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INFLUENCE OF PLANT GROWTH REGULATORS ON POD CHARACTERS IN PROMISING VARIETIES OF CLUSTER BEAN UNDER MAHANANDI CONDITIONS

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Abstract

The studies on influence of plant growth regulators on pod characters in culture bean under mahanandi conditions. The number of pods per plant exhibited significant variations due to growth regulator sprays in both the varieties. Among the growth regulators, the spray of CCC at 1500 ppm showed the highest quality of pod with bold size of both pod as well as seed. The highest weight of dry pods per plant also recorded in same cultivar HG 365. Among the growth regulators, maximum weight of dry pods per plant was recorded by the application of CCC at 1500 ppm which was on par with CCC 1000 ppm. This shows the significant effect of CCC at 1500 ppm on the pod characteristics.

Key words : Plant Growth Regulators, pod characters and varieties of cluster bean.

Introduction

Plant growth regulators (PGRs) are known to improve physiological efficiency including photosynthetic ability of plants and offer a significant role in realizing higher crop yields. The PGRs are known to influence the source-sink relationship and stimulate the translocation of photosynthetic assimilates, thereby increasing the productivity in various crops (Prabhavathi, 2005). Though, the plant growth regulators have great potential, their application has to be judiciously planned in terms of optimal concentration.

Kumar and Kaushik (2014) explained that the use of growth substances is one of the effective means of delaying the senescence of leaves as well as retarding the abscission of reproductive organs. Application of growth regulators also increase flower, fruit setting, grain filling and test weight in different crops where seed is economic product (Patel and Singh, 1980), Certain growth regulating chemicals like triacontanol are known to influence photosynthesis, nutrient uptake, enzymatic activity and gene regulation and is proved to be beneficial in various crops (Haleh and Ergin, 2010). Chloremquat chloride popularly known as CCC or cycocel, is known to alter the plant architecture and boost flowering response in several crops (Dorajeerao, 2010). One of the similar growth regulating chemical mepiquat chloride was found to be readily absorbed by the leaves and inhibit the biosynthesis of gibberellins, but promote root growth and improve drymatter assimilation in spite of reducing vertical growth *i.e.* height of plant. Studies on the influence of growth regulator chemicals specifically on seed cluster bean are limited and therefore considered for inclusion in the present study.

Material and Methods

The experiment was conducted in factorial randomized design with two factors *viz.,* varieties (2) and growth regulator (3) at each at 3 concentrations replicated thrice. The plot was laid out at Horticultural Research Station, Mahanandi, Kurnool district of Andhra Pradesh during both *Kharif* and *Rabi* seasons of the years 2014-15 and 2015-16. The data obtained on various characters were statistically analyzed in factorial randomized block design as described by Panse and Sukhatme (1985). The treatment means were tested for their significant difference by calculating critical difference values at 5% level of significance.

Results and Discussion

Pod length (cm)

The pod length table1 differed significantly due to spray of growth regulators during *Kharif* and *Rabi* seasons. The highest pod length (*Kharif* 6.89 cm; *Rabi* 6.34 cm) was recorded by HG 365. Among the growth regulators, maximum pod length (*Kharif* 7.48 cm; *Rabi* 6.89 cm) was recorded by the application of CCC at 1500 ppm which was on par with CCC 1000 ppm (*Kharif* 7.37 cm; *Rabi* 6.78 cm) (Plate 11). The lowest pod length was observed by the spray of MC 500 ppm (*Kharif* 5.95 cm; *Rabi* 5.48 cm) which was on par with MC 1000 ppm (*Kharif* 6.10 cm; *Rabi* 5.61 cm). Spray of TRIA 1500 ppm resulted in medium long pods (*Kharif* 6.92 cm; *Rabi* 6.36 cm). The control recorded a pod length of 5.59 cm in *Kharif* and 5.15 cm in *Rabi*.

