*Int.J.Curr.Microbiol.App.Sci* (2019) *8*(9): 234-240

*International Journal of Current Microbiology and Applied Sciences*
***ISSN: 2319-7706* Volume 8 Number 09 (2019)**
Journal homepage: http://www.ijcmas.com

**Original Research Article** https://doi.org/10.20546/ijcmas.2019.809.028

# Effect of Biofertilizers Applications on Growth and Flowering of African Marigold cv. 'Pusa Narangi Gainda' during Different Season of the Year under Mid-Hills Conditions of Himachal Pradesh

**Anju Kumari*, B.P. Sharma, Y.C. Gupta, Uday Sharma and Shweta Sharma**

*Department of Floriculture and Landscape Architecture*
*YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP)- 173230*

**Corresponding author*

**Keywords**

Azotobacter, PSB (phosphorus solubilizing bacteria), PGPR (plant growth promoting rhizobacteria), AM (Arbuscular mycorrhiza), NPK, FYM and marigold

**Article Info**

***Accepted:***
15 July 2019
***Available Online:***
10 August 2019

**A B S T R A C T**

The present investigation was carried out at the experimental farm of Department of Floriculture and Landscape Architecture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, HP in the year of 2016-2017 during different season (rainy season and summer season) and pooled data of both the season experiment were taken. The experiment was laid out in randomized block design replicated thrice and with 10 treatments. The treatments comprised of $N_2$ fixer (Azotobacter), PSB (phosphorus solublizing bacteria) PGPR (plant growth promoting rhizobacteria) and AM (Arbuscular mycorrhiza) with the three levels of NPK 70%, 80% and 90% respectively. Pertaining data exhibited growth and flowering parameters like highest plant height (72.48 cm), more leaf area (75.40 $cm^2$), higher plant spread (41.53 cm), more number of flowers per plant (40.34) and longest flowering duration (47.44 days) in plants supplied with Azotobacter + PSB + 70% RDF ($T_4$). With regards to season, plant height, leaf area, plant spread, number of flower per plant and flowering duration recorded to be more (70.76 cm, 78.91 $cm^2$, 42.09 cm, 38.60 and 42.87 days, respectively) during summer season planting as compared to rainy season planting while minimum number of days taken to bud appearance (53.04 days), minimum days taken to first flower opening (65.07 days) were observed with the application of same treatment ($T_4$) during rainy season. Whereas, maximum weight of individual flower (6.12 g) and largest flower diameter (5.85 cm) were recorded with Azotobacter + PSB + 80% RDF ($T_4$) during rainy season. Lowest values of growth and flowering traits were recorded in ($T_1$) control treated plants.

## Introduction

Marigold (*Tagetes erecta* L.) is one of the most specially grown loose flower crop which belongs to family Asteraceae. Marigold has been named after 'Virgin Mary'. The king Curtez after conquering Mexico got fascinated by the beauty of marigold flowers and he carried it to Spain. It was then offered to the 'attar' of Virgin Mary and thus got its name Mary's gold which is now popularly known as marigold (Marshal, 1969). It is also known as

friendship flower in United States and student lumen (student's flower) in Germany. It spreads to different regions of world during early parts of 16th century from Mexico (Bailey,1963). It occupies prominent position among the traditional loose flowers grown in India and ranks next only to jasmine in terms of production. It is extensively being used in religious and social occasions viz. to decorate the marriage homes, restaurant, temples, receptions, farewells, birthday occasions, wedding ceremonies and various public and social events. Its gaining popularity on aacount of its easy culture, wide adaptibilty, and increasing demand in the Asian subcontinent. Sometimes, the whole plant is used for decorations. It can be planted in beds for mass display, in mixed borders and can also be grown in pots In India, about 278 thousand hectares area is presently under floriculture with a production of 1656 thousand MT loose flowers annually. The total area under marigold is 55.89 thousand hectares with a production of about 511.31 thousand MT (NHB 2016-2017).

