The Pharma Innovation Journal 2022; 11(12): 3566-3570

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(12): 3566-3570

www.thepharmajournal.com
Received: 01-10-2022
Accepted: 05-11-2022

**Chandana M**
PG Scholar, Department of Horticulture, College of Agriculture, KSNUAHS, Shivamogga, Karnataka, India

**Hemla Naik B**
Director of Extension and Professor (HAG), Department of Horticulture, College of Agriculture, KSNUAHS, Shivamogga, Karnataka, India

**Nandish MS**
Associate Professor, Department of Agricultural Microbiology, College of Agriculture, KSNUAHS, Shivamogga Karnataka, India

**Champa BV**
Assistant Professor, Department of Horticulture, College of Agriculture, KSNUAHS, Shivamogga, Karnataka, India

**Kantharaj Y**
Assistant Professor, Department of Post-harvest Technology, College of Horticulture, Mudigere, KSNUAHS, Shivamogga, Karnataka, India

**Thippeshappa GN**
Professor and Head, Department of Soil Science and Agricultural Chemistry, College of Agriculture, KSNUAHS, Shivamogga, Karnataka, India

**Corresponding Author:**
**Hemla Naik B**
Director of Extension and Professor (HAG), Department of Horticulture, College of Agriculture, KSNUAHS, Shivamogga, Karnataka, India

# Effect of bio inoculants with graded levels of potassium on flower quality and yield of chrysanthemum (*Chrysanthemum morifolium* Ramat.) under protected condition

**Chandana M, Hemla Naik B, Nandish MS, Champa BV, Kantharaj Y and Thippeshappa GN**

**Abstract**
The bio inoculants plays a crucial role in reducing the inorganic fertilizer application and increasing the flowers quality and yield besides maintaining soil fertility. With this background, an experiment "Effect Of Bio inoculants with Graded Levels of potassium on flower quality and yield of Chrysanthemum (*Chrysanthemum morifolium* Ramat.) Under Protected Condition" was conducted at the department of Horticulture, College of Agriculture, Shivamogga during 2021-22. Ten treatments were replicated thrice in Randomized Complete Block Design. The observations were recorded on various flower quality and yield parameters. Among all treatments $T_7$ (100% N & P+ 75% K + KSB+ KSF) recorded highest individual flower weight (6.36 g), flower diameter (6.69 cm), shelf life (7.17 days), vase life (12.00 days), number of flowers per plant (77.93), flower yield per plant (360.60 g), per $m^2$ (4.16 kg) and per poly house (2.6 t/560 $m^2$), number of suckers per plant (7.21), per $m^2$ (68.11) and per polyhouse (28607.6). While, lowest was recorded under control. Hence, it is concluded that application of 75 per cent potassium and 100 per cent nitrogen and phosphorous along with bio inoculants is most effective in enhancing the flower quality and yield characters of chrysanthemum.

**Keywords:** Chrysanthemum, bio inoculants, potassium, protected condition, flower quality and yield

## Introduction
The field of floriculture is evolving into a high-tech, interdisciplinary frontier area based on scientific excellence. The Indian government has designated floriculture as a sunrise sector and commercial floriculture has developed into a high-tech operation that takes place in a greenhouse under controlled climatic conditions.

Chrysanthemum (*Chrysanthemum morifolium* Ramat.), a member of the Asteraceae family with the diploid chromosome number 2n = 36, is one of the most fascinating and ancient flower crops. It is indigenous to the northern hemisphere, primarily in Asia and Europe. Among the flower crops in the world, it ranks second in the international cut flower trade next to rose in importance among the flower crops in the world. Chrysanthemum flower suitable for various purposes like bedding plant, border planting, decoration of vase and for garden display. Chrysanthemum is used in our country for making garlands, bracelets, veni, flower decoration and religious offerings. Due to wide range of colours, shapes and size of flowers it has earned tremendous popularity. Moreover, the utility and popularity of chrysanthemum has increased greatly with the technique of year round blooming habit due to its ability to produce flowers round the year using cultivars based on their sensitivity to photoperiods.