Pod width (cm)

The pod width (Table 2) differed significantly due to spray of growth regulators during *Kharif* and *Rabi* seasons. The highest pod width (*Kharif* 1.31 cm; *Rabi* 1.20 cm) was recorded by HG 365. Among the growth regulators, maximum pod width (*Kharif* 1.42 cm; *Rabi* 1.31 cm) was recorded by the application of CCC at 1500 ppm which was on par with CCC 1000 ppm (*Kharif* 1.40 cm; *Rabi* 1.29 cm). The lowest pod width was observed by the spray of MC 500 ppm (*Kharif* 1.13 cm; *Rabi* 1.04 cm) which was on par with MC 1000 ppm (*Kharif* 1.16 cm; *Rabi* 1.07 cm) whereas, TRIA 1500 ppm recorded a pod width of 1.31 cm during *Kharif* and 1.21 cm during *Rabi*. The control plots produced 1.06 cm wide pods in *Kharif* and 0.98 cm wide pods in *Rabi*. Similar result found by Sharma and Lashkari (2009) in cluster bean.

Dry weight of pods per plant (g)

The spray of growth regulators resulted in significant differences in respect of dry weight of pods table 3 during *Kharif* and *Rabi* seasons. At 90 DAS, the highest dry weight of pod (*Kharif* 20.09 g; *Rabi* 17.74 g) was recorded by HG 365. Among the growth regulators, maximum dry weight of pods per plant (*Kharif* 22.49 g; *Rabi* 21.20 g) was recorded by the

Table 1: Pod length (cm) as influenced by growth regulators in cluster bean varieties during *Kharif* and *Rabi* 2015-16.

Growth regulators (ppm)(B)	Variety (A)					
	Kharif			*Rabi*		
	HG 365	HG 563	Mean	HG 365	HG 563	Mean
CCC 500	7.16	6.44	6.80	6.59	5.93	6.26
CCC 1000	7.76	6.98	7.37	7.14	6.42	6.78
CCC 1500	7.88	7.09	7.48	7.25	6.52	6.89
MC 500	6.27	5.64	5.95	5.77	5.19	5.48
MC 1000	6.42	5.77	6.10	5.90	5.31	5.61
MC 1500	6.45	5.80	6.12	5.93	5.34	5.63
TRIA 500	6.57	5.91	6.24	6.04	5.43	5.74
TRIA 1000	7.16	6.44	6.80	6.59	5.93	6.26
TRIA 1500	7.28	6.55	6.92	6.70	6.03	6.36
Control	5.97	5.22	5.59	5.49	4.80	5.15
Mean	6.89	6.18	6.54	6.34	5.69	6.02
Factor	S Em±	CD		S Em±	CD	
Variety (A)	0.008	0.02		0.008	0.02	
Growth regulators (B)	0.042	0.12		0.039	0.11	
Interaction (A × B)	-	NS		-	NS	

CD: CD at 5% level of significance CCC: Cycocel MC: Mepiquat chloride TRIA: Triacontanol

Table 2: Pod width (cm) as influenced by growth regulators in cluster bean varieties during *Kharif* and *Rabi* 2015-16.

Growth regulators (ppm)(B)	Variety (A)					
	Kharif			*Rabi*		
	HG 365	HG 563	Mean	HG 365	HG 563	Mean
CCC 500	1.36	1.22	1.29	1.25	1.13	1.19
CCC 1000	1.47	1.33	1.40	1.36	1.22	1.29
CCC 1500	1.50	1.35	1.42	1.38	1.24	1.31
MC 500	1.19	1.07	1.13	1.10	0.99	1.04
MC 1000	1.22	1.10	1.16	1.12	1.01	1.07
MC 1500	1.23	1.10	1.16	1.13	1.01	1.07
TRIA 500	1.25	1.12	1.19	1.15	1.03	1.09
TRIA 1000	1.36	1.22	1.29	1.25	1.13	1.19
TRIA 1500	1.38	1.24	1.31	1.27	1.15	1.21
Control	1.13	0.99	1.06	1.04	0.91	0.98
Mean	1.31	1.18	1.24	1.20	1.08	1.14
Factor	S Em±	CD		S Em±	CD	
Variety (A)	0.002	0.00		0.001	0.00	
Growth regulators (B)	0.008	0.02		0.007	0.02	
Interaction (A × B)	-	NS		-	NS	

