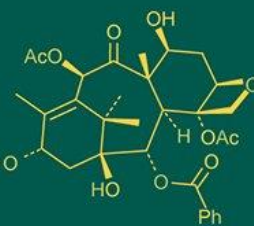
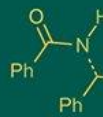


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(7): 1418-1422
www.biochemjournal.com
Received: 30-05-2026
Accepted: 10-07-2026

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Effect of chemical fertilizers and biofertilizer on yield parameters of golden rod (*Solidago canadensis*) cv. Local

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i7Sq.9245>

Abstract

A field experiment was conducted on 'Effect of chemical fertilizers and biofertilizer on yield parameters of golden rod (*Solidago canadensis*) cv. Local' at the Flower and Ornamental Nursery, College of Horticulture, Anand Agricultural University, Anand during *Kharif-Rabi* season of the year 2025-26. The experiment was laid out in a Randomized Block Design (Factorial) with three replications comprising three levels of recommended dose of fertilizers (100, 75 and 50% RDF) and four levels of Bio-NPK consortium (0, 1.00, 2.00 and 3.00 L/ha). Among the chemical fertilizer treatments, 100% RDF (150:100:100 kg/ha NPK) recorded the best performance by reducing the number of days to panicle initiation and first panicle harvest and by producing maximum panicle length, number of panicles per plant, number of panicles per plot, number of panicles per hectare and vase life. Similarly, application of 3.00 L/ha Bio-NPK consortium proved most effective in improving all the yield parameters. The interaction effect between chemical fertilizers and Bio-NPK consortium was found to be significant for number of panicles per plant, number of panicles per plot and number of panicles per hectare, whereas it remained non-significant for days to panicle initiation, days to first panicle harvest, panicle length and vase life.

Keywords: *Solidago canadensis* L., bio-NPK consortium, chemical fertilizers, panicle yield

Introduction

Floriculture has emerged as an important sector of horticulture due to its high economic returns, export potential and increasing demand for ornamental flowers. Among ornamental crops, golden rod (*Solidago canadensis* L.) is an important filler flower belonging to the family Asteraceae. It is widely valued for its attractive golden yellow panicles, long vase life and extensive use in bouquets and floral arrangements (Kaur & Arora, 2011; Vipanchika *et al.*, 2024) [7, 18]. Golden rod is a heavy feeder crop and requires balanced nutrition for optimum vegetative growth and flower production. Although chemical fertilizers provide essential nutrients for rapid plant growth, their continuous and indiscriminate use may adversely affect soil fertility and the environment (Parmar *et al.*, 2017) [9]. Biofertilizers improve nutrient availability through biological nitrogen fixation, phosphate solubilization and potassium mobilization, thereby enhancing nutrient uptake, plant growth and soil biological activity (Mondal *et al.*, 2003; Yadav *et al.*, 2011) [8, 19].

Materials and Methods

The present investigation was carried out on 'Effect of chemical fertilizers and biofertilizer on yield parameters of golden rod (*Solidago canadensis*) cv. Local' at Flower and Ornamental Nursery, College of Horticulture, Anand Agricultural University, Anand, Gujarat, India during *Kharif-Rabi* season of the year 2025-26. The experiment was laid out in a Randomized Block Design (Factorial) with three replications comprising 12 treatment combinations involving three levels of recommended dose of fertilizers (F₁: 100% RDF, 150:100:100 kg/ha NPK; F₂: 75% RDF, 112.5:75:75 kg/ha NPK; and F₃: 50% RDF, 75:50:50 kg/ha NPK) and four levels of Bio-NPK consortium (B₀: No biofertilizer, B₁: 1.00 L/ha, B₂: 2.00 L/ha and B₃: 3.00 L/ha).

20 t/ha Farmyard manure (FYM) was applied uniformly to all plots as a common basal dose during field preparation.

Nitrogen was supplied through Urea, phosphorus through Di-ammonium phosphate (DAP) and potassium through Muriate of potash (MOP). Full doses of phosphorus and potassium along with 50% nitrogen were applied as basal, while the remaining 50% nitrogen was applied 30 days after planting. Bio-NPK consortium was applied through soil drenching at the time of planting according to the respective treatments.

