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INFLUENCE OF PLANT GROWTH REGULATORS ON GROWTH AND DEVELOPMENT OF CLUSTER BEAN VARIETIES

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Abstract

The growth and development of cluster bean differed significantly due to spray of growth regulators during both *kharif* and *rabi* seasons at various growth stages and interactions. The highest leaf area per plant and pod yield per plot was recorded by HG 365. Among the growth regulators, maximum leaf area per plant and pod yield per plot was recorded by the application of CCC at 1500 ppm which was on par with 1000 ppm, where days to first flowering found lowest number of days to first flowering and days to 50% flowering was recorded by the var. HG 563. Among the growth regulators, earliest days to first flowering was recorded by the application of CCC at 1500 ppm which was on par with CCC 1000 ppm.

Key words : Plant Growth Regulators, development and cluster bean.

Introduction

Cluster bean is botanically called as *Cyamopsistetragonoloba* (L.) Taub. It belongs to the family Leguminaceae. The crop is popularly known as guar referring to its seed. India is considered as native place for guar or cluster bean. It has been used as vegetable in our country from hundreds of years. The crop is renowned as drought hardy, being deep rooted and having a low water requirement. It requires a low annual rainfall of about 400 mm to 500 mm. Guar tolerates high temperature and dry conditions, thus gaining popularity in arid and semi arid climates (Undersander *et al.,* 2006). Studies on varietal suitability have been initiated at different research centers, and their preliminary results pointed out the merit of certain varieties *viz.,* HG-563 and HG-365 (Prasanthi and Krishna, 2012).

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).

Material and methods

The above experiment was conducted during *Kharif* and *Rabi* in the year 2015-16 with mixed factorial RBD. The growth regulator chemicals *viz.,* mepiquat chloride (chamatkar), triacontanol and cycocel were procured from Vijayawada and used for foliar spray as per the designated treatments by preparing specified concentrations *i.e.* 500, 1000 and 1500 ppm for cultivars HG 365 and HG 563. 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

Leaf area per plant (cm^2)

The leaf area per plant differed significantly due to spray of growth regulators during both *kharif* and *rabi* seasons at various growth stages and interactions. The mean leaf area (Table 1a, 2b) was found to increase from 178.73 cm^2 and 159.07 cm^2 (30 DAS) to 305.63 cm^2 and 272.01 cm^2 (90 DAS) during *kharif* and *rabi* seasons respectively. At 90 DAS, the highest leaf area (*kharif* 307.47 cm^2; *rabi* 273.65 cm^2) was recorded by HG 365. Among the growth regulators, maximum leaf area (*kharif* 375.80 cm^2; *rabi* 334.46 cm^2) was recorded by the application of CCC at 1500 ppm which was on par with 1000 ppm (*kharif* 369.93 cm^2; *rabi* 329.23 cm^2). The lowest leaf area was observed by the spray of MC 500 ppm (*kharif* 263.94 cm^2; *rabi* 234.90 cm^2) preceded by MC 1000 ppm (*kharif* 281.97 cm^2; *rabi* 250.95 cm^2). Tricontanol concentrations recorded leaf area values in medium range, out of which, the maximum was at 1500 ppm (*kharif* 303.59; *rabi* 270.19) which was on-par with 1000ppm (*kharif* 298.45 cm^2; *rabi* 265.62 cm^2) during both the seasons. The control recorded a leaf area of 261.49 cm^2 in *kharif* and 232.72 cm^2 in *rabi* at 90 DAS.

