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Effect of planting dates and GA₃ on growth, flowering and yield of golden rod

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Abstract

An experiment entitled “Effect of planting dates and GA₃ on growth, flowering and yield of golden rod” was carried out during *Kharif* season of the year 2018-2019 at Satpuda Botanical Garden, Horticulture Section, College of Agriculture, Nagpur, Dr. PDKV, Akola (M.S.). The treatments comprised of four planting dates *viz.*, 15th June, 15th July, 15th August and 15th September and three levels of GA₃ *viz.* Control, 200 ppm GA₃ and 250 ppm GA₃. Before planting suckers of golden rod were dipped in GA₃ solution of different concentrations as per the treatment for 6 hours. The experiment was laid out in Factorial Randomized Block Design with three replications. The results revealed that, in respect of growth parameters, plant height with panicle, number of leaves plant⁻¹ and plant spread were recorded significantly maximum with the planting date of 15th June and suckers treatment with 200 ppm GA₃. In respect of flowering parameters, initiation of panicle and opening of first flower were registered significantly earliest when golden rod suckers planted on 15th June and treated with 200 ppm GA₃. The yield parameters like number of panicles plant⁻¹ and ha⁻¹ were also found significantly maximum with the planting date of 15th June and the sucker’s treatment with 200 ppm GA₃.

Keywords: Golden rod, planting date, GA₃, growth, flowering, yield

Introduction

Solidago commonly known as “Golden rod” belongs to the family Asteraceae. Golden rod (*Solidago canadensis* L.) is a perennial flowering plant which is grown for its attractive, long and straight flower stalk. It is commonly grown in beds, borders, rock gardens and also for cut flower in India. Because of its easy cultivation, adaptability to varying soil and climatic conditions and excellent keeping quality, there is a great scope for cultivation of golden rod in India. It is generally used as cut flower for indoor decoration as well as in bouquets making as a filler along with other flowers. It has a very good potential for dry flower industry.

This crop did not receive a much attention of researchers in the past under Vidharbha conditions and therefore, technological information for these areas is much scanty. Gibberellic acid 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-di-oxide fixation in the plant. Keeping in view the potentialities of gibberellic acid, the present study was undertaken to find out the suitable planting time and concentration of GA₃ for the better growth, flowering and yield of golden rod.

Materials and Methods

Present experiment was carried out at Satpuda Botanical Garden, Horticulture Section, College of Agriculture, Nagpur during 2018-2019. The treatment comprised of the four planting dates *viz.*, 15th June, 15th July, 15th August and 15th September and three GA₃ concentrations *viz.* Control, 200 ppm GA₃ and 250 ppm GA₃. The experiment was laid out in Factorial Randomised Block Design (FRBD) and 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 as per different dates of planting. 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

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carried out as and when required. Five plants were selected randomly from each plot for recording various growth parameters viz. plant height with panicle, number of leaves plant⁻¹ and plant spread, flowering parameters viz., days to initiation of panicle and days to opening of first flower and yield parameters like number of panicles plant⁻¹ and hectare⁻¹. 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 dates of planting and levels of GA₃ had significant effect on growth, flowering and yield parameters of golden rod.

Table 1: Effect of planting dates and GA₃ concentrations on growth, flowering and yield of golden rod

