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Response of golden rod (*Solidago canadensis* L.) to planting time and GA₃

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Abstract

A field experiment entitled “Response of golden rod (*Solidago canadensis* L.) to planting time and GA₃” was carried out during *kharif* season of the year 2018-2019 at Satpuda Botanic Garden, Horticulture Section, College of Agriculture, Nagpur (Dr. PDKV, Akola), M.S. (India). The treatments comprised of four planting time *viz.*, 15th June, 15th July, 15th August and 15th September and three GA₃ concentrations *viz.*, control i.e 0 ppm, 200 ppm and 250 ppm GA₃. The experiment was laid out in Factorial Randomized Block Design replicated thrice. The results of experiment revealed that, in respect of growth parameters *viz.*, number of suckers plant⁻¹ and fresh and dry weight of plant, flower quality parameters *viz.*, length of flower stalk, number of primary branches panicle⁻¹, length of panicle region, diameter of flower stalk and vase life of panicle were recorded significantly highest when planting was done on 15th June and the suckers treated with 200 ppm GA₃ before planting. In respect of yield parameters *viz.*, number of panicle hectare⁻¹ also the treatment of 15th June planting and the suckers treatment with 200 ppm GA₃ before planting was significantly superior than other treatments.

Keywords: Golden rod, planting time, GA₃, growth, flower yield and quality

Introduction

Golden rod (*Solidago canadensis* L.) belonging to family Asteraceae, is an erect growing hardy perennial plant grows well in almost all types of climate and soils ranging from light to heavy type. The soil rich in organic matter is ideal for its successful vegetative growth and flowering. It may be sparsely branched or unbranched with simple alternate leaves. The inflorescence of golden rod is very complex in nature. The flower stalks are harvested when about 25 per cent of the flowers on panicle are opened. Golden rod is an important flower crop basically as filler material in flower arrangement and bouquets. It has a promising and untapped export potential besides local demand.

Golden rod can be planted throughout the year in order to have flower spikes over a wide range of period. It is propagated through division of stools, from suckers or seeds. In moderate climate, suckers or stools are planted throughout the year although spring and rainy seasons are best for good growth. Though, they are gross feeders, soil rich in nutrients promote vegetative growth. Addition of organic manure in the soil is helpful to retain moisture in dry season.

This flower crop did not receive much attention of researchers in the past under Vidharbha conditions and therefore, technological information for these areas is much scanty. GA₃ plays a vital role in improvement of vegetative growth characters of the plant as it enhances the cell elongation and cell division by promoting the DNA synthesis in the cell. It reduces the juvenile phase due to an increase in photo-synthesis and respiration with enhanced carbon-dioxide fixation in the plant. It is also found that, production of flowers can be regulated by adopting proper time of planting of flower crop, so that the produce can be made available in the market whenever there is a good demand for these flowers. Considering the important role of these aspects for increasing productivity and profit of flower crops, the present experiment was proposed to study the response of golden rod to different planting time and GA₃ concentrations.

Materials and Methods

Present experiment was carried out at Satpuda Botanical Garden, Horticulture Section, College of Agriculture, Nagpur during 2018-2019. The treatments comprised of the four planting time *viz.*, 15th June, 15th July, 15th August and 15th September and three GA₃ concentrations *viz.* Control i.e. 0 ppm, 200 ppm and 250 ppm GA₃. The experiment was laid out in Factorial Randomised Block Design (FRBD) replicated thrice. Golden rod suckers were dipped with three levels of gibberellic acid (0, 200 and 250 ppm GA₃) solution for 6 hours.

Planting of GA₃ soaked golden rod suckers was done at different dates as per treatment. Farmyard manure was applied @ 600g/m² to all the plots uniformly and incorporated in to the soil, whereas, the fertilizers were applied @ 150:100:100 kg/ha N, P₂O₅ and K₂O, respectively. Irrigation was applied thrice in a week for one month and twice in week afterwards. Hand weeding was carried out as and when required. Five plants were selected randomly from each plot for recording various growth parameters viz., number of suckers plant⁻¹. Fresh weight of plant and dry weight of plant, flower quality parameters viz., length of flower stalk, number of primary branches panicle⁻¹, length of panicle region, diameter of flower stalk and vase life of panicle and yield parameter viz., number of panicles hectare⁻¹. The flower stalks were harvested at 25 per cent flower opening stage early in the morning with the help of secateurs. Immediately after harvesting, the basal portion of panicle was placed in water. Various observations were recorded at proper stages and the data was statistically analysed by the method suggested by Panse and Sukhatme (1995) [8].

Results and Discussion

The data presented in Table 1 revealed that, different treatments of time of planting and GA₃ concentrations had significant effect on all growth, flower quality and yield parameters of golden rod.