The quality of flowers is primarily a varietal trait, it is greatly influenced by climatic, geographical and nutritional factors. Nutritional factors playing a major role to get good quality exportable blooms, higher yields and long lasting post-harvest life. Potassium is the third major essential macronutrient for plant growth and development. Being essential or vital nutrient for plant growth, potassium ($K^+$) plays an important role in plant regulatory development including osmoregulation, plant-water relation and internal cation/anion balance, enzyme activation, protein and starch synthesis, respiratory and photosynthetic metabolism stomatal movement and water relations (turgor regulation and osmotic adjustment) by increasing protein production in plants (Rawat *et al*., 2016) [19].

Boodley (1975) [4] considered quality to be a function of nutrient level. Toxic levels of nutrients adversely affect the quality of ornamental plants and flowers.

Therefore, sufficient attention is needed to apply adequate quantity of nutrients through proper sources. By using inorganic fertilizers, one can get higher yield but indiscriminate use of chemical fertilizers has adverse effect on the soil structure, environment and fauna. Now-a-days, attention is being shifted towards alternate sources, *i.e*., organic manures and bio inoculants. Bio fertilizers or more appropriately called microbial inoculants are the preparations containing live or latent cells of efficient strains of microorganisms. These bio fertilizers are a cost effective renewable energy source and plays a crucial role in reducing the inorganic fertilizer application and at the same time increasing the quality and yield of flowers besides maintaining soil fertility. These may be biological nitrogen fixers, P-solubilizing, K-solubilizing and transformation of several elements into available forms. Common bio fertilizers used in horticulture crops are *Azotobacter*, Phosphorus solubilizing bacteria (*Pseudomonas striata*), Vesicular arbuscular mycorrhizal (VAM) fungi, Potassium solubilizing bacteria (*Bacillus mucilaginosus*) and Potassium solubilizing fungus (*Aspergillus awamori*). Efficient K-solubilizing microorganisms have been reported to enhance potassium uptake in plants leading to plant growth stimulation under polyhouse and field conditions. These K-solubilizing microorganisms (KSMs) could be applied as potential bio fertilizers along with application of rock K materials to provide a continuous supply of available potassium for increasing the crop yield.

## Materials and Methods

The present investigation was carried out during 2021-22 at College of Agriculture, Navile, Shivamogga, Karnataka. Rooted terminal cuttings of chrysanthemum var. Kolar Local used for planting on ridges and furrows in plot size of 3.3m x 1m with spacing 30 x 30cm (33 plants/plot). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. There were Ten treatments which were applied as., $T_1$ -100% RDF (control); $T_2$ -100% NPK + KSB; $T_3$ -100% NPK + KSF; $T_4$ -100% NPK + KSB+ KSF; $T_5$ -100% N & P+ 75% K+ KSB; $T_6$ -100% N & P+ 75% K+ KSF; $T_7$ -100% N & P+ 75% K+ KSB+KSF; $T_8$ -100% N & P+ 125% K+ KSB; $T_9$ -100% N & P+ 125% K+ KSF; $T_{10}$ - 100% N & P+ 125% K+ KSB +KSF.

In the present investigation, five bio inoculants were used, namely *Bacillus mucilaginosus*, *Aspergillus awamori*, *Azotobacter chroccacum*, *Pseudomonas striata* and *Glomus fasciculatum* were applied at 5 days before planting. Bio inoculants were mixed along with FYM and directly applied to the soil and the observations on growth and flower yield parameters were recorded from the tagged plants and the data were analyzed scientifically and interpreted the results and discussed as below.

## Results and Discussion

The results of the experimental study are reported and listed in Table 1 and 2.

### Flower quality parameters

The ultimate aim of any grower is to get increased yield of crop, followed by quality, which realizes more revenue. Among the several parameters which either directly or indirectly influence the yield and quality of chrysanthemum. In the parameters flower weight, flower diameter, shelf life and vase life significant differences were observed among the treatments (Table 1).