Treatments	Plant height with panicle (cm)	Number of leaves plant ⁻¹	Plant spread (cm)	Days to initiation of panicle (days)	Days to opening of first flower (days)	Yield of panicles plant ⁻¹	Yield of panicles hectare ⁻¹ (Lakh)
A. Planting dates (D)							
D ₁ - 15 th June	71.03	35.14	26.11	35.01	78.70	4.84	3.59
D ₂ - 15 th July	66.09	33.16	24.66	38.37	78.90	4.25	3.14
D ₃ - 15 th August	63.53	32.98	22.53	41.13	84.02	4.05	3.00
D ₄ - 15 th September	65.96	33.13	23.18	40.46	82.93	4.17	3.02
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	1.11	0.56	0.43	1.27	1.35	0.09	0.06
CD at 5%	3.26	1.66	1.27	3.73	3.96	0.26	0.18
B. GA₃ Concentrations (G)							
G ₀ - 0 ppm GA ₃	64.74	32.18	22.30	41.84	83.52	4.17	3.08
G ₁ - 200 ppm GA ₃	68.38	35.29	25.48	35.15	78.25	4.47	3.31
G ₂ - 250 ppm GA ₃	66.83	33.33	24.58	39.24	81.64	4.34	3.18
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.96	0.49	0.37	1.10	1.17	0.07	0.05
CD at 5%	2.82	1.44	1.10	3.23	3.43	0.21	0.15
C. Interaction (D x G)							
F test	N.S	N.S	Sig	N.S	N.S	N.S	N.S
SE (m) ±	2.35	1.20	0.91	2.69	2.86	0.19	0.13
CD at 5%	-	-	2.69	-	-	-	-

Table 2: Interaction effect of planting dates and levels of GA₃ on plant spread in golden rod

Treatment combinations	Plant spread (cm)
D ₁ G ₀ (Planting date of 15 th June + no sucker treatment with GA ₃ i. e. control)	23.70
D ₁ G ₁ (Planting date of 15 th June + sucker treatment with GA ₃ 200 ppm)	29.41
D ₁ G ₂ (Planting date of 15 th June + sucker treatment with GA ₃ 250 ppm)	25.23
D ₂ G ₀ (Planting date of 15 th July + no sucker treatment with GA ₃ i. e. control)	22.86
D ₂ G ₁ (Planting date of 15 th July + sucker treatment with GA ₃ 200 ppm)	25.70
D ₂ G ₂ (Planting date of 15 th July + sucker treatment with GA ₃ 250 ppm)	25.43
D ₃ G ₀ (Planting date of 15 th August + no sucker treatment with GA ₃ i. e. control)	21.18
D ₃ G ₁ (Planting date of 15 th August + sucker treatment with GA ₃ 200 ppm)	23.32
D ₃ G ₂ (Planting date of 15 th August + sucker treatment with GA ₃ 250 ppm)	23.10
D ₄ G ₀ (Planting date of 15 th Sept. + no sucker treatment with GA ₃ i. e. control)	21.48
D ₄ G ₁ (Planting date of 15 th Sept. + sucker treatment with GA ₃ 200 ppm)	23.50
D ₄ G ₂ (Planting date of 15 th Sept. + sucker treatment with GA ₃ 250 ppm)	24.56
F test	Sig.
SE (m) ±	0.91
CD at 5%	2.69

Growth parameters

Effect of planting dates

Significantly maximum plant height with panicle (71.03 cm), number of leaves plant⁻¹ (35.14) and plant spread (26.11 cm) were recorded when the golden rod suckers planted on 15th June and it was followed by planting date of 15th July (66.09 cm, 33.16 and 24.66 cm, respectively), whereas, minimum values were recorded with the planting date of 15th August (63.53 cm, 32.98 and 22.53 cm, respectively).

From the above results, it has been noticed that, planting date of 15th June was superior than other planting dates in respect of growth 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 the plants which stimulates cytokinin and gibberellins accumulation, modifying the hormonal balance and leading the growth parameters. These results are in close conformity with the findings of Dilta *et al.* (2006)^[3] in carnation and Pakhale *et al.* (2012)^[7] in African marigold.

Effect of GA₃ concentrations

The plant height with panicle (68.38 cm), number of leaves plant⁻¹ (35.29) and plant spread (25.48 cm) were observed significantly highest when the golden rod suckers treated with

200 ppm GA₃ which was statistically at par with 250 ppm GA₃ (66.83 cm, 24.58 cm and 33.33, respectively). However, minimum plant height with panicle (64.74 cm), number of leaves plant⁻¹ (32.18) and plant spread (22.30 cm) were reported in control treatment. The increase in growth parameters 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 increasing the growth parameters. These findings are also supported by Bharathi *et al.* (2009) [1] in tuberose, Nandre *et al.* (2009) [5] in China aster and Osman and Seweden (2014) [6] in golden rod.