Effect of planting time

Significantly maximum number of suckers plant⁻¹ (5.12), fresh weight of plant (204.32 g) and dry weight of plant (76.87 g), length of flower stalk (73.23 cm), number of primary branches panicle⁻¹ (32.45), length of panicle region (45.13 cm), diameter of flower stalk (0.71 cm) and vase life of panicle (7.02 days) were recorded with the treatment of 15th

June planting and it was statistically at par with 15th July planting in respect of fresh weight of plant (198.44 g), length of flower stalk (69.65 cm) and number of primary branches panicle⁻¹ (30.38). However, the treatment of 15th June planting was closely followed by 15th July planting in respect of number of suckers plant⁻¹ (4.73), dry weight of plant (72.82 g), length of panicle region (41.83 cm), diameter of flower stalk (0.67 cm) and vase life of panicle (6.45 days). Whereas, minimum number of suckers plant⁻¹ (4.36), fresh weight of plant (186.41 g) and dry weight of plant (69.17 g), length of flower stalk (66.20 cm), number of primary branches panicle⁻¹ (26.68), length of panicle region (39.12 cm), diameter of flower stalk (0.63 cm) and vase life of panicle (6.37 days) were reported with 15th August planting. Similarly, significantly maximum number of panicles ha⁻¹ (3.59 lakh) were harvested with the treatment of 15th June planting which was followed by planting on 15th July (3.14 lakh). However, minimum number of panicles ha⁻¹ (3.00 lakh) were noted with 15th August planting.

From the above results, it has been noticed that, planting on 15th June was superior than other planting dates in respect of various growth, flower quality and yield parameters. An increase in vegetative growth parameters due to early planting might be due to the favourable climatic conditions during earlier month's i.e. juvenile phase of plants which stimulates cytokinin and gibberellins accumulation, modifying the hormonal balance and leading the growth parameters, thereby proper development of required photosynthetic system which helps to increase the production of flowers and improve their quality which in turn resulted in increased number of better quality flower stalks ha⁻¹. Similar results have also been reported by Dilta *et al.* (2006) [3] in carnation and Sreekanth *et al.* (2006) [10] and Pakhale *et al.* (2012) [7] in African marigold.

Table 1: Growth, flower yield and quality of golden rod as influenced by planting time and GA₃

Treatments	Number of suckers plant ⁻¹	Fresh weight of plant (g)	Dry weight of plant (g)	Length of flower stalk (cm)	Number of primary branches panicle ⁻¹	Length of panicle region (cm)	Diameter of flower stalk (cm)	Vase life of panicle (days)	Number of panicles hectare ⁻¹ (lakh)
Planting dates (D)									
15 th June	5.12	204.32	76.87	73.23	32.45	45.13	0.71	7.02	3.59
15 th July	4.73	198.44	72.82	69.65	30.38	41.83	0.67	6.45	3.14
15 th August	4.36	186.41	69.17	66.20	26.68	39.12	0.63	6.37	3.00
15 th September	4.69	188.19	71.87	67.49	26.71	39.32	0.66	6.40	3.02
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.11	3.25	1.28	1.23	0.75	1.06	0.01	0.11	0.06
CD at 5%	0.33	9.53	3.77	3.61	2.22	3.13	0.03	0.32	0.18
GA₃ Concentrations (G)									
Control	4.33	187.37	69.47	66.10	27.45	38.75	0.63	6.19	3.07
200 ppm GA ₃	5.09	200.58	75.19	72.27	30.96	43.67	0.70	6.90	3.30
250 ppm GA ₃	4.75	195.06	73.39	69.07	28.75	41.63	0.68	6.60	3.18
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.10	2.81	1.11	1.06	0.65	0.92	0.01	0.09	0.05
CD at 5%	0.29	8.25	3.26	3.12	1.92	2.71	0.03	0.27	0.16
Interaction effect (D x G)									
F test	N.S	N.S	N.S	N.S	Sig.	N.S	N.S	Sig.	N.S
SE (m) ±	0.25	6.89	2.72	2.61	1.61	2.26	0.02	0.23	0.13
CD at 5%	-	-	-	-	4.72	-	-	0.69	-

Table 2: Interaction effect of planting time and GA₃ on primary branches panicle⁻¹ and vase life of panicle in golden rod