### Flower weight (g)

Flower weight influenced significantly due to different treatments. The plants treated with 100 per cent N and P and 75 per cent K along with KSB and KSF ($T_7$) recorded maximum flower weight of 6.36 g which was significantly higher than all other treatments and it was statistically on par with $T_4$ (6.01 g). Whereas, $T_1$ (100% RDF) recorded minimum flower weight (4.10 g). The significant increase in average flower weight may be due to higher potassium availability through KSMs and RDF. Due to better physical condition of soil and increased population of micro flora, thereby enhanced availability of nutrients through solubilization and mobilization process. Moreover, bio fertilizers produce the growth stimulating substances *viz*., auxin, gibberellins and cytokinins which contribute towards vigorous growth of the plant. This in turn increases photosynthesis and enhances food accumulation and also diversion of photosynthates towards sink resulting in better quality flowers. Difference in dry matter production and its distribution into different plant parts (leaf, stem and flower) with the inoculation of bio-inoculants were mainly responsible for the increased in flower yield, number of flowers and flower size. The earlier study of Swaroop (2011) [23] also confirms these findings in marigold, Kirar *et al.* (2014) [9] in China aster.

### Flower diameter (cm)

Flower diameter was considerably influenced by different treatments, with the maximum flower diameter (6.69 cm) observed when the plants were given (100% N and P + 75% K + KSB+ KSF) ($T_7$), which was statistically comparable to $T_4$ (6.13 cm). Under $T_1$, the minimum flower diameter of 4.13 cm was recorded (100% RDF). This may be assigned to early breaking of apical dominance followed by easy and better translocation of nutrients to the flowers brought about by inoculation with beneficial microbial inoculants like KSB and KSF. Potassium in soil which helps the plant in healthy growing condition resulting into the production of flower having more diameter. KSMs might have helped in increasing potassium availability by solubilizing fixed potassium in soil and making it available to plant and release the enzymes resulting in the production of larger flowers. Similar results are reported by Verma *et al.* (2011) [25] and Laishram (2013) [12] in chrysanthemum.

### Shelf life (days)

The flower's shelf life differed considerably between treatments. $T_7$ (100% N and P + 75% K + KSB+ KSF) had the longest shelf life (7.17 days) and was statistically comparable to $T_4$ (6.15 days). The RDF ($T_1$) has the shortest floral shelf life (3.17 days). It may be due to higher retention of water in the cells of flowers and flower desiccation as caused due to the beneficial effect of bio fertilizer like KSB, KSF and FYM. These findings are matching with those of Mashaldi (2000) [13].

### Vase life (Days)

Flowers vase life differed substantially between treatments. Treatment $T_7$ (100% N and P + 75% K + KSB+ KSF) had the longest vase life of 12.00 days, followed by the treatment $T_4$

(100% NPK + KSB+KSF) (10.67 days). The treatment 100 per cent RDF ($T_1$) had the shortest flower vase life (7.33 days). It might also be due to the presence of ethylene inhibitors or due to the presence of cytokinins which delay senescence of flowers. These findings are matching with those of Mashaldi (2000) [13] in marigold Verma *et al.*, 2011 [25] and Palagani *et al*., 2013 [17] in chrysanthemum.

**Flower and sucker yield and its attributing characters**

The data measured on flower yield aspects *viz*., number of flowers per plant, flower yield per plant, flower yield per $m^2$, flower yield per $560m^2$, number of suckers per plant, number of suckers per $m^2$ and number of suckers per 560 $m^2$ as influenced by different treatments are presented in the Table 2.

