus in the root zone for the growth and development of plants. In addition to phosphate solubilization these microbes can mineralize organic phosphorus into a soluble form. These reactions take place in the rhizosphere and the microorganism render more phosphorus into soil solubilization required for their smooth growth and metabolism. The surplus is available for plants to be absorbed. It also produce growth promoting substances, like auxins, gibberlines, cytokines etc. which influence the plant growth parameters by enhancing cell division, cell elongation and thus increasing the metabolic activity (Bhattacharya and Jain 2000 and Vivek *et al*., 2001). In addition to biofertilizers, the micronutrients resulted in the highest value of vegetative growth because micronutrients (Zn) play an important role in many physiological process and cellular formation within the plants. It also play an essential role in improving plant growth through the biosynthesis of endogenous hormones which is responsible for promoting of plant growth, strengthening plant cell wall and translocation of carbohydrates from leaves to other plant parts (Battal, 2004 and Hansch and Mendel, 2009). The same trends were also recorded by various scientists El-Gamelli, (2000), El-Shafee and El-Gamaily (2002), El-Tohamy *et al*., (2009) in onion, Alam *et al*. (2010) and Rohidas *et al.* (2010) in garlic.

Yield Attributing Characters

The average fresh weight of bulb, diameter of bulb, number of cloves per bulb, fresh weight of 50 cloves, dry weight of 50 cloves, yield of bulb per plot and yield of bulb per hectare increased *significantly with application of biofertilizers and micronutrients over control (Table-2). the maximum values of yield and yield attributes* i.e. fresh weight of bulb (34.37 g), diameter of bulb (5.49 cm), number of cloves per bulb (30.67 clove), fresh weight of 50 cloves (86.67 g), dry weight of 50 cloves (42.50 g), yield of bulb per plot (5.15 kg) and yield of bulb per hectare (229.03 q ha-1) was *recorded with the inoculation of PSB and foliar application of ZnSO4 @ 0.4% (T5) and minimum under* control (T0) *respectively. These results are in conformity with the findings of* Nagar and Meena (2004) in cluster bean, Srivastava *et al*., (2005) in

garlic, Kadlag *et al*. (2007) in tomato, Kachari and Korla (2009) in cauliflower, Rohidas *et al*., (2010) in garlic, Abedin *et al*., (2012) in onion and Darzi and Seyedhadi (2012) in dill. The increase in yield and yield attributes by the application of biofertilizer and micronutrient might be due to availability of sufficient amount of nitrogen, phosphorus by solubilization of natural status of nutrient present in soil and increase uptake of nutrients and effective utilization of nutrients for increased metabolism and synthesis of carbohydrates, greater vegetative growth and subsequent partitioning and translocation from leaf (source) to the head (sink) and also release of energy rich organic compounds by the biofertilizers which ultimately increased auxin activities, growth and activity of microbial saprophytes and phosphates activity which ultimately influenced the yield and yield attributes. In addition with biofertilizers the micronutrient (Zn) might have influenced the formation of some growth horomens in the plant as it is

Table 1. Effect of biofertilizers and micronutrients on growth attributes of garlic var. 'G-282'

Treatment No.	Plant height (cm)		Number of leaves		Leaf length (cm)	Neck thickness (cm)	Total chlorophyll (mg/g)	
	60 DAS	130 DAS	60 DAS	130 DAS			60 DAS	90 DAS
T0	37.73	64.33	6.10	12.70	31.74	0.60	0.20	0.53
T1	45.77	72.63	7.10	14.18	37.10	0.78	0.39	0.62
T2	44.73	71.27	6.67	14.10	36.50	0.70	0.30	0.71
T3	42.87	69.93	6.60	13.97	35.28	0.65	0.27	0.61
T4	46.03	72.40	6.57	13.90	36.04	0.68	0.32	0.68
T5	48.83	77.30	7.50	14.80	39.27	0.92	0.43	0.78
T6	47.30	74.50	7.12	14.23	37.99	0.84	0.41	0.72
T7	45.47	73.93	6.73	14.20	36.57	0.74	0.31	0.69
T8	44.03	69.97	6.83	13.93	35.72	0.65	0.30	0.68
T9	47.77	73.78	7.13	14.30	37.20	0.85	0.42	0.73
T10	45.37	72.01	6.57	14.17	36.95	0.76	0.38	0.70
T11	44.60	70.77	6.67	14.03	36.59	0.72	0.35	0.63
S.Em±	2.09	2.38	0.26	0.38	1.61	0.04	0.03	0.09
CD at 5 %	4.35	4.93	0.54	0.79	3.34	0.08	0.07	0.08

Table 2. Effect of biofertilizers and micronutrients on yield attributes of garlic var. 'G-282'

Treatments			Number of cloves par bulb	Fresh weight of 50 cloves (g)	Dry weight of 50 cloves (g)	Bulb yield Kg plot-1	Total bulb yield ha-1 (q)
	Fresh weight of bulb (g)	Bulb diameter (cm)					
T0	26.67	3.67	24.33	71.00	31.53	4.00	177.77
T1	32.58	4.96	27.67	81.33	38.58	4.79	217.18
T2	31.25	4.63	26.00	78.67	36.28	4.69	208.59
T3	29.67	4.58	26.00	79.00	36.11	4.40	195.40
T4	32.17	4.93	27.00	79.33	37.03	4.73	214.51
T5	34.37	5.49	30.67	86.67	42.50	5.15	229.03
T6	32.73	5.13	28.67	82.67	39.28	4.86	216.00
T7	29.83	4.78	27.00	80.67	36.80	4.48	198.96
T8	27.41	4.77	26.67	77.67	35.66	4.11	182.66
T9	30.17	4.92	28.83	81.67	38.63	4.52	201.03
T10	29.51	4.79	28.00	78.00	36.93	4.41	196.59
T11	29.36	4.64	27.33	79.33	36.37	4.39	195.70
S.Em ±	1.39	0.31	1.36	2.89	1.25	0.31	9.71
C.D. at 5%	2.87	0.64	2.82	6.01	3.97	0.64	28.66

T0-control, T1- $ZnSO_4$ @ 0.4%, T2 Boric acid @ 0.2%, T3 $CuSO_4$ @ 0.05%, T4 PSB, T5 PSB + $ZnSO_4$, T6 PSB + Boric acid, T7 PSB + $CuSO_4$, T8 *Azotobacter*, T9 *Azotobacter* + $ZnSO_4$, T10 *Azotobacter* + Boric acid, T11 *Azotobacte*r + $CuSO_4$, PSB & *Azotobacter* @ 2 kg ha-1 seed treatment.

associated with water relation in the plants and also involved in auxins metabolism like tryptophane synthetase, tryptomine metabolism, influence the activity of dehydrogenase enzymes eg. Pyridine nucleotide, glucose-6 phosphate and triose phosphate and also synthesis of tryptophane, a compound of proteins and needed for the production of growth hormones such as IAA and GA. Similar finding were recorded by Sharangi et al. (2003), Abd-El-Moneem et al. (2005) in garlic, Kumar and Sen (2005) in okra, Mahfouz and Sharaf-Eldin (2007) in fennel, Upadhyay et al. (2012) in cabbage.

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