Treatment combinations	Primary branches panicle ⁻¹	Vase life of panicle (days)
D ₁ G ₀ (Planting date of 15 th June + no sucker treatment with GA ₃ i. e. control)	28.01	6.15
D ₁ G ₁ (Planting date of 15 th June + sucker treatment with GA ₃ 200 ppm)	37.76	7.73
D ₁ G ₂ (Planting date of 15 th June + sucker treatment with GA ₃ 250 ppm)	31.59	7.07
D ₂ G ₀ (Planting date of 15 th July + no sucker treatment with GA ₃ i. e. control)	29.59	6.21
D ₂ G ₁ (Planting date of 15 th July + sucker treatment with GA ₃ 200 ppm)	31.45	6.76
D ₂ G ₂ (Planting date of 15 th July + sucker treatment with GA ₃ 250 ppm)	30.11	6.39
D ₃ G ₀ (Planting date of 15 th August + no sucker treatment with GA ₃ i. e. control)	25.95	6.12
D ₃ G ₁ (Planting date of 15 th August + sucker treatment with GA ₃ 200 ppm)	27.69	6.61
D ₃ G ₂ (Planting date of 15 th August + sucker treatment with GA ₃ 250 ppm)	26.41	6.40
D ₄ G ₀ (Planting date of 15 th Sept. + no sucker treatment with GA ₃ i. e. control)	26.26	6.29
D ₄ G ₁ (Planting date of 15 th Sept. + sucker treatment with GA ₃ 200 ppm)	26.96	6.51
D ₄ G ₂ (Planting date of 15 th Sept. + sucker treatment with GA ₃ 250 ppm)	26.91	6.42
F test	Sig.	Sig.
SE (m) ±	0.61	0.23
CD at 5%	4.72	0.69

Effect of GA₃ concentrations

Significantly highest number of suckers plant⁻¹ (5.09), fresh weight of plant (200.58 g) and dry weight of plant (75.19 g), length of flower stalk (72.27 cm), number of primary branches panicle⁻¹ (30.96), length of panicle region (43.67 cm), diameter of flower stalk (0.70 cm) and vase life of panicle (6.90 days) was recorded with the treatment of 200 ppm GA₃ which was found statistically at par with 250 ppm GA₃ in respect of fresh weight of plant (195.06 g), dry weight of plant (73.39 g), length of panicle region (41.63 cm), and diameter of flower stalk (0.68 cm), however, it was closely followed by 250 ppm GA₃ in respect of number of suckers plant⁻¹ (4.75), length of flower stalk (69.07 cm), number of primary branches panicle⁻¹ (28.75) and vase life of panicle (6.60 days). Whereas, minimum number of suckers plant⁻¹ (4.33), fresh weight of plant (187.37 g) and dry weight of plant (69.47 g), length of flower stalk (66.10 cm), number of primary branches panicle⁻¹ (27.45), length of panicle region (38.75 cm), diameter of flower stalk (0.63 cm) and vase life of panicle (6.19 days) were reported in control treatment i.e. 0 ppm GA₃. The number of panicles hectare⁻¹ (3.30 lakh) was registered significantly maximum when the golden rod suckers treated with 200 ppm GA₃ and it was found statistically at par with 250 ppm GA₃ (3.18 lakh). Whereas, minimum number of panicles ha⁻¹ (3.07 lakh) were reported in the control treatment. An increase in growth parameters in golden rod with GA₃ treatment over control might be because of the fact that GA₃ promotes vegetative growth by inducing active cell division and cell elongation, which might have resulted in increased growth parameters which is essential for production of carbohydrates in the plants. These carbohydrates are translocated towards the reproductive parts of the plants for maximum production of better quality flowers. These results are in conformity with the findings of Bharathi *et al.* (2009)^[1] in tuberose, Dalal *et al.* (2009)^[2] in gerbera, Nandre *et al.* (2009)^[5] in China aster, Rajput *et al.* (2011)^[9] and Osman and Seweden (2014)^[6] in golden rod and Dogra *et al.* (2012)^[4] in gladiolus.

Interaction effect

The interaction effect of planting time and GA₃ on various growth, flower quality and yield parameters in golden rod was found statistically non-significant, however, primary branches panicle⁻¹ and vase life of panicle were influenced significantly by interaction effect of planting time and GA₃.

The treatment combination of D₁G₁ (planting on 15th June with sucker treatment of 200 ppm GA₃) significantly recorded maximum primary branches panicle⁻¹ and vase life of panicle

(37.76 and 7.73 days, respectively) which was closely followed by D₂G₁ (planting on 15th July with sucker treatment of 200 ppm GA₃). However, primary branches panicle⁻¹ and vase life of panicle (25.95 and 6.12 days, respectively) was observed in the treatment combination of D₃G₀ (planting on 15th August with no treatment of GA₃ i.e. control). An increase in primary branches panicle⁻¹ and vase life of panicle in golden rod might have been due to the combine effect of planting time i. e. 15 June and suckers treatment with GA₃ 200 ppm.

From the findings of present investigation, it may be concluded that the vegetative growth, flower quality and yield parameters in golden rod were found significantly superior when planted on 15th June and suckers treated with 200 ppm GA₃ before planting.

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