Days to first flowering

The days to first flowering table 2 differed significantly due to spray of growth regulators during *kharif* and *rabi* seasons. The lowest number of days to first flowering (*kharif* 21.80; *rabi* 20.06) was recorded by the var. HG 563. Among the growth regulators, earliest days to first flowering (*kharif* 20.28; *rabi* 18.66) was recorded by the application of CCC at 1500 ppm which was on par with CCC 1000 ppm (*kharif* 20.90; *rabi* 19.23). The highest number of days to first flowering was observed by the spray of MC 1500 ppm (*kharif* 26.24; *rabi* 24.14) which was on par with MC 1000 ppm (*kharif* 25.63; *rabi* 23.58). Application of TRIA 1500 ppm resulted in the attainment of first flowering at 23.29 days in *kharif* 21.43 days in *rabi*. The control recorded 24.04 days to first flowering in *kharif* and 22.12 days in *rabi*.

Days to 50% flowering

The days to 50% flowering table 3 differed significantly due to spray of growth regulators during *kharif* and *rabi* seasons. The earliest occurrence of 50% flowering (*kharif* 24.65; *rabi* 22.68) was observed in the var. HG 563. Among the growth regulators, the lowest number of days to 50% flowering (*kharif* 23.09; *rabi* 21.24) was recorded by the application of CCC at 1500 ppm which was on par with CCC 1000 ppm (*kharif* 23.71; *rabi* 21.81). The highest delay to 50% flowering was noticed by the spray of MC 1500 ppm (*kharif* 29.02; *rabi* 26.70) which was on par with MC 1000 ppm (*kharif* 28.41; *rabi* 26.14). Foliar spray of TRIA 1500 ppm

Table 1 a: Leaf area (cm^2) per plantas influenced by growth regulators in cluster bean varieties during *kharif* 2015-16.

Growth regulators (ppm)(B)	Variety (A)								
	30 DAS			60 DAS			90 DAS		
	HG 365	HG 563	Mean	HG 365	HG 563	Mean	HG 365	HG 563	Mean
CCC 500	191.52	189.22	190.37	344.74	340.60	342.67	327.50	323.57	325.53
CCC 1000	217.64	215.02	216.33	391.75	387.04	389.39	372.16	367.69	369.93
CCC 1500	221.09	218.44	219.76	397.96	393.19	395.58	378.07	373.53	375.80
MC 500	155.28	153.42	154.35	279.50	276.15	277.83	265.53	262.34	263.94
MC 1000	165.89	163.90	164.89	298.60	295.02	296.81	283.67	280.26	281.97
MC 1500	173.33	171.25	172.29	311.99	308.25	310.12	296.39	292.83	294.61
TRIA 500	165.31	163.33	164.32	297.56	293.99	295.78	282.68	279.29	280.99
TRIA 1000	175.58	173.48	174.53	316.05	312.26	314.15	300.25	296.65	298.45
TRIA 1500	178.61	176.46	177.54	321.49	317.64	319.57	305.42	301.75	303.59
Control	153.84	151.99	152.92	276.91	273.59	275.25	263.07	259.91	261.49
Mean	179.81	177.65	178.73	323.66	319.77	321.71	307.47	303.78	305.63
Factor	S Em±	CD		S Em±	CD		S Em±	CD	
Variety (A)	0.313	0.90		0.563	1.63		0.535	1.55	
Growth regulators (B)	1.564	4.52		2.815	8.14		2.675	7.74	
Interaction (A x B)	-	NS		3.209	9.28		3.049	8.82	

CD: CD at 5% level of significance DAS: Days after sowing CCC: Cycocel MC: Mepiquat chloride TRIA: Triacontanol

Table 1 b: Leaf area (cm^2) per plant as influenced by growth regulators in cluster bean varieties during *rabi* 2015-16.

