

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.612.435>

Effect of Exogenous Application of GA₃ SSSAS A Male Gametocide on Yield Parameters in Soybean

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ABSTRACT

Keywords

Soybean,
Gametocides, GA₃,
Yield parameters.

Article Info

Accepted:
28 October 2017
Available Online:
10 December 2017

An experiment was conducted to observe the effect of exogenous application of GA₃ on yield parameters of two popular soybean varieties viz., Co (Soy)3 and JS 335 when it was used as a gametocide to induce male sterility. In both the varieties pods per cluster was maximum at lower concentration of GA₃. GA₃ @ 700 ppm on combined sprays yielded least number of pods per plant in the test varieties. The trait number of seeds per plant in the variety JS 335 showed a positive trend with concentration of GA₃ and the same trait showed a negative trend in the variety Co (Soy)3. GA₃ combined sprays @ 700 ppm in JS 335 and 500 ppm in Co (Soy)3 resulted in higher seed yield per plant. GA₃ at 500 ppm spray on 25 DAS has pronounced effect on 100 seed weight in JS 335. Significant differences have been observed in the GA₃ treated plants when compared with the control plants.

Introduction

Soybean [*Glycine max* (L.) Merrill] is a widely used oil seed and protein crop of the world. It is a good source of unsaturated fatty acids, minerals like Calcium and Phosphorus besides rich in vitamin A, B, C and D, so it can meet up different nutritional needs. It is referred to "the protein hope of the future" as well as "the miracle golden bean" because of its high nutritive value containing about 42-45% protein and 20-25% edible oil. Soybean being self-fertilized, its inherent variability is very much circumscribed. Genetic improvement in this crop could also be brought by conventional methods of

hybridization. Hybridization is a tedious operation in soybean due to cleistogamous flower, small floral parts and flower drop and drying of stigma under high temperature and low humidity conditions after emasculation. To overcome this, the most avidly pursued fields of endeavor is the construction of male sterile lines. A method of producing male sterile lines which circumvents the difficulties of genetic induction is the use of chemical hybridizing agents. The principle involved here is that the chemical acts as a gametocide selectively altering the male gamete, i.e., pollen, by inducing physiological

abnormalities, which in turn prevent pollen development, pollen shed, or pollen viability (Dubey and Singh, 1967). These chemicals apart from having influence on male gamete development also affect all aspects of plant growth and development, from seed germination to flowering and fruit ripening. Hence, the present investigation aims on the study of the effect of GA_3 , male gametocide on the yield parameters of soybean genotypes.

Materials and Methods

The field experiment was conducted at the Department of Pulses, Center for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore, involving Co (Soy)3 and JS 335, the promising varieties of soybean. The treatments included three concentrations of GA_3 viz., 500, 600 and 700 ppm with 10 foliar sprays for each concentration, however control plants were treated with distilled water. The experiment was laid out in Randomized Block Design with 31 treatments in two replications. Spraying was started before the onset of flowering, 15 days after sowing (DAS) in JS 335 and 25 days after sowing in Co (Soy)3. All the sprays arranged in such a way that each concentration was tried once, twice, thrice and four sprays at 5 days of interval up to 30 DAS in JS 335 and 40 DAS in Co(Soy)3.

The details of 10 foliar sprays per concentration of each chemicals for Co(Soy)3 is as follows 25 DAS, 25+30 DAS, 25+30+35 DAS, 25+30+35+40 DAS, 30 DAS, 30+35 DAS, 30+35+40 DAS, 35 DAS, 35+40 DAS and 40 DAS. Whereas for the variety JS 335 the treatments were fixed as 15 DAS, 15+20 DAS, 15+20+25 DAS, 15+20+25+30 DAS, 20 DAS, 20+25 DAS, 20+25+30 DAS, 25 DAS, 25+30 DAS and 30 DAS. Five plants per replication in each treatment were randomly selected and tagged for recording

the observations on yield parameters viz., number of pods per cluster, number of pods per plant, number of seeds per pod, number of seeds per plant, seed yield per plant and 100 seed weight in both the varieties.

