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Effect of *Azotobacter*, *Azospirillum* and different level of inorganic fertilizer on growth and flowering of petunia

■ **P.C. SARWA[1], M. SONI[1], P.P. VAIDYA** AND **J.S. KHANDEKAR[1]**

Members of the Research Forum

Associated Authors:
[1]Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Sciences, Naini, ALLAHABAD (U.P.) INDIA

Author for correspondence :
P.P. VAIDYA
Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, AKOLA (M.S.) INDIA
Email : pratham1828746@gmail.com

ABSTRACT : Modern agriculture has been heavily dependent on chemical fertilizers to meet the food, flower demand of ever increasing population. In recent years, chemical pesticides and fertilizers were extensively applied to obtain higher crop yield. Overusing agrochemicals led to several agricultural problems such as poor cropping system. The excessive application of chemicals nitrogen fertilizer accelerated soil acidification and threatened an air and groundwater contamination at the sometime. Using organic fertilizers and bio-fertilizers offers a safe option for reducing the agrochemicals inputs. Hence, the current trend throughout the world is to expose the possibility of using alternate nutrient sources or increasing the efficiency of chemical fertilizers by supplementing them with organic fertilizers and bio-inoculants comprising largely microbes like bacteria. Among the different microbial inoculants or bio-fertilizers, *Azospirillum*, nitrogen fixing bacteria, *Azatobacter* and decomposing microorganism are considered as bio fertilizers. An experiment was carried out in Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad (U.P.) during 2011-2012.The treatment was laid out in simple Randomized Block Design (RBD) with ten treatments replicated thrice. The treatment consisted of two different biofertilizers *viz*., *Azotobacter* and *Azospirillum* with different levels of inorganic fertilizers (N: P: K) as a combination. A combination dose of *Azotobacter* and *Azospirillum* with different levels of nitrogen at 50%, 75%, 100% and full dose of P: K (basal dose) was applied at 30, 60, 90 and 120 days after transplanting. It was observed that Treatment T_8 (*Azospirillum* + *Azotobacter* + 100% dose of NPK) had significant effect on vegetative, reproductive stages of plant as well as increase the quality and yield of the flowers, when compared to control.

KEY WORDS : *Azotobacter*, *Azospirillum*, NPK, Petunia, Biofertilizers

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Flowers are associated with mankind from the down of civilization. It is said that in India man is born with flowers, live with flowers and finally dies with flower. Flowers are used for various purposes in our day to day life like worshipping, religious and social function, wedding, interior decoration and self adornment. Saying it with, flowers is very common and different flowers are used to convey the human feeling. It must however, be recognized that floriculture is not limited to flower production alone but also includes activities related to production and use of ornamental and flower plants for interior decoration and landscape use. Petunia is a popular, easy to grow and versatile annual with showy flowers and has the longest season of bloom of all garden annuals. A wide range of colours and forms has been developed over the years, which are classified on the basis of the characteristics of flowers. Petunia plants are perennials but are generally grown as half-hardy annulas in open gardens. Petunias were among the first flowers artificially hybridized in America in 1946. Petunia belongs to the family Solanaceae and Genus petunia, has its origin in South America. Petunia has 25 species including synthetic garden species *Petunia hybrida* (Vilm) which has arisen in historical times from two wild sp. *viz*., *Petunia axillaries* and *Petunia violacea*. The modern petunias are the result of crosses between two South

American species namely *Petunia integrifolia* and *petunia nyctaginiflora*. From these hybrids, many cultivars having diverse growth habits, size and colour of flowers have been isolated for cultivation. As a result of all these efforts, the petunias of today are the most popular, loveliest and a valuable race of garden plants.