Growth regulators (ppm)(B)	Variety (A)								
	30 DAS			60 DAS			90 DAS		
	HG 365	HG 563	Mean	HG 365	HG 563	Mean	HG 365	HG 563	Mean
CCC 500	170.45	168.41	169.43	306.82	303.13	304.97	291.47	287.98	289.73
CCC 1000	193.70	191.37	192.53	348.65	344.47	346.56	331.22	327.25	329.23
CCC 1500	196.77	194.41	195.59	354.19	349.94	352.06	336.48	332.44	334.46
MC 500	138.20	136.54	137.37	248.76	245.77	247.27	236.32	233.48	234.90
MC 1000	147.64	145.87	146.75	265.75	262.56	264.16	252.46	249.44	250.95
MC 1500	154.26	152.41	153.34	277.67	274.34	276.01	263.79	260.62	262.21
TRIA 500	147.13	145.36	146.24	264.83	261.65	263.24	251.59	248.57	250.08
TRIA 1000	156.27	154.39	155.33	281.29	277.91	279.60	267.22	264.01	265.62
TRIA 1500	158.96	157.05	158.01	286.13	282.70	284.41	271.82	268.56	270.19
Control	136.92	135.27	136.10	246.45	243.49	244.97	234.13	231.32	232.72
Mean	160.03	158.11	159.07	288.05	284.60	286.33	273.65	270.37	272.01
Factor	S Em±	CD at 5%		S Em±	CD at 5%		S Em±	CD at 5%	
Variety (A)	0.290	0.84		0.632	1.83		0.784	2.27	
Growth regulators (B)	1.450	4.19		3.161	9.14		3.920	11.34	
Interaction (A x B)	1.653	-		NS	10.42		4.468	12.92	

CD: CD at 5% level of significance DAS: Days after sowing CCC: Cycocel MC: Mepiquat chloride TRIA: Triacontanol

resulted in intermediary values for days to 50% flowering during both the seasons (*kharif* 24.39; *rabi* 22.44). The control recorded 26.97 days to 50% flowering in *kharif* and 24.81 days in *rabi*.

Dry pod yield per plot (kg)

The pod yield per plot table 4 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*.

Table 2: Days to first flowering 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	22.54	20.74	21.64	20.74	19.08	19.91
CCC 1000	21.77	20.03	20.90	20.03	18.43	19.23
CCC 1500	21.13	19.44	20.28	19.44	17.88	18.66
MC 500	26.43	23.79	25.11	24.32	21.89	23.10
MC 1000	26.98	24.28	25.63	24.82	22.34	23.58
MC 1500	27.62	24.86	26.24	25.41	22.87	24.14
TRIA 500	25.45	21.63	23.54	23.41	19.90	21.66
TRIA 1000	26.01	20.77	23.39	23.93	19.10	21.52
TRIA 1500	26.65	19.93	23.29	24.52	18.34	21.43
Control	25.55	22.53	24.04	23.51	20.73	22.12
Mean	25.01	21.80	23.41	23.01	20.06	21.53
Factor	S Em±	CD		S Em±	CD	
Variety (A)	0.026	0.08		0.024	0.07	
Growth regulators (B)	0.132	0.38		0.122	0.35	
Interaction (A x B)	-	NS		-	NS	

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

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

Table 3: Days to 50% flowering 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	25.47	23.43	24.45	23.43	21.56	22.49
CCC 1000	24.70	22.72	23.71	22.72	20.90	21.81
CCC 1500	24.05	22.13	23.09	22.13	20.36	21.24
MC 500	29.36	26.42	27.89	27.01	24.31	25.66
MC 1000	29.90	26.91	28.41	27.51	24.76	26.14
MC 1500	30.55	27.49	29.02	28.10	25.29	26.70
TRIA 500	27.62	24.86	26.24	25.41	22.87	24.14
TRIA 1000	26.65	23.98	25.31	24.52	22.06	23.29
TRIA 1500	25.67	23.10	24.39	23.62	21.26	22.44
Control	28.48	25.46	26.97	26.20	23.42	24.81
Mean	27.24	24.65	25.95	25.06	22.68	23.87
Factor	S Em±	CD		S Em±	CD	
Variety (A)	0.028	0.08		0.025	0.07	
Growth regulators (B)	0.138	0.40		0.127	0.37	
Interaction (A x B)	0.157	0.46		-	NS	

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

Table 4: 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 x B)	0.059	0.17		0.050	0.14	

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

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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