The chemical fertilizers are important sources of nutrients but the indiscriminate use of chemical fertilizers poses the threat of environmental pollution and soil health degradation. At present, we are not in a position to abandon the use of chemical fertilizers completely, so the best option available is to use the biofertilizers in lesser amounts. Thus, integrated nutrient management is a strategy for advocating judicious and efficient use of chemical with matching addition of organic manures and biofertilizers. Therefore, emphasis is now focused on the use of organic manures such as farm yard manure, and bio-fertilizers like Azotobacter, Phosphate Solubilising Bacteria (PSB), AM fungi and PGPR (Plant Growth Promoting Rhizobacteria). Azotobacter is a non symbiotic bacterium which fixes atmospheric nitrogen in to soil (Somani, 2005). Phosphate solublizing organism are not only able to solubilize insoluble forms of inorganic P but are also capable to mineralize organic forms of P, thus improving the availability of native soil P. Keeping the above facts in view, the present investigation was conducted with the objectives of to see the effect of biofertlizers and its combinations and to find out appropriate dose of biofertilizers on growth and flowering parameters of African marigold respectively.

## Materials and Methods

The present investigation was conducted at the at the experimental farm of Department of Floriculture and Landscape Architecture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, HP in the year of 2016-2017 to study the effect of biofertilizers on growth and flowering of African marigold and data of both season were taken during 2016-2017. African marigold cv. 'Pusa Narangi Gainda' was planted during different season *viz*, rainy season and summer season respectively with the spacing of 30 x30 cm and with 1x 1 $m^2$ plot size. The experiment was laid out in randomized block design (Factorial) with three replication which comprised 10 treatments *viz*, $T_1$ 100% NPK of RDF), $T_2$ Azotobacter+PSB+90% (RDF), $T_3$ Azotobacter+PSB+80% (RDF), $T_4$ Azotobacter+PSB+70% (RDF), $T_5$ Azotobacter+AM+90% (RDF), $T_6$ Azotobacter+AM+80% (RDF), $T_7$ Azotobacter+AM+70% (RDF), $T_8$ PGPR+90% (RDF), $T_9$ PGPR+80% (RDF) and $T_{10}$ PGPR+70% (RDF). The data of both seasons were analyzed statistically for interpretation of results.

## Results and Discussion

The data on growth parameters is presented in Table 1 clearly indicated that highest plant height (72.48 cm) over $T_1$ (control) observed with $T_4$ (Azotobacter + PSB + 70% RDF).

More leaf area (75.40 $cm^2$) observed in plants supplied with $T_4$ (Azotobacter + PSB + 70% RDF) which found to be statistically at par (73.59, and 73.59 $cm^2$, respectively) with $T_3$ (Azotobacter + PSB + 80%RDF) and $T_7$ (Azotobacter + AM + 80% RDF). Which might be attributed to the fact that the conjoint application of Azotobacter and PSB along with reduced dose of chemical fertilizers would have increased the total beneficial microbial population in the rhizosphere of the plant roots which in turn resulted in an increased leaf area by increasing the availability of nutrients (P, K, Zn, Cu etc.) as well as plant growth hormone production (Kaushal, 2006 and Tilak, 1993). Maximum plant spread (41.53 cm) to be recorded with the application of $T_4$ (Azotobacter + PSB + 70% RDF), whereas it was minimum (34.80 cm) in plants being grown with $T_4$ (Azotobacter + PSB + 70% RDF) Which may be due to increased cell multiplication and elongation due to enhanced nutrient uptake by plants following inoculated with Azotobacter and PSB probably caused the increased plant height. Similar result was found by Preethi *et al.,* (1999) in Edward rose; Ravindra *et al.,* (2013) in China aster; Renukaradhaya (2006) in Carnation. In respect of seasons, more plant height (70.76 cm), highest leaf area (78.91 $cm^2$) and maximum plant spread (42.09 cm) were recorded during summer season planting over rainy season planting. This is might be due to the availability of congenial growing conditions for growth of African marigold during summer season and subsequently the plants could put up more vegetative growth. These results are in confirmation with These results are in close to agreement with the earlier work of Mohanty *et al.,* (1993) in African marigold; Dilta *et al.,* (2007) in China aster.

