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Effect of plant growth substances on yield, quality and economics of golden rod (*Solidago canadensis* L.)

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Abstract

Effect of plant growth substances on yield and quality of golden rod (*Solidago Canadensis* L.) experiment was carried out during March 2022 to November 2022 at College Farm, College of Horticulture, SDAU, Jagudan, Gujarat. The experiment was comprised of two factors time of spray with three levels viz., T₁ (30 DAT), T₂ (45 DAT) and T₃ (30 and 45 DAT) and plant growth substances with six levels. viz., p₁(GA₃ @ 100 ppm), p₂(GA₃ @ 150 ppm), p₃ (Triacantanol @ 20 ppm), p₄(Triacantanol @ 30 ppm), p₅ (CCC @ 500 ppm), p₆ (CCC @ 1000 ppm). T₂ (Spray at 30 DAT + GA₃ @ 150 ppm) found superior on yield and quality parameters viz., number of panicle per plant, number of panicle per plot, number of panicle per hectare, vase life of panicle and longevity of panicles on plant.

Keywords: 30 and 45 DAT, time of spray, GA₃, Triacantanol, CCC

Introduction

'Solidago' commonly known as golden rod belongs to family Asteraceae. It is perennial in nature and unexploded flower crop in limited areas for its flower stalk. Golden rods are grown in beds, borders or rock gardens. They are also used as cut flower for indoor decoration and bouquets. Because of its easy cultivation, adaptability to varying soil and climatic condition and excellent keeping quality, there is a great scope for cultivation of golden rod in India. Golden rod is propagated by division of stools, from suckers or seeds. The commercial cultivation of golden rod has not yet been exploited throughout the India. Even though golden rod is cultivated in small scale by many farmers, the flowers (panicle) of golden rod are marketed to various places in Gujarat e.g. Surat, Ahmedabad, Vadodra etc. species of golden rod used for medicinal preparations, tea making, essential oils, flavonoids, glycosides, tannins, saponins and various organic acids derived from solid ago are used as anti-inflammatory agents in ointment for urinogential and chlorine skin problems, apart from being used as adjuvant along with other remedies for asthma, arthristis and rheumatism.

Plant growth regulators play an important role in respect to growth, flowering and yield. The plant growth regulators are compound that in minor amounts which modify the physiological processes of plants and ultimately the yield and quality of plant. Plant growth substances have been used as an effective tool to improve vegetative as well as reproductive function of plant.

Materials and Methods

A field experiment on golden rod was conducted at College Farm, College of Horticulture, S. D. Agricultural University, Jagudan, Gujarat, India during March 2022 to November 2022. The experiment was laid out in Factorial Randomized Block Design with eighteen treatments comprising of two factor viz., time of spray (T) viz., T₁ (30 DAT), T₂ (45 DAT), T₃ (30 and 45 DAT) and plant growth substances (P) viz., p₁ (GA₃ @ 100 ppm), p₂ (GA₃ @ 150 ppm), p₃ (Triacantanol @ 20 ppm), p₄ (Triacantanol @ 30 ppm), p₅ (CCC @ 500 ppm), p₆ (CCC @ 1000 ppm).

The combination of treatments comprised of Spray at 30 DAT + GA₃@ 100 ppm(T₁), Spray at 30 DAT + GA₃ @ 150 ppm(T₂), Spray at 30 DAT + Triacantanol@ 20 ppm(T₃), Spray at 30 DAT + Triacantanol @ 30 ppm(T₄), Spray at 30 DAT + CCC @ 500 ppm(T₅), Spray at 30 DAT + CCC @ 1000 ppm(T₆), Spray at 45 DAT + GA₃ @ 100 ppm(T₇), Spray at 45 DAT + GA₃ @

150 ppm(T₈), Spray at 45 DAT + Triaccontanol @ 20 ppm(T₉), Spray at 45 DAT + Triaccontanol @ 30 ppm(T₁₀), Spray at 45 DAT + CCC @ 500 ppm(T₁₁), Spray at 45 DAT + CCC @ 1000 ppm(T₁₂), Spray at 30 and 45 DAT + GA₃ @ 100 ppm(T₁₃), Spray at 30 and 45 DAT + GA₃ @ 150 ppm(T₁₄), Spray at 30 and 45 DAT + Triaccontanol @ 20 ppm(T₁₅), Spray at 30 and 45 DAT + Triaccontanol @ 30 ppm(T₁₆), Spray at 30 and 45 DAT + CCC @ 500 ppm(T₁₇), Spray at 30 and 45 DAT + CCC @ 1000 ppm(T₁₈) replicated thrice. Statistical analysis of the data pertaining to yield and quality parameters were analysed as per the methods described by Panse and Sukhatme (1985) [5].