Observations on yield parameters, namely days to panicle initiation, days to first panicle harvest, panicle length, number of panicles per plant, number of panicles per plot, number of panicles per hectare and vase life, were recorded from five randomly selected plants in each net plot at appropriate stages. The experimental data were subjected to analysis of variance (ANOVA) following the procedure described by Steel and Torrie (1980) ^[16] for Randomized Block Design (Factorial) and treatment means were compared using the critical difference (CD) test at the 5% level of significance.

Results and Discussions

Effect of chemical fertilizers (F)

The significantly the minimum number of days required for panicle initiation (53.92 days) was recorded in 100% RDF (150:100:100 kg/ha NPK). This might be due to adequate supply of nutrients, which accelerated physiological activities and promoted early reproductive development. Similar findings were also reported by Halagi *et al.* (2023) ^[16] and Sonara *et al.* (2023) ^[15] in African marigold.

The significantly the minimum number of days required for first panicle harvest (92.46 days) was observed in 100% RDF (150:100:100 kg/ha NPK). This might be due to enhanced nutrient availability, which accelerated growth and reproductive development, leading to early flowering and harvesting. Similar findings were also reported by Dobariya *et al.* (2023) ^[2] and Halagi *et al.* (2023) ^[16] in African marigold.

The significantly the maximum panicle length (38.01 cm) was recorded in 100% RDF (150:100:100 kg/ha NPK). This might be due to improved root proliferation and enhanced absorption of nutrients, which facilitated better translocation of assimilates towards developing panicles and consequently resulted in elongation of panicles. Similar findings were also reported by Geeta *et al.* (2016) ^[5], Gawade *et al.* (2019) ^[3] and Ashok *et al.* (2023) ^[1] in chrysanthemum.

The significantly the highest number of panicles per plant (4.67) was found in 100% RDF (150:100:100 kg/ha NPK). This might be due to adequate and balanced supply of nutrients, which promoted vigorous vegetative growth and production of more flowering shoots, thereby increasing the number of panicles. Similar findings were also reported by Poudel *et al.* (2017) ^[9], Rajput *et al.* (2020) ^[12] and Sonara *et al.* (2023) ^[15] in African marigold.

The significantly the maximum number of panicles per plot (70.42) was observed in 100% RDF (150:100:100 kg/ha NPK). This might be due to enhanced vegetative growth and increased production of flowering shoots under balanced nutrient supply, which consequently resulted in higher panicle yield per plot. Similar findings were also reported by Gaidhani *et al.* (2020) ^[4], Patade *et al.* (2020) ^[10] and Dobariya *et al.* (2023) ^[2] in annual chrysanthemum.

The significantly the highest number of panicles per hectare (3.66 lakhs) was recorded in 100% RDF (150:100:100 kg/ha NPK). This might be attributed to increased number of

panicles per plant and per plot owing to optimum nutrient supply. Similar findings were also reported by Singh *et al.* (2017) ^[13] and Sonara *et al.* (2023) ^[15] in African marigold.

Effect of biofertilizer

The significantly the minimum number of days required for panicle initiation (56.15 days) was recorded in 3.00 L/ha Bio-NPK consortium (B₃). This might be attributed to enhanced nutrient availability and production of growth-promoting substances by beneficial microorganisms, which hastened flower initiation. Similar findings were also reported by Solanki and Parmar (2026) ^[14] in golden rod.

The significantly the minimum number of days required for first panicle harvest (88.84 days) was found in 3.00 L/ha Bio-NPK consortium (B₃). This might be due to increased metabolic activities and better utilization of nutrients, which accelerated flower development and hastened harvesting. Similar findings were also reported by Parmar *et al.* (2017) ^[9], Suhashi *et al.* (2021) ^[17] and Vipanchika *et al.* (2024) ^[18] in golden rod.