Perusal data from Table 2 indicates that earlier days for bud appearance (53.04 days) noticed with $T_4$ (Azotobacter + PSB + 70% RDF), while it was late (57.85 days) with ($T_1$) 100% NPK however, earliest days taken to first flower opening (65.07 days) recorded with the application of $T_4$ (Azotobacter + PSB + 70% RDF) while it was maximum (71.95 days) in plants receiving $T_1$ (100% NPK). This may be ascribed to the easy uptake of nutrients and simultaneous transport of growth promoting substances like auxins, gibberellins, vitamins and organic acids produced by biofertilizers to the axillary buds resulting in earliness to reach harvesting stage. Sheergojri *et al.,* (2013) observed minimum number of days taken for full opening of flower with an application of NPK along with Azotobacter inoculation in dahlia. Similar result is in line with the findings of Vasanthi (1994) in Jasmine; Narashima Raju and Haripriya (2001) in Crossandra obtained similar findings regarding days taken to bud appearance and days taken to first flower opening.

Maximum number of flowers per plant (40.34) to be recorded with the $T_4$ (Azotobacter + PSB + 70% RDF) while it was minimum (29.12) with $T_1$ (100% NPK) The significant increase in number of flowers might be attributed to more leaf area which might have resulted in production and accumulation of maximum photosynthates, resulting into production of more number of flowers. Further, these results got support from Mittal *et al.,* (2010) in African marigold; Meshram *et al.,* (2008) in annual Chrysanthemum and Chougala *et al.,* (2014) in double daisy.

It is clear from Table 3, maximum individual flower weight (6.12 g) was observed with $T_3$ (Azotobacter + PSB + 80% RDF), however, it was minimum (4.21 g) in plants grown with $T_1$ (100% NPK). Amongst these treatments, larger flower size (5.85 cm) observed with $T_3$, (Azotobacter + PSB + 80% RDF), while it was smallest (4.35 cm) in plants supplied with 100% RDF of NPK ($T_1$) which might be attributed to that biofertilizers enhance the

level of auxins which divert the photo assimilates to the developing flower buds, resulting in increased petal number thereby, increasing the individual flower weight and flower diameter.

**Table.1** Effect of biofertilizers on vegetative growth of African marigold during different planting seasons

| Treatments | | Plant height (cm) | | | Leaf area ($cm^2$) | | | Plant spread (cm) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rainy Season | Summer Season | Mean | Rainy Season | Summer Season | Mean | Rainy Season | Summer Season | Mean |
| $T_1$ | 100% NPK of RDF | 50.60 | 65.18 | 57.89 | 59.61 | 69.51 | 64.56 | 30.00 | 39.59 | 34.80 |
| $T_2$ | Azotobacter+PSB+90% (RDF) | 60.80 | 70.65 | 65.73 | 61.82 | 80.43 | 71.13 | 34.87 | 42.36 | 38.62 |
| $T_3$ | Azotobacter+PSB+80% (RDF) | 64.50 | 72.71 | 68.61 | 64.96 | 82.21 | 73.59 | 35.44 | 42.50 | 38.97 |
| $T_4$ | Azotobacter+PSB+70% (RDF) | 67.10 | 77.86 | 72.48 | 66.89 | 83.91 | 75.40 | 38.14 | 44.92 | 41.53 |
| $T_5$ | Azotobacter+AM+90% (RDF) | 59.20 | 70.38 | 64.79 | 61.39 | 80.26 | 70.83 | 34.07 | 42.05 | 38.06 |
| $T_6$ | Azotobacter+AM+80% (RDF) | 64.00 | 71.94 | 67.97 | 62.43 | 83.04 | 72.74 | 34.87 | 42.43 | 38.65 |
| $T_7$ | Azotobacter+AM+70% (RDF) | 64.80 | 72.72 | 68.76 | 66.47 | 80.04 | 73.26 | 37.66 | 43.22 | 40.44 |
| $T_8$ | PGPR+90% (RDF) | 52.90 | 68.44 | 60.67 | 59.70 | 71.81 | 65.76 | 31.07 | 40.53 | 35.80 |
| $T_9$ | PGPR+80% (RDF) | 57.50 | 69.16 | 63.33 | 61.21 | 79.14 | 70.18 | 33.47 | 41.78 | 37.63 |
| $T_{10}$ | PGPR+70% (RDF) | 56.70 | 68.58 | 62.64 | 59.77 | 77.83 | 68.80 | 31.20 | 41.50 | 36.35 |
| **Mean** | | 59.80 | 70.76 | 65.28 | 62.42 | 78.91 | 70.67 | 34.10 | 42.09 | 38.09 |
| $CD_{0.05}$ | | Season : 1.39<br>Treatments : 3.10<br>SeasonxTreatments : 4.39 | | | Season : 1.62<br>Treatments : 2.82<br>SeasonxTreatments : 3.99 | | | Season : 0.62<br>Treatments : 1.40<br>Season xTreatments : 1.99 | | |