Bio-fertilizers are microorganisms that enrich the nutrients quality of soil. In agriculture, the use of artificial fertilizers still ensure better yields, but soils and the environment become more polluted and depleted of important nutrients. Biofertilizers contains symbiotic and non-symbiotic microorganism that can result in higher resistance of plant to diseases and increase plant growth rate (Kumar *et al.*, 2001, 2008). Biofertilizers is environmentally friendly fertilizers that not only prevents damaging the natural sources, but also helps to some extent clean the nature from precipitated chemical fertilizer and can provide better nourishment to plant. Using biofertilizers offers a better option in reducing agrochemicals inputs, and helps to maintain soil fertility and strength. One of the dominant non-symbiotic nitrogen fixing heterotrophic bacterium in Indian soils is *Azotobacter*. The ability to fix elemental nitrogen is a vital physiological characteristic of *Azotobacter* spp. The range of fixation is 2-15 mg N fixed / g of carbon source utilized, although higher values have been reported.

RESEARCH METHODS

The experiments were carried out in the field of horticulture department, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad during 2010-2011 in Randomized Block Design. The experimental site is situated at a latitude of 200 and 150 North and longitude of 600 3' East and at an altitude of 98 meters above mean sea level (MSL). The area of Allahabad district comes under subtropical belt in the South east of Uttar Pradesh. Which experiences extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46^0C – 48^0 C and seldom falls as low as 4^0C – 5^0C. The relative humidity ranged between 20 to 94 per cent .The average rainfalls in this area is around 1013.4 mm annually. The treatment consisted of two different biofertilizers *viz.*, *Azotobacter* and *Azospirillum* with different levels of inorganic fertilizers (N: P: K) as a combination. A combination dose of *Azotobacter* (250 g/ ha) and *Azospirillum* (250 g/ ha) with different levels of nitrogen at 50%, 75%, 100% and full dose of P: K (basal dose) was applied at 30, 60, 90 and 120 days after transplanting. Treatments were T_1 (Control), T_2 (*Azospirillum* + 100% dose of NPK), T_3 (*Azospirillum* + 50% N + 100% dose of PK), T_4 (*Azospirillum* + 75% N + 100% dose of PK), T_5 (*Azotobacter* + 100% dose of NPK), T_6 (*Azotobacter* + 50% N + 100% dose of PK), T_7 (*Azotobacter* + 75% N + 100% dose of PK), T_8 (*Azospirillum* + *Azotobacter* + 100% dose of NPK), T_9 (*Azospirillum* + *Azotobacter* + 50% N + 100% dose of PK), T_{10} (*Azospirillum* + *Azotobacter* + 75% N + 100% dose of PK).

Sources of nitrogen, phosphorus and potassium were urea (46%), single super phosphate (18%) and muriate of potash (50%), respectively. Fertilizer was applied according to the treatments with first application after 30 days of planting and second one applied after 60 days, 90 days and 120 days after transplanting. Fertilizer was applied according to the treatments whereas other management practices like irrigation, weeding, hoeing, spraying etc. where same for all treatments during entire period of study. Plants were allowed to grow and data on various vegetative and floral characteristics were collected *viz.*, plant height (cm), plant spread (cm) were measured with the help of measuring tape, number of branches

Table 1 : Effect of *Azotobacter*, *Azospirillum* and different level of inorganic fertilizer on the qualitative and quantities characters of petunia