The significantly the maximum panicle length (39.02 cm) was recorded in 3.00 L/ha Bio-NPK consortium (B₃). This might be due to increased microbial activity and improved uptake of essential nutrients, which enhanced photosynthetic efficiency and facilitated greater accumulation and translocation of assimilates towards developing panicles, thereby resulting in elongation of panicles. Similar findings were also reported by Geeta *et al.* (2016) ^[5], Suhashi *et al.* (2021) ^[17] and Ashok *et al.* (2023) ^[1] in chrysanthemum.

The significantly the highest number of panicles per plant (5.43) was observed in 3.00 L/ha Bio-NPK consortium (B₃). This might be due to enhanced microbial activity and increased availability of nutrients, which favoured better flower initiation and development of more flowering shoots. Similar findings were also reported by Geeta *et al.* (2016) ^[5], Gawade *et al.* (2019) ^[3] and Ashok *et al.* (2023) ^[1] in chrysanthemum.

The significantly the maximum number of panicles per plot (71.97) was recorded in 3.00 L/ha Bio-NPK consortium (B₃). This might be due to improved microbial activity and efficient utilization of nutrients, which promoted flower initiation and development of more flowering shoots. Similar findings were also reported by Geeta *et al.* (2016) ^[5], Parmar *et al.* (2017) ^[9] and Gawade *et al.* (2019) ^[3] in chrysanthemum.

The significantly the highest number of panicles per hectare (3.99 lakhs) was found in 3.00 L/ha Bio-NPK consortium (B₃). This might be attributed to enhanced nutrient mobilization and increased production of flowering shoots, which ultimately resulted in higher panicle yield per unit area. Similar findings were also reported by Suhashi *et al.* (2021) ^[17], Ashok *et al.* (2023) ^[1] and Solanki and Parmar (2026) ^[14] in golden rod.

Interaction effect (FxB)

The interaction effect between different levels of chemical fertilizers and Bio-NPK consortium was found to be significant for number of panicles per plant. The significantly highest number of panicles per plant (6.34) was recorded in the treatment combination of F₁B₃ (100% RDF + 3.00 L/ha Bio-NPK consortium). This might be due to the synergistic effect of balanced fertilization and beneficial microorganisms, which enhanced nutrient availability and utilization, resulting in better vegetative growth and

production of more flowering shoots. Similar findings were also reported by Geeta *et al.* (2016)^[5], Gawade *et al.* (2019)^[3] and Ashok *et al.* (2023)^[1] in chrysanthemum.

The interaction effect between different levels of chemical fertilizers and Bio-NPK consortium was found to be significant for number of panicles per plot. The significantly maximum number of panicles per plot (80.40) was recorded in the treatment combination of F₁B₃ (100% RDF + + 3.00 L/ha Bio-NPK consortium). This might be due to the combined effect of balanced nutrition and beneficial microorganisms, which improved nutrient availability and

enhanced flower production, thereby increasing panicle yield. Similar findings were also reported by Ashok *et al.* (2023)^[1], Vipanchika *et al.* (2024)^[18] and Solanki and Parmar (2026)^[14] in golden rod.

The interaction effect of different levels of recommended dose of fertilizers and biofertilizer was found significant on number of panicles per hectare. The treatment combination of F₁B₃ (100% RDF + 3.00 L/ha Bio-NPK consortium) was recorded significantly maximum number of panicles per hectare (4.46 lakhs).

Table 1: Effect of chemical fertilizers and biofertilizer on days to panicle initiation and days to panicle harvest of golden rod

Treatment	Days to panicle initiation	Days to panicle harvest
Chemical Fertilizers (F)		
F1:100% RDF (150:100:100 kg/ha NPK)	53.92	92.46
F2:75% RDF (112.50:75:75 kg/ha NPK)	67.26	97.54
F3:50% RDF (75:50:50 kg/ha NPK)	70.01	103.60
S.Em±	1.81	0.98
CD at 5%	5.32	2.89
Biofertilizer (B)		
B0: No Biofertilizer	69.81	107.79
B1:1.00 L/ha Bio-NPK consortium	68.06	101.47
B2:2.00 L/ha Bio-NPK consortium	60.90	93.37
B3:3.00 L/ha Bio-NPK consortium	56.15	88.84
S.Em±	2.09	1.13
CD at 5%	6.15	3.33
Interaction effect (F x B)		
S.Em±	3.63	1.97
CD at 5%	NS	NS
CV%	9.87	3.48