**Table.2** Effect of biofertilizers on flowering attributes of African marigold during different planting seasons

| Treatments | | Number of days taken to bud formation (days) | | | Days taken to first flower opening (days) | | | Number of flowers per plant | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rainy Season | Summer Season | Mean | Rainy Season | Summer Season | Mean | Rainy Season | Summer Season | Mean |
| $T_1$ | 100% NPK of RDF | 54.50 | 61.20 | 57.85 | 67.13 | 76.76 | 71.95 | 24.07 | 34.17 | 29.12 |
| $T_2$ | Azotobacter+PSB+90% (RDF) | 51.60 | 56.53 | 54.07 | 63.20 | 70.20 | 66.70 | 26.67 | 39.35 | 33.01 |
| $T_3$ | Azotobacter+PSB+80% (RDF) | 51.10 | 55.58 | 53.45 | 63.60 | 69.13 | 66.37 | 32.47 | 41.20 | 36.84 |
| $T_4$ | Azotobacter+PSB+70% (RDF) | 49.80 | 55.87 | 53.04 | 62.13 | 68.00 | 65.07 | 37.20 | 43.47 | 40.34 |
| $T_5$ | Azotobacter+AM+90% (RDF) | 51.70 | 56.80 | 54.25 | 64.73 | 70.67 | 67.70 | 25.27 | 37.76 | 31.52 |
| $T_6$ | Azotobacter+AM+80% (RDF) | 50.20 | 56.47 | 53.14 | 63.07 | 68.20 | 65.64 | 27.80 | 40.79 | 34.30 |
| $T_7$ | Azotobacter+AM+70% (RDF) | 51.20 | 56.47 | 53.84 | 63.20 | 69.95 | 66.58 | 35.07 | 42.97 | 39.02 |
| $T_8$ | PGPR+90% (RDF) | 53.00 | 58.53 | 55.77 | 66.07 | 74.13 | 70.10 | 24.54 | 36.05 | 30.30 |
| $T_9$ | PGPR+80% (RDF) | 51.90 | 58.13 | 55.02 | 65.13 | 71.33 | 68.23 | 24.27 | 34.83 | 29.55 |
| $T_{10}$ | PGPR+70% (RDF) | 52.40 | 58.47 | 55.44 | 65.80 | 74.00 | 69.90 | 24.47 | 35.40 | 29.94 |
| **Mean** | | 51.74 | 57.43 | 54.59 | 64.41 | 71.24 | 67.83 | 28.18 | 38.60 | 33.39 |
| $CD_{0.05}$ | | Season : 0.23<br>Treatments : 0.51<br>Season x Treatments : 0.72 | | | Season : 0.33<br>Treatments : 0.74<br>Season x Treatments : 1.05 | | | Season : 0.96<br>Treatments : 2.14<br>Season x Treatments : 3.03 | | |