In terms of the number of flowers produced per plant, different treatments had a considerable impact. Plants inoculated with 100 per cent N and P + 75 per cent K + KSB+ KSF ($T_7$) produced more flowers (77.93) and were statistically comparable with $T_4$ plants (76.13). $T_1$ (100% RDF) was found to have the least flowers per plant (54.76). In terms of the flowers yield produced per plant, different treatments had a considerable impact. Plants inoculated with 100 per cent N and P + 75 per cent K + KSB+ KSF ($T_7$) produced higher flower yield (360.60 g) and were statistically comparable with $T_4$ plants (347.58 g). $T_1$ (100% RDF) was found to have the least flowers per plant (248.41 g). The higher yield per $m^2$ was observed in $T_7$ (100% N and P + 75% K + KSB+ KSF) (4.16 kg) and it was on par with $T_4$ (100% NPK+ KSB+KSF) (3.86 kg) and $T_{10}$ (100% N and P+125% K+KSB+KSF) (3.65 kg).Whereas, the lowest yield per $m^2$ was recorded in $T_1$ (100% RDF) (2.81 kg). Among all the treatments, $T_7$ (100% N and P + 75% K + KSB+ KSF) registered the maximum yield per 560 $m^2$ (2.68 t) and it was at par with $T_4$ (100% NPK+ KSB+KSF) (2.55 t). The minimum yield was recorded in $T_1$ (100% RDF) (1.99 t).

In treatment $T_7$ (100% N and P + 75% K + KSB+ KSF) the maximum number of suckers are produced (7.21) and it was compatible with $T_4$ (100% NPK+ KSB+KSF) (6.89). However, the minimum number of suckers are produced in $T_1$ (100% control) (4.81). In terms of the sucker yield produced per $m^2$, plants inoculated with 100 per cent N and P + 75 per cent K + KSB+ KSF ($T_7$) produced higher sucker yield (68.11) and were statistically comparable with $T_4$ plants (65.11). T1 (100% RDF) was found to have the least suckers per $m^2$ (38.06). The higher sucker yield per 560 $m^2$ was observed in $T_7$ (100% N and P + 75% K + KSB+ KSF) (38143.5) and it was on par with $T_4$ (100% NPK+ KSB+KSF) (36460.7) and $T_{10}$ (100% N and P+125% K+KSB+KSF) (35338.5).Whereas, the lowest suckers yield per 560 $m^2$ was recorded in $T_1$ (100% RDF) (21315.5).

Increase in yield of flowers due to active and rapid multiplication of microorganisms especially in rhizosphere creating favourable condition for nitrogen fixation and potassium solubilization at higher rate through nitrogen supply by nitrogenous fertilizers and supply of other nutrients, bacterial secretion, hormone production and supply of antibacterial and antifungal compounds, which were favourable for growth and ultimately increased yield (Kumar *et al.*, 2009) [10] in marigold.

The possible reason for better performance of yield attributes and higher yield could be due to possible role of KSB, KSF, *Azotobacter*, VAM and PSB through uptake of nutrients and water, higher leaf number and area. More photosynthesis enhanced food accumulation which might have resulted in better plant growth and subsequently higher number of flowers per plant and hence more number of flower yield per hectare. Moreover, presence of growth promoting substances such as auxin, gibberellins and cytokinin due to presence of bio fertilizers would have also contributed in development and accumulation of sink resulting in better growth and subsequently higher number of flowers per plant and higher flower yield per $560m^2$. The results are in agreement with the earlier findings of Thumar *et al*., 2013 [24] and Jadhav *et al*., 2014 [8] in marigold, Patanwar *et al.*, 2014 [18] in chrysanthemum, Sheergojri *et al.*, 2013 [20] in dahlia, Meshram *et al*., 2008 [15] in chrysanthemum.

**Table 1:** Effect of bio inoculants with graded levels of potassium on flower quality parameters of Chrysanthemum

| Treatments | | Individual flower Weight (g) | Flower diameter (cm) | Shelf life (days) | Vase life (days) |
|---|---|---|---|---|---|
| $T_1$ | 100% RDF | 4.10 | 4.13 | 3.17 | 7.33 |
| $T_2$ | 100% NPK + KSB | 5.23 | 5.83 | 4.66 | 8.33 |
| $T_3$ | 100% NPK + KSF | 4.82 | 4.74 | 3.17 | 8.67 |
| $T_4$ | 100% NPK+ KSB+ KSF | 6.01 | 6.13 | 6.15 | 10.67 |
| $T_5$ | 100% N & P+ 75% K+ KSB | 5.85 | 5.89 | 5.67 | 10.33 |
| $T_6$ | 100% N & P+ 75% K + KSF | 5.21 | 4.83 | 4.83 | 9.67 |
| $T_7$ | 100% N & P+ 75% K + KSB+ KSF | 6.36 | 6.69 | 7.17 | 12.00 |
| $T_8$ | 100% N & P+ 125% K+ KSB | 5.47 | 5.49 | 5.67 | 8.67 |
| $T_9$ | 100% N&P+ 125% K + KSF | 4.76 | 4.99 | 4.17 | 8.33 |
| $T_{10}$ | 100% N&P+ 125% K+ KSB+ KSF | 5.31 | 6.03 | 5.14 | 10.67 |
| S. Em ± | | 0.19 | 0.17 | 0.22 | 0.47 |
| C.D. @ 5% | | 0.56 | 0.50 | 0.65 | 1.40 |