Table 2: Effect of chemical fertilizers and biofertilizer on length of panicle and vase life of panicle of golden rod

Treatment	Length of panicle	Vase life of panicle
Chemical Fertilizers (F)		
F1:100% RDF (150:100:100 kg/ha NPK)	38.01	6.40
F2:75% RDF (112.50:75:75 kg/ha NPK)	33.80	5.86
F3:50% RDF (75:50:50 kg/ha NPK)	29.82	5.86
S.Em±	1.02	0.49
CD at 5%	3.00	1.43
Biofertilizer (B)		
B0: No Biofertilizer	25.44	5.09
B1:1.00 L/ha Bio-NPK consortium	33.93	5.99
B2:2.00 L/ha Bio-NPK consortium	37.12	6.33
B3:3.00 L/ha Bio-NPK consortium	39.02	6.76
S.Em±	1.18	0.42
CD at 5%	3.47	1.24
Interaction effect (F x B)		
S.Em±	2.05	0.24
CD at 5%	NS	NS
CV%	10.48	7.02

Table 2: Effect of chemical fertilizers and biofertilizer on number of panicle per plant, number of panicle per plot and number of panicle per hectare of golden rod

Treatment	Number of panicle per plant	Number of panicle per plot	Number of panicle per hectare
Chemical Fertilizers (F)			
F1:100% RDF (150:100:100 kg/ha NPK)	4.67	70.42	3.66
F2:75% RDF (112.50:75:75 kg/ha NPK)	3.96	59.17	3.28
F3:50% RDF (75:50:50 kg/ha NPK)	3.63	56.55	3.11
S.Em±	0.11	0.83	0.03
CD at 5%	0.34	2.43	0.10
Biofertilizer (B)			
B0: No Biofertilizer	2.79	53.67	2.60
B1:1.00 L/ha Bio-NPK consortium	3.48	57.99	3.22
B2:2.00 L/ha Bio-NPK consortium	4.64	64.56	3.58
B3:3.00 L/ha Bio-NPK consortium	5.43	71.97	3.99
S.Em±	0.13	0.95	0.04
CD at 5%	0.40	2.81	0.12
Interaction effect (F x B)			
S.Em±	0.23	1.66	0.07
CD at 5%	0.69	4.87	0.21
CV%	10.08	4.63	3.84

Table 3: Interaction effect of chemical fertilizers and biofertilizer on number of panicle per plant in golden rod

B F	Number of panicle per plant			
	B0	B1	B2	B3
F1	3.36	3.66	5.35	6.34
F2	2.70	3.28	4.39	5.50
F3	2.34	3.53	4.21	4.46
S.Em±	0.23			
CD at 5%	0.69			
CV%	10.08			

Table 4: Interaction effect of chemical fertilizers and biofertilizer on number of panicle per plot in golden rod

B F	Number of panicle per plot			
	B0	B1	B2	B3
F1	61.13	66.23	73.93	80.40
F2	54.38	53.78	57.71	70.82
F3	45.51	53.96	62.05	64.68
S.Em±	1.66			
CD at 5%	4.87			
CV%	4.63			

Table 5: Interaction effect of chemical fertilizers and biofertilizer on number of panicle per hectare in golden rod

B F	Number of panicle per hectare (Lakhs)			
	B0	B1	B2	B3
F1	2.48	3.60	4.10	4.46
F2	3.02	2.98	3.20	3.93
F3	2.32	3.09	3.44	3.59
S.Em±	0.07			
CD at 5%	0.21			
CV%	3.84			

Conclusion

Based on the results of the present investigation, it can be concluded that the application of 100% RDF (150:100:100 kg/ha NPK) along with 3.00 L/ha Bio-NPK consortium was found to be the most effective for improving the yield of golden rod cv. Local. Therefore, the combined application of 100% RDF along with 3.00 L/ha Bio-NPK consortium was recommended for obtaining higher yield of golden rod.

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