Results and Discussion

Yield parameters

The data on yield attributes characters such as number of panicle per plant, numbers of panicle per plot, number of panicle per hectare are depicted in Table 1.

Number of panicle per plant

Various time of spray, plant growth substances and their interaction produced significant effect on number of panicle per plant. Significantly maximum number of panicle per plant (7.68) was recorded at 30 DAT (T₁). Among plant growth substances, significantly maximum number of panicle per plant (8.97) was recorded with the application of GA₃ @ 150 ppm (p₂). The interaction effect of time of spray and plant growth substances significantly increased number of panicle per plant (10.20) with the treatment combination of T₁p₂ (Spray at 30 DAT + GA₃ @ 150 ppm).

The increased panicle yield, observed in GA₃treatments might be due to cell elongation and production of maximum food material by enhancing photosynthesis (Chopde *et al.*, 2015) [1]. Similar views have also been expressed by Hinge *et al.* (2024) [2] in golden rod and Shyla and Kumar (2021) [7] in gladiolus.

Number of panicle per plot

The data revealed that the effect of time of spray, plant growth substances and their interaction produced significant effect on number of panicle per plot. 30 DAT (T₁) recorded significantly maximum number of panicle per plot (37.77). In case of the plant growth substances, application of GA₃ @ 150 ppm (p₂) found maximum number of panicle per plot (39.67). Maximum number of panicle per plot (43.00) were recorded with the treatment combination of T₁p₂ (Spray at 30 DAT + GA₃ @ 150 ppm).

Number of panicle per hectare

Various time of spray, plant growth substances and their interaction produced significant effect on number of panicle per hectare. 30 DAT (T₁) recorded significantly maximum number of panicle per hectare (467764). In case of the plant growth substances, application of GA₃ @ 150 ppm (p₂) recorded maximum number of panicle per hectare (489711.93). The interaction effect of time of spray and plant growth substances significantly maximum number of panicle per hectare (530864.20) recorded with the treatment combination of T₁p₂ (Spray at 30 DAT + GA₃ @ 150 ppm).

The increase in yield attributes might be due to the fact that gibberellic acid stimulated overall vegetative growth of plants facilitating more photosynthetic area and metabolic activities resulting in more transport and utilization of the photosynthetic product which ultimately resulted in higher flower yield (Shanmuganm and Muthuswamy 1974) [6]. These results are also in same with the earlier findings of Kudmate *et al.* (2016) [4] in annual chrysanthemum, Kalaimani *et al.* (2017) [3] in African marigold and Hinge *et al.* (2024) [2] in golden rod.

Quality parameters

The data on quality characters such as vase life of panicle and longevity of panicles on plants are depicted in Table 2.

Vase life of panicle

Various time of spray, plant growth substances and their interaction on vase life of panicle was found statistically non significant.

Longevity of panicles on plant

Various time of spray, plant growth substances and their interaction on longevity of panicles on plants was found statistically non significant.

Quality parameters

Economics

The details of economics *i.e.* gross return, cost of cultivation, net return and BCR on data basis for different treatments have been calculated and presented in Table 3. It apparent from Table 3 that the treatment T₂ (combination of T₁p₂) noted maximum gross return of ₹ 530864 per hectare, net return ₹ 392268 per hectare and benefit cost ratio 3.83.

Table 3: Effect of time of spray, plant growth substances on economics and Benefit Cost Ratio

Treatments	Yield per hectare	Gross realization (Rs/ha)	Total cost of cultivation (Rs/ha)	Net returns (Rs/ha)	Benefit Cost Ratio
T ₁ p ₁	506173	506173	136786	369387	3.70
T ₁ p ₂	530864	530864	138596	392268	3.83
T ₁ p ₃	452675	452675	135166	317509	3.34
T ₁ p ₄	444444	444444	136166	308278	3.26
T ₁ p ₅	366255	366255	228091	138164	1.60
T ₁ p ₆	497942	497942	323016	174926	1.54
T ₂ p ₁	473251	473251	137512	335739	3.44
T ₂ p ₂	440329	440329	139322	301007	3.16
T ₂ p ₃	390947	390947	135892	255055	2.87
T ₂ p ₄	358025	358025	136892	221133	2.61
T ₂ p ₅	481481	481481	228817	252664	2.10
T ₂ p ₆	390947	390947	323742	67205	1.20
T ₃ p ₁	481481	481481	141132	340349	3.41
T ₃ p ₂	497942	497942	144752	353190	3.44
T ₃ p ₃	465021	465021	137892	327129	3.37
T ₃ p ₄	349794	349794	139892	209902	2.50
T ₃ p ₅	493827	493827	323742	170085	1.52
T ₃ p ₆	460905	460905	513592	-52687	0.89