CD: CD at 5% level of significance CCC: Cycocel MC: Mepiquat chloride TRIA: Triacontanol

application of CCC at 1500 ppm which was on par with CCC 1000 ppm (*Kharif* 22.28 g; *Rabi* 21.00 g). The lowest dry weight of pod was observed by the spray of MC 1500 ppm (*Kharif* 16.60 g; *Rabi* 15.66 g) preceded by MC 1000 ppm (*Kharif* 16.95 g; *Rabi* 15.97 g) whereas, TRIA 1500 ppm resulted in intermediate values of dry weight of pods per plant (*Kharif 18.18* g, *Rabi* 17.13 g). The control recorded a dry weight of pod of 11.48 g in *Kharif* and 10.85 g in *Rabi* at 90 DAS. Similar result found by Singh *et al.,* (1993) in mung bean.

Table 3: Average Weight of dry pod (mg) as influenced by growth regulators in cluster bean varieties during *Kharif* and *Rabi* 2015-16.

Growth regulators (ppm)(B)	Variety (A)					
	Kharif			*Rabi*		
	HG 365	HG 563	Mean	HG 365	HG 563	Mean
CCC 500	326.71	293.86	310.28	300.57	270.35	285.46
CCC 1000	353.93	318.35	336.14	325.62	292.88	309.25
CCC 1500	359.38	323.25	341.31	330.63	297.39	314.01
MC 500	285.87	257.13	271.50	263.00	236.56	249.78
MC 1000	292.67	263.25	277.96	269.26	2.19	255.73
MC 1500	294.04	264.48	279.26	270.51	243.32	256.92
TRIA 500	299.48	269.37	284.43	275.52	247.82	261.67
TRIA 1000	326.71	293.86	310.28	300.57	270.35	285.46
TRIA 1500	332.15	298.76	315.46	305.58	274.86	290.22
Control	272.26	237.86	255.06	250.47	218.83	234.65
Mean	314.32	282.02	298.17	289.17	259.46	274.31
Factor	S Em±	CD		S Em±	CD	
Variety (A)	0.383	1.11		0.352	1.02	
Growth regulators (B)	1.914	5.54		1.761	5.09	
Interaction (A × B)	2.182	6.31		-	NS	

CD: CD at 5% level of significance CCC: Cycocel MC: Mepiquat chloride TRIA: Triacontanol

Table 4: Number of pods per plant as influenced by growth regulators in cluster bean varieties during *Kharif* and *Rabi* 2015-16.

Growth regulators (ppm)(B)	Variety (A)					
	Kharif			*Rabi*		
	HG 365	HG 563	Mean	HG 365	HG 563	Mean
CCC 500	117.86	106.01	111.94	108.43	97.53	102.98
CCC 1000	127.68	114.85	121.26	117.47	105.66	111.56
CCC 1500	129.65	116.61	123.13	119.27	107.28	113.28
MC 500	103.13	92.76	97.94	94.88	85.34	90.11
MC 1000	105.58	94.97	100.28	97.14	87.37	92.25
MC 1500	106.07	95.41	100.74	97.59	87.78	92.68
TRIA 500	108.04	97.18	102.61	99.39	89.40	94.40
TRIA 1000	117.86	106.01	111.94	108.43	97.53	102.98
TRIA 1500	119.82	107.78	113.80	110.24	99.16	104.70
Control	98.22	85.81	92.01	90.36	78.94	84.65
Mean	113.39	101.74	107.56	104.32	93.60	98.96
Factor	S Em±	CD		S Em±	CD	
Variety (A)	0.138	0.40		0.127	0.37	
Growth regulators (B)	0.691	2.00		0.635	1.84	
Interaction (A × B)	0.787	2.28		-	NS	

CD: CD at 5% level of significance CCC: Cycocel MC: Mepiquat chloride TRIA: Triacontanol

Number of pods per plant

The number of pods per plant table 4 differed significantly due to spray of growth regulators during *Kharif* and *Rabi* seasons. The highest number of pods per plant (*Kharif* 113.39; *Rabi* 104.32) was recorded by HG 365. Among the growth regulators, maximum number of pods per plant (*Kharif* 123.13; *Rabi* 113.28) was recorded by the application of CCC at 1500 ppm which was on par with CCC 1000 ppm (*Kharif* 121.26; *Rabi* 111.56). The lowest number of pods per plant was observed by the spray of MC 500 ppm (*Kharif* 97.94; *Rabi* 90.11) which was on par with MC 1000 ppm (*Kharif* 100.28; *Rabi* 92.25). Medium values in respect of the number of pods per plant were recorded by TRIA 1500 ppm during both the seasons (*Kharif* 113.80; *Rabi* 104.70). The control recorded 92.01 pods per plant in *Kharif* and 84.65 in *Rabi*.