Note:
RDF - 40: 60: 40 kg N $P_2O_5$ $K_2O$ acre$^{-1}$
FYM – 8 t acre $^{-1}$ common for all treatments
Bio-inoculants: 5 kg acre$^{-1}$
KSB- Potassium Solubilizing Bacteria (*Bacillus mucilaginosus*)
KSF- Potassium Solubilizing Fungus (*Aspergillus awamori*)
FYM, *Azotobacter chroccacum*, VAM - Vesicular Arbuscular Mycorrhiza (*Glomus fasciculatum*) and PSB (*Pseudomonas striata*) at 5 kg per acre is common for all treatments.

**Table 2:** Effect of bio inoculants with graded levels of potassium on flower yield and its attributing characters of Chrysanthemum

| Treatments | | Number of flowers per plant | Flower yield per plant (g) | Flower yield per $m^2$ (kg) | Flower yield per $560m^2$ (t) | Number of suckers per plant | Number of suckers per $m^2$ | Number of suckers per $560m^2$ |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | 100% RDF | 54.76 | 248.41 | 2.81 | 1.99 | 4.81 | 38.06 | 21315.5 |
| $T_2$ | 100% NPK + KSB | 65.11 | 270.45 | 3.41 | 2.38 | 6.29 | 58.10 | 32534.1 |
| $T_3$ | 100% NPK + KSF | 58.10 | 260.60 | 3.01 | 2.26 | 6.08 | 47.08 | 26363.9 |
| $T_4$ | 100% NPK+ KSB+ KSF | 76.13 | 347.58 | 3.86 | 2.55 | 6.89 | 65.11 | 36460.7 |
| $T_5$ | 100% N & P+ 75% K+ KSB | 71.12 | 290.48 | 3.61 | 2.45 | 6.41 | 61.10 | 34216.9 |
| $T_6$ | 100% N & P+ 75% K + KSF | 62.10 | 265.44 | 3.01 | 2.26 | 5.85 | 56.09 | 31412.3 |
| $T_7$ | 100% N & P+ 75% K + KSB+ KSF | 77.93 | 360.60 | 4.16 | 2.68 | 7.21 | 68.11 | 38143.5 |
| $T_8$ | 100% N & P+ 125% K+ KSB | 68.11 | 281.45 | 3.41 | 2.33 | 6.24 | 51.09 | 28607.6 |
| $T_9$ | 100% N&P+ 125% K + KSF | 62.10 | 260.43 | 3.31 | 2.18 | 5.30 | 44.07 | 24681.2 |
| $T_{10}$ | 100% N&P+ 125% K+ KSB+ KSF | 74.99 | 320.85 | 3.65 | 2.49 | 6.63 | 63.11 | 35338.5 |
| S. Em ± | | 2.40 | 8.40 | 0.12 | 0.08 | 0.20 | 1.60 | 1273.14 |
| C.D. @ 5% | | 7.12 | 24.95 | 0.36 | 0.23 | 0.61 | 4.75 | 3782.69 |

Note:
RDF - 40: 60: 40 kg N $P_2O_5$ $K_2O$ acre$^{-1}$
FYM – 8 t acre $^{-1}$ common for all treatments
Bio-inoculants: 5 kg acre$^{-1}$
KSB- Potassium Solubilizing Bacteria (*Bacillus mucilaginosus*)
KSF- Potassium Solubilizing Fungus (*Aspergillus awamori*)
FYM, *Azotobacter chroccacum*, VAM - Vesicular Arbuscular Mycorrhiza (*Glomus fasciculatum*) and PSB (*Pseudomonas striata*) at 5 kg per acre is common for all treatments