Table 1: Effect of time of spray, plant growth substances and their interaction on various yield and quality parameters of golden rod

Plant growth substances (P)	Number of panicle per plant				Number of panicle per plot				Number of panicle per hectare			
	Time of spray (T)											
	T ₁	T ₂	T ₃	Mean	T ₁	T ₂	T ₃	Mean	T ₁	T ₂	T ₃	Mean
p ₁ (GA ₃ @ 100 ppm)	8.40	8.46	7.66	8.17	41.00	38.33	39.00	39.44	506172.84	473551.03	481481.48	486968.45
p ₂ (GA ₃ @ 150 ppm)	10.20	8.20	8.53	8.97	43.00	35.67	40.33	39.67	530864.20	440329.22	497942.39	489711.93
p ₃ (Triacantanol @ 20 ppm)	6.20	6.26	6.60	6.35	36.67	31.67	37.67	35.33	452674.90	390946.50	465020.58	436213.99
p ₄ (Triacantanol @ 30 ppm)	7.60	5.86	5.06	6.17	36.00	29.00	28.33	31.11	444444.44	358024.69	349794.24	384087.79
p ₅ (CCC @ 500 ppm)	6.86	6.93	5.33	6.37	29.67	39.00	40.00	36.22	366255.14	481481.48	493827.16	447187.93
p ₆ (CCC @ 1000 ppm)	6.86	5.33	6.86	6.35	40.33	31.67	37.33	36.44	497942.00	390947.00	460905.00	449931.00
Mean	7.68	6.84	6.67		37.77	34.22	37.11		467764.00	422497.00	458162.00	
	t	p	t × p		t	p	t × p		t	p	t × p	
S.Em±	0.16	0.23	0.40		1.02	1.44	2.50		12692.34	17949.68	31089.76	
C. D. (5%)	0.47	0.67	1.16		2.90	4.10	7.11		36125.52	51089.21	88489.10	
C.V.%	10.02				11.90				11.90			

Note: T₁: 30 DAT, T₂: 45 DAT, T₃: 30 and 45 DAT

Table 2: Effect of time of spray, plant growth substances and their interaction on various yield and quality parameters of golden rod

Plant growth substances (P)	Vase life of panicle				Longevity of panicles on plants			
	Time of spray (T)							
	T ₁	T ₂	T ₃	Mean	T ₁	T ₂	T ₃	Mean
p ₁ (GA ₃ @ 100 ppm)	6.13	5.03	4.80	5.32	9.06	7.13	5.83	7.34
p ₂ (GA ₃ @ 150 ppm)	5.83	4.33	4.23	4.80	6.06	8.73	6.46	7.08
p ₃ (Triaccontanol @ 20 ppm)	4.53	4.96	4.63	4.71	6.86	5.70	6.93	6.50
p ₄ (Triaccontanol @ 30 ppm)	3.93	3.73	4.73	4.13	5.36	5.20	6.36	5.64
p ₅ (CCC @ 500 ppm)	4.30	4.90	4.86	4.68	6.63	6.76	7.46	6.95
p ₆ (CCC @ 1000 ppm)	4.73	5.33	4.26	4.77	7.16	7.60	7.03	7.26
Mean	4.91	4.71	4.58		6.86	6.85	6.68	
	t	p	t × p		t	p	t × p	
S. Em±	0.17	0.24	0.43		0.89	0.44	0.77	
C. D. (5%)	NS	NS	NS		NS	NS	NS	
C.V. %	15.78				19.66			

Note: T₁: 30 DAT, T₂: 45 DAT, T₃: 30 and 45 DAT

Conclusion

Based on these experimental results, it can be concluded that the application of GA₃ @ 150 ppm at 30 DAT is the best in terms of yield and quality parameters in golden rod.

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