The pods per cluster and the number of pods per plant exhibited significant variations due to growth regulator sprays in both the varieties. The highest number of clusters with more pods was produced from the variety HG 365 as compared to HG 563 which may be attributed to its genotypic potential. It is also due to contribution from an extended duration of time taken from flowering to pod drying on the plants. Among the growth regulators, the spray of CCC at 1500 ppm showed the highest quality of pod with bold size of both pod as well as seed. Plants which were early to initiate flowering and early for completing flowering phase, also vested with greater amount of time to translocate their photosynthates into reproductive parts or pod clusters which might be

the reason for good growth of individual clusters and bearing more number of pods in them. The differences between concentrations of 1000 ppm and 1500 ppm was not statistically significant in CCC and also in other chemicals, but the effect was in the decreasing order from CCC to mepiquat chloride, the middle one being traicontanol. This is also evident from the data on corresponding values of days taken for various mile stones in flowering like initiation, 50% flowering and completes flowering stages. Non-significant increase in cluster number and pod number with additional concentration might be due to the corresponding non- significant increase in majority of vegetative parameters and the durations between different stages of flowering.

Table 5: Dry pod yield per plant (g) as influenced by growth regulators in cluster bean varieties during *Kharif* and *Rabi* 2015-16.

Growth regulators (ppm)(B)	Variety (A)					
	Kharif			*Rabi*		
	HG 365	HG 563	Mean	HG 365	HG 563	Mean
CCC 500	27.23	24.49	25.86	25.05	22.53	23.79
CCC 1000	29.49	26.53	28.01	27.13	24.41	25.77
CCC 1500	29.95	26.94	28.44	27.55	24.78	26.17
MC 500	23.82	21.43	22.62	21.92	19.71	20.81
MC 1000	24.39	21.94	23.16	22.44	20.18	21.31
MC 1500	24.50	22.04	23.27	22.54	20.28	21.41
TRIA 500	24.96	22.45	23.70	22.96	20.65	21.81
TRIA 1000	27.23	24.49	25.86	25.05	22.53	23.79
TRIA 1500	27.68	24.90	26.29	25.46	22.90	24.18
Control	22.69	19.82	21.25	20.87	18.24	19.55
Mean	26.19	23.50	24.85	24.10	21.62	22.86
Factor	S Em±	CD		S Em±	CD	
Variety (A)	0.032	0.09		0.029	0.08	
Growth regulators (B)	0.160	0.46		0.147	0.42	
Interaction (A × B)	-	NS		-	NS	

CD: CD at 5% level of significance CCC: Cycocel MC: Mepiquat chloride TRIA: Triacontanol

Table 6: Dry pod yield per plot (kg) as influenced by growth regulators in cluster bean varieties during *Kharif* and *Rabi* 2015-16.

Growth regulators (ppm)(B)	Variety (A)					
	Kharif			*Rabi*		
	HG 365	HG 563	Mean	HG 365	HG 563	Mean
CCC 500	4.81	3.89	4.35	4.07	3.30	3.68
CCC 1000	5.65	4.57	5.11	4.78	3.87	4.32
CCC 1500	5.82	4.71	5.27	4.93	3.99	4.46
MC 500	3.69	2.98	3.33	3.12	2.52	2.82
MC 1000	3.86	3.13	3.49	3.27	2.65	2.96
MC 1500	3.90	3.15	3.53	3.30	2.67	2.98
TRIA 500	4.04	3.27	3.66	3.42	2.77	3.10
TRIA 1000	4.81	3.89	4.35	4.07	3.30	3.68
TRIA 1500	4.97	4.02	4.50	4.21	3.41	3.81
Control	3.34	2.55	2.95	2.83	2.16	2.49
Mean	4.49	3.62	4.05	3.80	3.06	3.43
Factor	S Em±	CD		S Em±	CD	
Variety (A)	0.010	0.03		0.009	0.03	
Growth regulators (B)	0.052	0.15		0.044	0.13	
Interaction (A × B)	0.059	0.17		0.050	0.14	