**Table.3** Effect of biofertilizers on flowering parameters of African marigold during different planting seasons

| Treatments | | Individual flower weight (g) | | | Flower diameter (cm) | | | Flower duration (days) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rainy Season | Summer Season | Mean | Rainy Season | Summer Season | Mean | Rainy Season | Summer Season | Mean |
| $T_1$ | 100% NPK of RDF | 4.26 | 4.16 | 4.21 | 4.45 | 4.25 | 4.35 | 34.59 | 41.50 | 38.05 |
| $T_2$ | Azotobacter+PSB+90% (RDF) | 5.02 | 4.80 | 4.91 | 5.23 | 4.80 | 5.02 | 36.21 | 48.02 | 42.12 |
| $T_3$ | Azotobacter+PSB+80% (RDF) | 7.10 | 5.13 | 6.12 | 6.55 | 5.14 | 5.85 | 40.73 | 49.50 | 45.12 |
| $T_4$ | Azotobacter+PSB+70% (RDF) | 6.04 | 5.54 | 5.79 | 5.50 | 5.25 | 5.38 | 42.07 | 52.81 | 47.44 |
| $T_5$ | Azotobacter+AM+90% (RDF) | 5.57 | 4.93 | 5.25 | 5.47 | 4.88 | 5.18 | 35.95 | 47.47 | 41.71 |
| $T_6$ | Azotobacter+AM+80% (RDF) | 4.93 | 4.68 | 4.81 | 5.07 | 4.76 | 4.92 | 38.91 | 48.10 | 43.51 |
| $T_7$ | Azotobacter+AM+70% (RDF) | 6.47 | 5.39 | 5.93 | 5.91 | 5.20 | 5.56 | 41.39 | 51.78 | 46.59 |
| $T_8$ | PGPR+90% (RDF) | 4.26 | 4.22 | 4.24 | 4.76 | 4.16 | 4.46 | 35.87 | 47.29 | 41.58 |
| $T_9$ | PGPR+80% (RDF) | 4.85 | 4.40 | 4.63 | 4.97 | 4.64 | 4.67 | 35.40 | 43.93 | 39.67 |
| $T_{10}$ | PGPR+70% (RDF) | 4.72 | 4.43 | 4.58 | 4.85 | 4.65 | 4.75 | 35.65 | 47.11 | 41.38 |
| **Mean** | | 5.32 | 4.77 | 5.05 | 5.28 | 4.82 | 5.01 | 37.68 | 42.87 | 40.28 |
| $CD_{0.05}$ | | Season : 0.22<br>Treatments : 0.48<br>Season x Treatments : 0.68 | | | Season : 0.12<br>Treatments : 0.26<br>Season x Treatments : 0.37 | | | Season : 0.71<br>Treatments : 1.59<br>Season x Treatments : 2.26 | | |

The result are in agreement with the finding of Dalawai and Naik (2014) in China aster. With regards to season, earlier days for bud appearance (51.74 days), minimum days taken to first flower opening (64.41 days), highest individual flower weight (5.32 g) and largest flower diameter (5.28 cm) recorded during rainy season as compared to summer season. The reason might be that long day conditions experienced by the summer season planting produced more vegetative growth and hence, flowering was delayed, whereas, during August onwards, there were short day conditions that resulted in the formation of flower buds in lesser time period. These results corroborate the findings of Singh and Arora, (1988) and Samantaray *et al.*, (1999) who observed that apical flower- bud formation was hastened in marigold plants when planted after September and before March mainly due to short day conditions. More individual flower weight and flower diameter were noticed during rainy season which might be attributed to moderate temperature prevailing during the crop period which is favorable for the production of bigger size flowers in July planted crop. These results are in close agreement with the earlier findings of Dhawale *et al.,* (2003) and Kaushal *et al.*, (2014) in China aster.