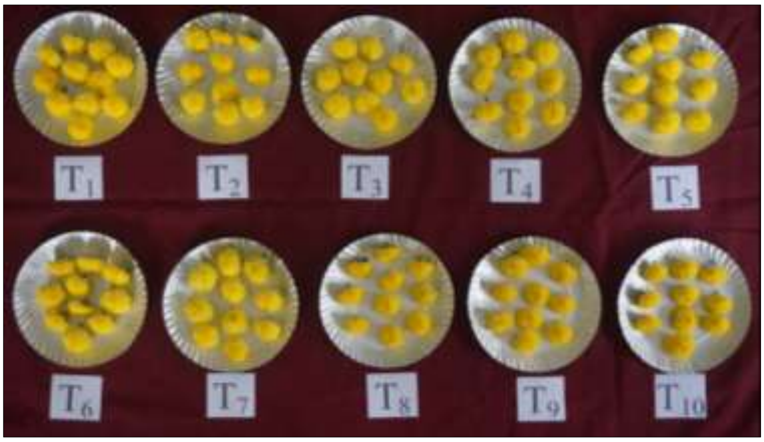


**Plate 1:** Shelf life of different bio inoculants treated flowers

**Plate 2:** Vase life of different bio inoculated treated flowers

## Conclusion

From the present investigation it can be concluded that, application of 75 per cent potassium and 100 per cent nitrogen and phosphorous along with bio inoculants (KSB- *Bacillus mucilaginosus*, KSF- *Aspergillus awamori*, *Azotobacter chroccacum*, VAM- *Glomus fasciculatum* and PSB- *Pseudomonas striata*) is most effective in enhancing the growth, flowering, yield and quality characters of chrysanthemum. This also suggests the potential for lowering the recommended potassium fertilizer dosage up to 25 per cent along with bio inoculants, which is economical and eco-friendly for chrysanthemum farming.

## References

1. Archana DS, Savalgi VP, Alagawadi AR. Effect of potassium solubilizing bacteria on growth and yield of maize. Soil Biology and Ecology. 2008;28(1):9-18.
2. Bagyalakshmi B, Ponmurugan P, Marimuthu S. Influence of potassium solubilizing bacteria on crop productivity and quality of tea (*Camellia sinensis*). African Journal of