Results and Discussion

Number of pods per cluster

Among the GA_3 dosages maximum number of pods per cluster was observed in JS 335 when sprayed on 30 DAS of 500 ppm (4.70) followed by 700 ppm spray on 15 DAS (4.40) and minimum was recorded on 700 ppm single spray on 25 DAS (2.40). In Co(Soy)3 maximum pods per cluster was observed in 500 ppm spray on 35+40 DAS (4.10) followed by 600 ppm spray on 35 DAS (4.00) and minimum was on 700 ppm spray on 25+30+35+40 DAS (2.00). GA_3 sprays resulted in maximum pods per cluster in JS 335. The results corresponded to the findings of Wang *et al.*, (1996), Naserpur (2007) and Azizi *et al.*, (2012).

Total number of pods per plant

Application of GA_3 produced maximum number of pod per plant in variety JS 335 on 700 ppm spray on 20+25+30 DAS (38.20) followed by 500 ppm spray on 20+25 DAS (37.00) and minimum number of pods per plant was recorded on 700 ppm spray on 25 DAS (12.60). In variety Co(Soy)3 maximum number of pods per plant was recorded on 600 ppm spray on 35 DAS (47.60) followed by 500 ppm spray on 35+40 DAS (45.70) and minimum number was by 700 ppm spray on 30+35+40 DAS (23.50). GA_3 @ 700 ppm on combined sprays yielded least number of pods in the test varieties (Plate 16 a). Lesser total of number pods in GA_3 treatment was solely due to inter nodal growth. Akhter *et al.*, (2007) also reported similar finding in mustard at GA_3 @ 75 ppm spray

Comparison between normal Soybean plant from control (A) and GA₃ 700 ppm treated plant of JS 335 (B)

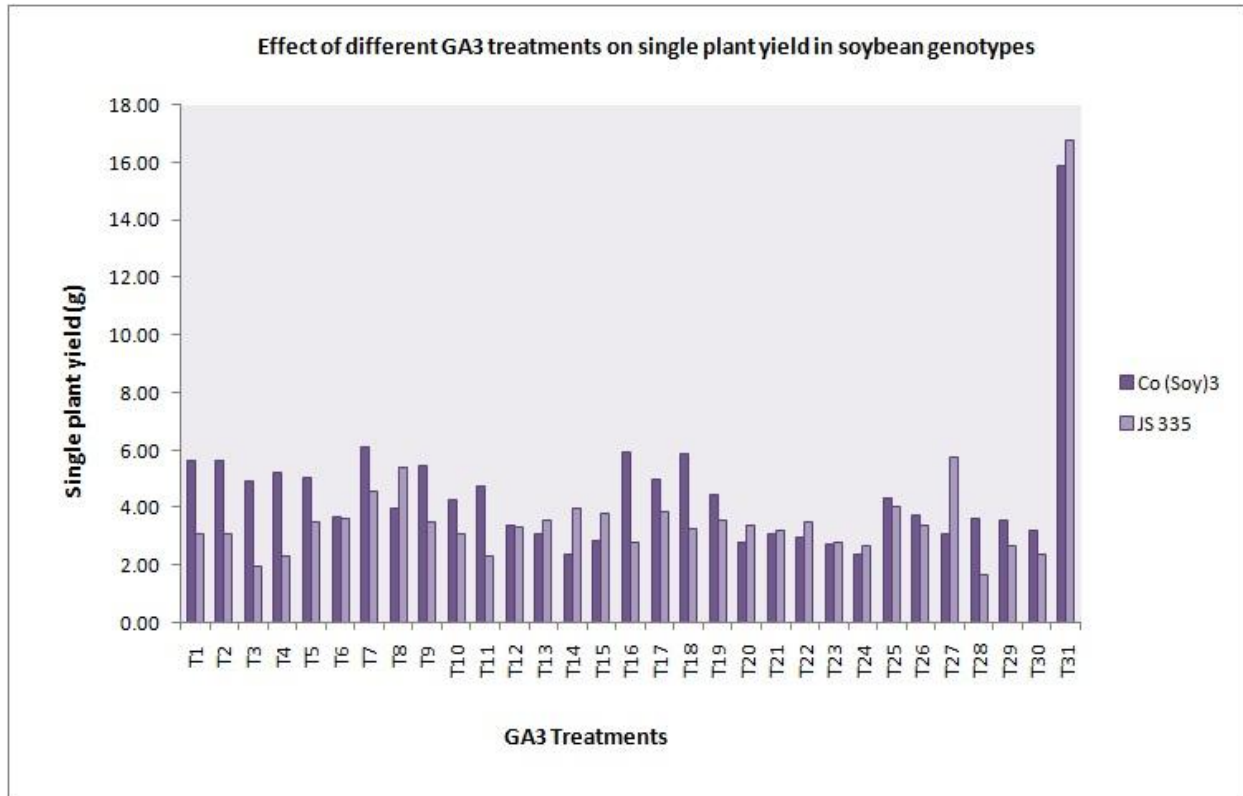
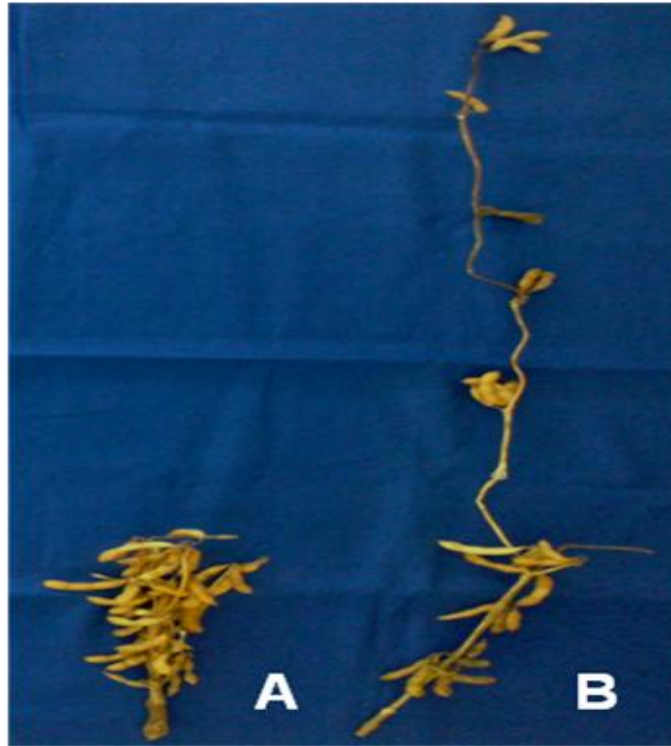