It was the discovered that maximum duration of flowering (47.44 days) during 2016-2017 were recorded with $T_4$ (Azotobacter + PSB + 70% RDF), however it was shortest (38.05) with $T_1$ (100% NPK). This result got support

from Airadevi (2012) in annual Chrysanthemum who recorded maximum flowering duration with Azospirillum + PSB + 50% vermicompost equivalent to recommended dose of N + 50% NPK. Further, Palagani *et al.,* (2013) observed that the plants receiving 75 per cent N + 75 per cent P + 100 per cent K + vermicompost @ 1.25 t/ha + cocopeat @ 0.875t/ha + *Azotobacter* @ 2kg/ha + PSB @ 2kg/ha resulted in maximum duration of flowering in chrysanthemum (*Chrysanthemum morifolium* Ramat). More number of flowers and longest flowering duration was recorded during summer season over rainy season. This might be due to the reason that February- March planted crop could have put more vegetative growth that would have produced more number of flower bud which ultimately contributed for longest flowering duration in African marigold. Chanda and Roychoudhary (1991) reported the similar results in African marigold.

## Acknowledgments

I wish to acknowledge the timely help, full co-operation and uninterrupted encouragement of my parents, dear friends and all the faculty member of the department who helped me in every way willingly and selfless.

## Interaction effect

Interaction between season and treatments revealed that plants grown during summer season retained higher plant height (77.86 cm), highest plant spread (44.92 cm), maximum leaf area (83.21 $cm^2$), more number of flower per plant 43.47) and longest flowering duration (52.81 days) recorded with the $T_4$ (Azotobacter + PSB + 70 %RDF) when the plants being grown during summer season. Earlier days for bud formation (50.20 days) and minimum days for first flower opening (62.13 days) were observed during rainy season planting when plants supplied with $T_4$ (Azotobacter + psb + 70% RDF). Maximum individual flower weight (7.10 g) and larger flower size (6.55 cm) were obtained with the application of $T_3$ (Azotobacter + PSB + 80% RDF) during summer season planting.

## References

Anonymous. 2016. National Horticulture Board. Department of Agriculture and Cooperation, Government of India. Retrieved from www.nhb.gov.in.

Airadevi, A.P. 2012. Integrated nutrient management studies in garland chrysanthemum (*Chrysanthemum coronarium* L.). Bioinfolet 9(4A): 430-434.

Bailey, L.H. 1963. The Standard encyclopedia of Horticulture, III, McMillian Co. Ltd. New York

Chanda, S and Roychaudhary, N. 1991. The effect of planting dates and spacing on growth, flowering and yield of African marigold (*Tagetes erecta* L.) cv. 'Siracole'. *The Horticulture Journal* 4(2): 53-56.

Chougala, V., V.S. Patil., and Paramagoudar, P. 2014. Effect of integrated nutrient management on yield and quality of double daisy (*Aster amellus* L.). *Trends in Biosciences* 7(14): 1820-1823.

Dalawai, B., and Naik H. 2014. Integrated nutrient management studies in carnation (*Dianthus caryophyllus*) cv. 'Soto' under protected condition. *International Journal of Agricultural Sciences* 2:2-24.

Dhawle, D.V., M.M. Dhamke and Panchbhai, D.M. 2003. Effect of different planting densities and season on flowering of China aster. *Journal of Maharashtra Agricultural Universities* 19(3): 349-352.

Dilta, B.S., Y.C. Gupta and Sharma, P. 2007. Effect of different planting dates on performance of China aster (*Callistephus chinensis* Nees.). *The Asian Journal of Horticulture* 2(2): 245-248.

Kaushal. S., B.S. Dilta, S.V.S. Chaudhary and Gupta, Y.C. 2014. Effect of planting dates on growth and flowering of China aster

(*Callistephus chinensis* L.). *International Journal of Farm Sciences* 4(1):60-71.

Kaushal, R. 2006. Use of Vriksha Mitra biofertilizers on Apple. Project report, Department of Soil Science and Water Management, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, India.