CD: CD at 5% level of significance CCC: Cycocel MC: Mepiquat chloride TRIA: Triacontanol

Dry pod yield per plant (g)

The spray of growth regulators influenced the weight of dry pods per plant table 5 significantly during *Kharif* and *Rabi* seasons. The highest weight of dry pods per plant (*Kharif* 26.19 g; *Rabi* 24.10 g) was recorded by HG 365. Among the growth regulators, maximum weight of dry pods per plant (*Kharif* 28.44 g; *Rabi* 26.17 g) was recorded by the application of CCC at 1500 ppm which was on par with CCC 1000 ppm (*Kharif* 28.01 g; *Rabi* 25.77 g) (Fig. 12). The lowest weight of dry pods per plant was observed by the spray of MC 500 ppm (*Kharif* 22.62 g; *Rabi* 20.81 g) which was on par with MC 1000 ppm (*Kharif* 23.16 g; *Rabi* 21.31 g) whereas, TRIA 1500 ppm resulted in medium weight of dry pods per plant (*Kharif* 26.29 g; *Rabi* 24.18 g). The control recorded a weight of dry pods per plant of 21.25 g in *Kharif* and 19.55 g in *Rabi*.

Dry pod yield per plot (kg)

The pod yield per plot table 6 differed significantly due to spray of growth regulators during *Kharif* and *Rabi* seasons. The highest pod yield per plot (*Kharif* 4.49 kg; *Rabi* 3.80 kg) was recorded by HG 365. Among the growth regulators, maximum pod yield per plot (*Kharif* 5.27 kg; *Rabi* 4.46 kg) was recorded by the application of CCC at 1500 ppm which was on par with CCC 1000 ppm (*Kharif* 5.11 kg; *Rabi* 4.32 kg). The lowest pod yield per plot was observed by the spray of MC 500 ppm (*Kharif* 3.33 kg; *Rabi* 2.82 kg)

which was on par with MC 1000 ppm (*Kharif* 3.49 kg; *Rabi* 2.96 kg). Foliar application of TRIA 1500 ppm recorded a medium pod yield per plot during both the seasons (*Kharif* 4.50 kg, *Rabi* 3.81 kg). The control recorded a pod yield per plot of 2.95 kg in *Kharif* and 2.49 kg in *Rabi*.

The pod yield is the most essential parameter contributing to the seed yield because the only difference lies in pericarps encircling the seeds. The effect of growth regulators was found significant on the pod yield per plant and per plot in both the varieties. As it was observed in case of growth, flowering and quality parameters, the pod yield was found to be highest in case of spray of CCC at 1500 ppm being significantly superior to the same chemical at 1000 ppm. This merit is also revealed from the stand point of corresponding superiority in having highest duration of pod maturity and bold sized pods and seeds ultimately leading to the highest individual weight of pods per plant with growth regulator sprays. The next chemicals in the order were triacontanol and mepiquat chloride above the control. The highest concentration of both these chemicals was at parity with 1000 ppm concentration of the corresponding chemicals. The highest concentration of mepiquat chloride (MC 1500 ppm) was found on par with the lowest concentration of traiacontenol (TRIA 500 ppm) and similarly the highest of triacontenol (TRIA 1500 ppm) was at parity with the lowest concentration of CCC (cycocel 500 ppm).

The additional concentration beyond 1000 ppm in mepiquat chloride and triacontanol was not resulting in significant superiority in the weight of dry pods per plant as well as per plot. This was not true in case of CCC. The differences in the pod yield or weight of dry pods per plant can be attributed to the similar differences in growth parameters, growth rates and flowering periods as well as pod maturity duration.

Similar observations were made by Prabhavathi (2005) who reported that the application of lihocin (1000 ppm) resulted in significantly higher pod yield followed by miraculan @ 1000 ppm and mepiquat chloride @ 1000 ppm as compared to control in cluster bean. These effects were attributed to their corresponding effect on growth parameters and growth rates as also evident in the present study.

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