Table.1 Effect of GA₃ on yield parameters in soybean

Chemical concentration	Spray combination		Treatment	Pods /cluster		Pods / plant		Seeds / pod		Seeds / plant		HSW (g)		SPY (g)	
	Co (Soy)3	JS 335		Co3	JS 335	Co3	JS 335	Co3	JS 335	Co3	JS 335	Co3	JS 335	Co3	JS 335
Concentration I GA3 - 500ppm	25 DAS	15 DAS	T1	3.0	4.3	39.9	20.0	2.3	2.1	58.4	29.7	9.67	10.32	5.65	3.07
	25+30 DAS	15+20 DAS	T2	3.4	4.3	43.6	18.5	2.3	2.3	56.4	32.5	9.70	9.49	5.61	3.09
	25+30+35 DAS	15+20+25 DAS	T3	3.6	2.7	42.0	12.7	2.2	2.3	50.9	20.7	9.77	9.35	4.89	1.94
	25+30+35+40 DAS	15+20+25+30 DAS	T4	3.3	2.7	36.1	17.3	2.4	2.2	53.1	26.4	9.50	8.81	5.19	2.33
	30 DAS	20 DAS	T5	3.2	3.7	34.9	19.2	2.0	2.4	51.6	35.6	9.29	9.77	5.05	3.48
	30+35 DAS	20+25 DAS	T6	3.2	4.3	27.8	37.0	2.4	2.2	37.5	37.1	9.73	9.73	3.65	3.61
	30+35+40 DAS	20+25+30 DAS	T7	3.3	3.6	44.3	26.5	2.2	2.2	61.6	26.5	9.90	17.18	6.10	4.55
	35 DAS	25 DAS	T8	3.0	3.4	31.9	30.5	2.2	2.1	40.5	30.4	9.73	17.63	3.94	5.36
	35+40 DAS	25+30 DAS	T9	4.1	4.2	45.7	22.0	1.7	2.3	56.1	37.3	9.72	9.36	5.45	3.49
	40 DAS	30 DAS	T10	3.4	4.7	30.5	21.6	1.6	2.3	43.4	33.0	9.82	9.41	4.26	3.11
Concentration II GA3 - 600ppm	25 DAS	15 DAS	T11	3.3	3.7	39.1	16.4	2.4	2.1	48.1	24.8	9.85	9.29	4.74	2.30
	25+30 DAS	15+20 DAS	T12	2.3	4.0	25.6	23.4	2.6	2.4	34.3	35.2	9.90	9.48	3.40	3.34
	25+30+35 DAS	15+20+25 DAS	T13	2.6	3.7	27.9	25.6	2.4	2.1	31.6	36.4	9.81	9.76	3.10	3.55
	25+30+35+40 DAS	15+20+25+30 DAS	T14	2.4	3.5	24.5	27.7	2.2	2.2	24.4	40.5	9.82	9.84	2.40	3.99
	30 DAS	20 DAS	T15	2.6	4.3	29.9	26.9	2.4	2.4	29.4	39.5	9.61	9.52	2.83	3.76
	30+35 DAS	20+25 DAS	T16	3.4	4.3	40.1	20.6	2.5	2.4	60.1	30.3	9.88	9.22	5.94	2.80
	30+35+40 DAS	20+25+30 DAS	T17	3.1	3.7	41.5	27.3	2.3	2.3	50.6	40.2	9.78	9.55	4.95	3.84
	35 DAS	25 DAS	T18	4.0	4.1	47.6	22.4	2.3	2.5	59.6	33.6	9.80	9.65	5.84	3.24
	35+40 DAS	25+30 DAS	T19	2.7	3.7	30.5	18.4	2.6	2.7	44.4	37.6	9.97	9.52	4.43	3.58
	40 DAS	30 DAS	T20	2.5	2.9	30.5	22.3	2.4	2.3	33.7	35.0	8.31	9.70	2.80	3.40
Concentration III GA3 - 700ppm	25 DAS	15 DAS	T21	2.6	4.4	23.9	19.6	2.4	2.5	31.6	35.6	9.73	9.00	3.08	3.20
	25+30 DAS	15+20 DAS	T22	2.4	3.3	25.9	26.3	2.4	2.7	31.0	38.4	9.47	9.10	2.94	3.49
	25+30+35 DAS	15+20+25 DAS	T23	2.3	3.2	29.1	25.6	2.3	2.3	29.1	35.4	9.42	7.90	2.74	2.80
	25+30+35+40 DAS	15+20+25+30 DAS	T24	2.0	2.7	27.5	19.2	2.5	2.4	24.3	34.0	9.86	7.81	2.40	2.65
	30 DAS	20 DAS	T25	2.6	3.4	31.0	20.4	2.3	2.3	44.5	40.5	9.70	9.95	4.32	4.03
	30+35 DAS	20+25 DAS	T26	2.5	3.0	24.1	21.4	2.2	2.5	38.3	36.3	9.76	9.32	3.74	3.38
	30+35+40 DAS	20+25+30 DAS	T27	2.3	3.9	23.5	38.2	2.4	2.6	31.3	61.9	9.92	9.32	3.11	5.77
	35 DAS	25 DAS	T28	2.6	2.4	36.4	12.6	2.0	2.7	37.4	20.7	9.65	7.87	3.61	1.63
	35+40 DAS	25+30 DAS	T29	2.4	2.6	29.6	16.6	2.4	2.2	36.2	29.5	9.78	9.09	3.54	2.68
	40 DAS	30 DAS	T30	2.6	3.1	34.6	16.5	2.6	2.4	32.6	26.3	9.80	9.12	3.20	2.40
Control	Water spray		T31	5.3	4.8	63.7	45.6	3.0	3.0	125.1	86.9	12.47	13.65	15.88	16.74
			Grand Mean	3.30		28.73		2.34		40.24		9.87		4.12	
SEd			V	0.034		0.036		0.032		0.058		0.059		0.020	
			T	0.133		0.143		0.125		0.023		0.231		0.079	
			VT	0.188		0.202		0.177		0.325		0.327		0.110	
CD (P=0.05)			V	0.068		0.072		0.064		0.116		0.117		0.041	
			T	0.266		0.286		0.250		0.459		0.462		0.159	
			VT	0.377		0.405		0.355		0.649		0.653		0.225	