Marshal, C. 1969. Encyclopedia of Gardening. Paul Hanyla, London. 20:2213-2214.

Meshram, N., S.Badge, S.A. Bhongle and Khiratkar, S.D. 2008. Effect of bio-inoculants with graded doses of NPK on flowering, yield attributes and economics of annual chrysanthemum. *Journal of Soils and Crops* 18:217-220.

Mittal, R., H.C. Patel, D.D. Nayee and Sitapara, H.H. 2010. Effect of integrated nutrient management on growth and yield of African marigold (*Tagetes erecta* L.) cv. 'Local'. *The Asian Journal of Horticulture* 5(2): 347-349.

Mohanty, C.R., T.K. Behera and Samantaray, D. 1993. Effect of planting time and spacing on growth and flower yield of marigold cv. 'African Yellow'. *South Indian Horticulture* 45(1/2): 41-44.

Narasimha, Raju S and Haripriya, K. 2001. Integrated nutrient management in crossandra (*Crossandra infundibuliformis* L.) cv. Dindigul Local. *South Indian Horticulture* 49:181-184.

Preethi, T.L., C.M. Pappiah and Anbu, S. 1999. Studies on the effect of *Azosprillium* sp. nitrogen and ascorbic acid on the growth and flowering of Edward rose (*Rosa bourboniana* Desp.). *South Indian Horticulture* 47:106-110.

Ravindra, P., M. Hanumanthappa, J.N. Hegde, K.J. Maheshwar and Nagesha, L. 2013. Effect of integrated nutrient management on growth, yield and vase life of China aster (*Callistephus chinensis* (L.) Nees) for coastal Karnataka. *Environment and Ecology* 31:1104-1106.

Renukaradya, S., C.M. Pradeepkumar, H.M. Santhosha, M. Dronachari and Shashikumar, R.S. 2006. Effect of integrated system of plant nutrition management on growth, yield and flower quality of carnation (*Dianthus caryophyllus* L.) under greenhouse. *The Asian Journal of Horticulture* 6: 106-112.

Samantaray, D., C.R. Mohanty and Behera, T.K. 1999. Effect of planting time and spacing on growth and flower yield of marigold (*Tagetes erecta* L.) cv. 'African Yellow'. *Indian Journal of Horticulture* 56(4): 382-385.

Sheergojri, G.A., Z.A. Neelofar Rather, F.U. Khan, I.T. Nazki and Qadri, Z.A. 2013. Effect of chemical fertilizers and bio-inoculants on growth and flowering of dahlia (*Dahlia variabilies* Desf.) cv. 'Pink Attraction'. *Applied Biological Research* **15**: 121-129.

Singh, J and Arora, J.S. 1988. Effect of planting times and spacing on growth, flower and seed production of marigold cv. 'African Giant Double Orange'. *The Punjab Vegetable Grower* 23: 41-44.

Somani, L.L. 2005. *Handbook of Biofertilizers*. Agrotech Publishing Academy, Udaipur. 1167p.

Tilak, K.V.B.R. 1993. In: *Bacterial Fertilizers*. Indian Council of Agricultural Research, Krishi Anusandhan Bhawan, Pusa, New Delhi.

Vasanthi. 1994. Studies on the effect of graded levels of nitrogen, phosphorus with azospirillum and phosphobacteria on growth and yield of jasmine cv. 'jathimalli' M.Sc. Thesis. Tamil Nadu Agricultural University, Coimbatore.

**How to cite this article:**

Anju Kumari, B.P. Sharma, Y.C. Gupta, Uday Sharma and Shweta Sharma. 2019. Effect of Biofertilizers Applications on Growth and Flowering of African Marigold cv. 'Pusa Narangi Gainda' during Different Season of the Year under Mid-Hills Conditions of Himachal Pradesh. *Int.J.Curr.Microbiol.App.Sci.* 8(09): 234-240. doi: https://doi.org/10.20546/ijcmas.2019.809.028