	Vegetative growth parameters				Reproductive growth parameters				
Treatments	Plant height (cm)	Plant spread (cm)	Number of branches per plant	Number of leaves per plant	Days required for first flower bud emergence (days)	Fresh weight of flower (g)	Dry weight of flower (g)	Diameter of flower (cm)	Weight of ten flowers (g)
T_1 (Control)	20.27	40.87	10.60	241.33	66.47	0.73	0.57	5.68	0.71
T_2	26.97	57.53	12.40	503.93	58.80	0.85	0.75	7.79	0.82
T_3	26.05	61.87	13.00	500.87	53.47	0.87	0.69	7.60	0.91
T_4	25.89	57.73	13.07	487.67	66.60	0.85	0.76	7.56	0.95
T_5	24.19	53.60	12.33	480.80	53.53	0.89	0.77	7.87	0.95
T_6	25.46	65.80	12.20	410.07	55.27	0.88	0.77	8.29	0.87
T_7	27.13	51.87	13.13	496.67	58.20	0.85	0.77	7.91	0.93
T_8	27.97	69.15	18.07	1559.93	62.47	1.02	0.86	8.51	0.99
T_9	26.40	64.27	12.87	479.93	60.67	0.84	0.76	7.63	0.89
T_{10}	27.80	62.33	12.27	449.80	61.47	0.88	0.76	7.34	0.89
F- test	S	S	S	S	S	S	S	S	S
S.E. ±	0.93	2.87	0.71	62.86	3.41	0.05	0.06	0.43	0.03
C. D. (P = 0.05)	1.95	6.03	1.50	132.07	7.17	0.10	0.12	0.89	0.07

S=Significant

per plant, number of leaves per plant, days required for first flower bud emergence, fresh weight of flower (g), dry weight of flower (g), diameter of flower (cm), total number of flowers per plant. Weight of flowers (fresh and dry weight) was calculated by weighing each flower on the eclectic balance and flower diameter (cm) was measured with the help of vernier caliper.

The observation were recorded at successive stage of growth, *i.e.*, at every 30 days intervals. The data recorded during the course of investigation on growth, yield and quality components were subjected to two way classification analysis of variance (ANOVA) as outlined by Panse and Sukhatme (1985) where the 'F' test was significant for comparison of the treatment means, CD values were worked out at 5% probability level.

RESEARCH FINDINGS AND DISCUSSION

The result present in Table 1 reveals that plant height (27.97cm), plant spread (69.15 cm), number of branches per plant (18.07) and number of leaves per plant (1559.93) were significantly increased with the application of treatment T_8 (*Azospirillum* + *Azotobacter* + 100% dose of NPK). The increase in the dose of nitrogenous fertilizers might be due to the property of the nitrogen to enhance the vegetative growth of plant and its involvement in various metabolic processes of plant. Similar results were also observed by Mallick *et al.* (2001) and Chattapathdyay and Kumar (2001). The presence of ammonium ions in ammonium sulfate has been reported to increase nitrate and ammonium absorption in plants (Fenn *et al.*, 1994) thereby supplying adequate nutrition for the growth of plant. Good vegetative growth by higher doses of nitrogen and phosphorus in gladiolus has also been reported by Jain and Verma (2003).

Treatment T_3 (*Azospirillum* + 50% N + 100% dose of PK) had a pronounced effect on the days to first flower bud emergence resulting in requiring lesser number of days (53.47 days) for the first bud emergence over other treatments. Higher levels of nitrogen are known to prolong vegetative growth by encouraging vigorous growth, more photosynthetic area for greater production and mobilization of photosynthetic resulting in delay of the reproductive phase which consequently delay flowering (Kumar *et al.*, 2003). Corroborative findings were also reported by Gowda *et al.* (1988) and Dod *et al.* (1991) in gladiolus.

Maximum fresh weight of flower (1.02 g) and dry weight of flower (0.86 g), diameter of flower (8.51 cm) and weight of ten flowers (0.99 g) was observed with treatment T_8 (*Azospirillum* + 50% N + 100% dose of PK). This might be due to the presence of ammonium which might have participated in higher protein synthesis and thus improved the vegetative growth, dry matter accumulation and partitioning of nutrients towards the developing flower buds (Kumar *et al.*, 2003). Beneficial effects of NPK on floral characters have been reported by Potti and Arora (1986) and Sharma and Singh (2001).

Conclusion:

From the present results it is concluded that, in respect of cultivation of petunia, under Allahabad conditions, the application of treatment T_8 (*Azospirillum* + *Azotobacter* + 100% dose of NPK) was effective in enhancing growth and yield of flower, attributing parameters as the cost benefit ratio was best in treatment T_8 (1:2:67) of petunia.

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