Number of seeds per pod

Among GA₃ sprays, maximum number of seeds per pod in variety JS 335 was on single spray of 700 ppm on 25 DAS (2.70), which was at par to two sprays of same dose at 15+20 DAS and two sprays of 600 ppm at 25+30 DAS followed by 700 ppm spray on 20+25+30 DAS (2.60) and minimum seeds per pod was on 500 ppm spray on 15 DAS (2.10), which was in par with 600 ppm spray on 25 DAS, 15+20+25 DAS and 500 ppm spray on 25 DAS. In variety Co(Soy)3 maximum number of seeds per pod was recorded on 700 ppm spray on 40 DAS (2.60), which was on par with 600 ppm spray on 35+40 DAS and 25+30 DAS followed by 600 ppm spray on 30+35 DAS (2.50), which was in par with 700 ppm spray on 25+30+35+40 DAS and minimum was on 500 ppm spray on 40 DAS (1.60). Water treated control plants showed maximum seeds per pod (3.00), followed by GA₃ @ 700 ppm on 25 DAS in JS 335. These results corresponded to the findings of Wang *et al.*, (1996) and Naserpur (2007). In a study by Azizi *et al.*, (2012) in soybean, higher number of seeds per pod was achieved with the GA₃ treatments. GA₃ treatment increased the leaf area, provided a dense canopy cover, and resulted in suitable growth and photosynthetic activity.

Total number of seeds per plant

Among GA₃ sprays, maximum number of seeds per plant in variety JS 335 was recorded on 700 ppm spray on 20+25+30 DAS (61.90) followed by 600 ppm spray on 15+20+25+30 DAS (40.50), which was in par with 700 ppm spray on 20 DAS and minimum was on 500 ppm spray on 15+20+25 DAS (20.70), which was on par with 700 ppm spray on 25 DAS. In variety Co(Soy)3 maximum seeds per plant was recorded on spray on 500 ppm spray on 30+35+40DAS (61.60) followed by 600 ppm

spray on 30+35 DAS (60.10) and minimum was on 700 ppm spray on 25+30+35+40 DAS (24.30).

Seed yield per plant (g)

Among the GA₃ sprays, maximum seed yield per plant in variety JS 335 was recorded on 700 ppm spray on 20+25+30 DAS (5.77 g) followed by 500 ppm spray on 25 DAS (5.36 g) and minimum was on 700 ppm spray on 25 DAS (1.63 g). In variety Co (Soy)3 maximum seed yield per plant was recorded on spray of 500 ppm on 30+35+40 DAS (6.10 g) followed by 600 ppm spray on 30+35 DAS (5.94 g) and minimum was on 600 ppm spray on 25+30+35+40 DAS (2.40 g), which was on par with 700 ppm spray on 25+30+35+40 DAS. GA₃ combined sprays @ 700 ppm in JS 335 and 500 ppm in Co(Soy)3 resulted in higher seed yield per plant. Sarkar *et al.*, (2002) also noticed higher seed yield at 200 ppm concentration in soybean (Table 1).

Hundred seed weight (g)

Among GA₃ sprays, maximum 100 seed weight in variety JS 335 was recorded on 500 ppm spray on 25 DAS (17.63 g) followed by 500 ppm spray on 20+25+30 DAS (17.18 g) and minimum was on 700 ppm spray on 15+20+25+30 DAS (7.81 g). In variety Co (Soy)3 maximum 100 seed weight was recorded on spray with 600 ppm on 35+40 DAS (9.97 g) followed by 700 ppm spray on 30+35+40 DAS (9.92 g) and minimum was on 600 ppm spray on 40 DAS (8.31 g). GA₃ at 500 ppm spray on 25 DAS has pronounced effect on 100 seed weight in JS 335. GA₃ had significant effect on number of pods per plant, number of seeds per pod, and 100 seed weight. Azizi *et al.*, (2012) in Soybean, Shinde *et al.*, (1989) in sorghum also noticed the similar effect of GA₃. Sarkar *et al.*, (2002) in soybean also reported GA₃ at lower concentration resulted in more 100 seed weight when used

at 100 ppm concentration. This increase in 100-seed weight was as a result of increases to leaf area index and growth rate that facilitated transmission of materials to the developing seeds in the treatment.

Application of a suitable concentration of GA₃ has an important influence on the yield and yield components in soybean. GA₃ sprays resulted in maximum pods per cluster. Single initial spray of GA₃ @ 700 ppm produced more number of seeds per pod. GA₃ at 500 ppm spray on 25 DAS had recorded pronounced effect on 100 seed weight. The above experimental results inferred that the yield attributing traits could be modified by the application of GA₃. Through further investigations by fixing suitable concentration of GA₃ and proper stage of plant development for application of GA₃ the yield of soybean can be improved.

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How to cite this article:

Abirami, S. and Kalaimagal, T. 2017. Effect of Exogenous Application of GA₃ SSSAS A Male Gametocide on Yield Parameters in Soybean. *Int.J.Curr.Microbiol.App.Sci*. 6(12): 3779-3784. doi: <https://doi.org/10.20546/ijcmas.2017.612.435>