Agricultural Research. 2012;7(30):4250-4259.
3. Biradar M, Naik BH, Ganapathi M, Asha K. Effect of balanced nutrition and bio-inoculants on flower yield and quality attributes of chrysanthemum (*Dendranthema grandiflorum* Tzvelev), Journal of Plant Development. 2017;9(12):1119-1122.
4. Boodley JW. Plant nutrition and flower quality. Journal of Horticultural Sciences. 1975;10(1):41-48.
5. Clarson D. Potash bio fertilizer for ecofriendly agriculture. Agro-clinic and Research Centre, Poovanthuruthu, Kottayam (Kerala), India; c2004. p. 98-110.
6. Ektakumari Avijit Sen VK, Srivastava Ram K, Singh Y, Singh BR, Maurya Vijaya P, Sarma B. Effect of different potassium solubilizing bacteria (KSB) and *Trichoderma* on soil microbial status of baby corn (*Zea mays* L.). International Journal of Chemical Studies. 2018;6(3): 180-183.
7. Gurav SB, Singh BR, Katwate SM, Sabale RN, Kakade DS, Dhane AV. Influence of NPK nutrients on yield and quality in rose under protected condition. Journal of Ornamental Horticulture. 2004;7(3&4):239-242.
8. Jadhav PB, Singh A, Mangave BD, Patil NB, Patel DJ, Dekhane SS, *et al*. Effect of organic and inorganic fertilizers on growth and yield of African marigold (*Tagetes erecta* L.) cv. Pusa Basanti Gainda. Annals of Biological Research. 2014;5(9):10-14.
9. Kirar KPS, Lekhi R, Sharma S, Sharma R. Effect of integrated nutrient management practices on growth and flower yield of china aster (*Callistephus chinensis* L.) cv. *Princess* Excellent Publishing House; c2014. p. 234-237.
10. Kumar D, Singh BP, Singh VN. Effect of integrated nutrient management on growth, flowering behavior and yield of African marigold (*Tagetes erecta* L.) cv. African Giant Double Orange. Journal of Horticultural Sciences. 2009;4(2):134-137.
11. Kumar KR, Singh KP, Raju DVS. Symbiotic effect of arbuscular mycorrhizal fungi on growth and flowering of micro propagated plants of chrysanthemum (*Chrysanthemum dendranthemum* Ramat). International Journal of Bio resource and Stress Management. 2014;5(3):369-374.
12. Laishram N. Studies on integrated nutrient management for commercial flower production of chrysanthemum (*Dendranthema grandiflorum* Tzvelev.). M. Sc. (Agri.) Thesis. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan; c2013.
13. Mashaldi A. Effect of organic and inorganic fertilizers on growth, yield and post-harvest life of marigold (*Tagetes erecta* L.) cv. Double orange. M. Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad (Karnataka); c2000.
14. Meena VS, Maurya BR, Verma PJ, Meena R. Potassium solubilizing microorganisms for sustainable agriculture. Journal of Agriculture and Social Sciences. 2013;5:73-76.
15. Meshram N, Badge S, Bhongle SA, Khiratkar SD. Effect of bio inoculants with graded doses of NPK on flowering, yield attributes and economics of annul chrysanthemum. Journal of Soil and Crops. 2008;18(1):217-220.
16. Nayak B. Uptake of potash by different plants with the use of potash mobilizing bacteria (*Frateuria aurantia*). *Thesis*, Odisha University of Agriculture and Technology, Bhubaneswar; c2001.
17. Palagani N, Barad AV, Bhosale N, Thumar BV. Influence of integrated plant nutrition on growth and flower yield of chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. IIHR-6 under saurashtra condition. Asian Journal of Horticulture. 2013;8(2):502-506.
18. Patanwar M, Sharma G, Banjare C, Chandravanshi D, Sahu E. Growth and development of chrysanthemum (*Dendranthema grandiflorum* Tzvelev) as influenced by integrated nutrient management. International Journal of Environmental Sciences. 2014;4:459-462.
19. Rawat J, Sanwal P, Saxena J. Potassium and its role in sustainable agriculture. In Potassium soulubilizing microorganisms for sustainable agriculture; c2016. p. 235-253
20. Sheergojri GA, Neelofar Rather ZA, Khan FU, Nazki IT, Qadri ZA. Effect of chemical fertilization and bio-inoculants on growth and flowering of dahlia (*Dahlia variabilies* Desf.) cv. Pink Attraction. Applied Biological Research. 2013;15(2):121-129.
21. Subhashini DV. Growth promotion and increased potassium uptake of Tobacco by potassium mobilizing bacterium *Frateuria aurantia* grown at different potassium levels in Vertisols. Communications in Soil Science and Plant Analysis. 2015;46(2):210- 220.
22. Sugumaran P, Janarthan B. Solubilization of potassium obtaining minerals by bacteria and their effect on plant growth. World Journal of Agricultural Sciences. 2007;3(3):350-355.
23. Swaroop K. Influence of biofertilizers on growth and productivity of flower and seed yield of marigold cv. Pusa Narangi Gainda. Journal of Ornamental Horticulture. 2011;14(3&4):45-48.
24. Thumar BV, Barad AV, Neelima P, Nilima B. Effect of integrated system of plant nutrition management on growth, yield and flower quality of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. Asian Journal of Horticulture. 2013;8(2):466-469.
25. Verma SK, Angadi SG, Patil VS, Mokashi AN, Mathad JC, Mummigatti UV. Growth, yield and quality of chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. Raja as influenced by integrated nutrient management. Karnataka Journal of Agricultural Sciences. 2011;24(5):681-683.