Interaction effect

The interaction effect of planting dates and levels of GA₃ on growth parameters *viz.* plant height with panicle and number of leaves plant⁻¹ in golden rod was found statistically non-significant. However, in respect of plant spread the interaction effect was found significant.

The treatment combination of D₁G₁ (planting on 15th June with 200 ppm GA₃) significantly recorded maximum plant spread (29.41 cm) which was followed by D₂G₁ (planting on 15th July with 200 ppm GA₃) i.e. 25.70 cm. However, minimum plant spread (21.18 cm) was observed in the treatment combination of D₃G₀ (planting on 15th August with no treatment of GA₃ i.e. control). An increase in plant spread of golden rod might have been due to the combine effect of planting date i. e. 15 June and suckers treatment with gibberellic acid 200 ppm.

Flowering parameters

Effect of planting dates

Days required for initiation of panicle and opening of first flower were recorded significantly minimum with the planting date of 15th June (35.01 and 78.70 days, respectively) which was found statistically at par with 15th July (38.37 and 78.90 days, respectively). However, maximum days taken for initiation of panicle (41.13 days) and days to opening of first flower (84.02 days) was noted with the planting date of 15th August. The flowering was delayed with 15th August planting which might have been due to non-availability of required temperature and day length for initiation of panicle and opening of first flower in golden rod due to which the juvenile phase of the plant might have been extended.

Effect of GA₃ concentration

Significantly minimum days were required for initiation of panicle (35.15 days) and opening of first flower (78.25 days) when the suckers of golden rod treated with 200 ppm GA₃ which was followed by 250 ppm GA₃ (39.24 and 81.64 days, respectively), whereas, significantly late initiation of panicle (41.84 days) and opening of first flower (83.52 days) were reported with the control treatment. The minimum days to opening of first flower by GA₃ might be due to the fact that, GA₃ is quite effective in reducing the juvenile period of plants. More or less similar results are reported by Bharathi *et al.* (2009) [1] in tuberose, Dalal *et al.* (2009) [2] in gerbera and Dogra *et al.* (2012) [4] in gladiolus.

Interaction effect

The interaction effect of planting dates and levels of GA₃ on flowering parameter *viz.* days to initiation of panicle and days to opening of first flower in golden rod was found statistically non-significant.

Yield parameters

Effect of planting dates

Significantly maximum number of panicles plant⁻¹ (4.84) and ha⁻¹ (3.59 lakh) were harvested with the planting date of 15th June which was followed by 15th July (4.25 and 3.14 lakh). However, minimum number of panicles plant⁻¹ (4.05) and ha⁻¹ (3.00 lakh) were noted with 15th August planting date. The plants planted on 15th June produced good vegetative growth, thereby proper development of required photosynthetic system which helps to increase the production of flowers which in turn resulted in increased number of panicles plant⁻¹ and ha⁻¹. Similar results have also been reported by Sreekanth *et al.* (2006) [10] and Pakhale *et al.* (2012) [7] in African marigold.

Effect of GA₃ concentrations

The number of panicles plant⁻¹ (4.47) and hectare⁻¹ (3.31 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 (4.34 and 3.18 lakh). Whereas, minimum number of panicles plant⁻¹ (4.17) and ha⁻¹ (3.07 lakh) were reported in the control treatment. This increase in number of panicles per plant and per hectare due to GA₃ application over control might be due to increased vegetative growth in respect of plant height and spread and number of leaves, which is essential for production of carbohydrates in the plants. These carbohydrates are translocated towards the reproductive parts of the plants for production of flowers. These results are in conformity with the findings of Nandre *et al.* (2009) [5] in China aster and Rajput *et al.* (2011) [9] in golden rod.

Interaction effect

The interaction effect due to the date of planting and GA₃ levels on the yield of panicles plant⁻¹ and ha⁻¹ was found non-significant.

Thus, it can be inferred from the present investigation that, maximum growth and flower yield with earliest flowering was recorded in golden rod when the suckers planted on 15th June and treated with 200 ppm GA₃.

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