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A comparison of growth promoting and retarding compounds on yield performance in greengram during *Rabi*

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ABSTRACT

The growth promoting compounds *viz.,* NAA (20 ppm) and brassinosteroid (20ppm) recorded significantly higher values for total dry matter production (TDM) over growth retardant treatments at all growth stages of greengram. However, photosynthetic rate, SCMR values, and nitrogen harvest index were higher with growth retarding substance *viz.,* chlormequat chloride. However, the seed yield was significantly more with NAA (20 ppm) followed by mepiquat chloride 5% AS, brassinosteroid (20 ppm) and chlormequat chloride (137.5 g a.i ha^{-1}).

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Key words : Greengram, Plant growth regulators, Dry matter production, Biochemical parameters, Yield

INTRODUCTION

Greengram occupies a prominent place by virtue of its high nutritive value, short duration and its ability to suit any cropping systems. The plant growth regulators (PGRs) have been playing an important role in overcoming the hurdles in manifestation of biological productivity in pulses. The use of plant growth regulators are known to improve the physiological efficiency including photosynthetic ability of plants and offer a significant role in realizing higher crop yields. The plant growth regulators are also known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates, thereby increasing the productivity. Use of these regulators should be judicious in any given cropping system. The present paper deals with the effect of certain growth promoting and retarding compounds on yield performance in greengram.

MATERIALS AND METHODS

A field experiment on greengram was conducted during *Rabi* 2009-2010 at Student's Farm, College of Agriculture, Rajendranagar, Hyderabad. The experiment consisted of 9 treatments *viz.*, chlormequat chloride 50% SL (137.5 g a.i ha^{-1},162.5 g a.i ha^{-1}, 187.5 g a.i ha^{-1}and 375.0 g a.i ha^{-1}), mepiquat chloride 5% AS, NAA (20 ppm), brassinosteroid (20 ppm), water spray and control. The experiment was laid out in Randomized Block Design using the cv. WGG-37 with three replications. The growth regulators were sprayed at flower initiation stage (38 DAS). The destructive sampling was done at fortnightly intervals starting from 30 DAS. At each sampling five plants from the second row from either side in each plot were uprooted and component parts were separated and oven dried at 70^{0}C. To know the number of root nodules, plants were dugout carefully and the roots were washed to remove the soil sticking to the roots and nodules. The crop was harvested when most of the pods turned black. The plants from one m^2 area were harvested and were used for the estimation of dry matter production and yield attributes. The photosynthetic rate (Pn) was measured using Infra Red Gas Analyzer of PP systems (Model TPS-1). A field experiment on greengram was conducted during *Rabi* 2009-2010 at Student's Farm, College of Agriculture, Rajendranagar, Hyderabad. The experiment consisted of 9 treatments *viz.,* chlormequat chloride 50% SL (137.5 g a.i ha^{-1},162.5 g a.i ha^{-1}, 187.5 g a.i ha^{-1}and 375.0 g a.i ha^{-1}), Mepiquat chloride 5% AS, NAA (20 ppm), Brassinosteroid (20 ppm), Water spray and Control. The experiment was laid out in Randomized Block Design using the cv. WGG-37 with three replications. The growth regulators were sprayed at flower initiation stage (38 DAS). The destructive sampling was done at fortnightly intervals starting from 30 DAS. At each sampling five plants from the second row from either side in each plot were uprooted and component parts were separated and oven dried at 70^{o}C. To know the number of root nodules,

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RESULTS AND DISCUSSION

Partitioning of dry matter among various plant parts is a major determinant for both total dry matter production (TDM) and economic yield. Amount of total dry matter produced is an indication of overall efficiency of utilization of resources and better light interception by the leaf. The data recorded for total dry matter production revealed that there is a gradual increase in total dry matter upto harvest (Table 1). It was more in NAA (20 ppm) (531.93 g m^{-2}) followed by brassinosteroid (20ppm) (524.82 g m^{-2}) over control. The increase in the dry matter with NAA can be attributed to the increased photosynthesis and SCMR values. Patel and Saxena (1994) and Lakshmamma and Rao (1996) also reported increased dry matter production due to the application of NAA in blackgram.

The number of root nodules per plant increased gradually upto pod setting stage and declined thereafter. Among growth regulators NAA (20 ppm) recorded maximum number of root nodules (35.6 per plant) followed by chlormequat chloride 375.0 g a.i. ha^{-1} (34.2 per plant) (Table 2). Photosynthesis is the primary process, which form the basis for yield determination. In the present study, the photosynthetic rate increased from flowering to pod setting stage and thereafter decreased. At flowering stage there was significant differences in

Table 1: Effect of different growth promoting and retarding substances on total dry weight (g m^{-2}) in greengram

Treatments	Days after sowing				
	30	45	60	75	At harvest
Chlormequat Chloride 50%SL (137.5 g a.i/ha)	36.56	161.78	274.25	420.79	485.38
Chlormequat Chloride 50% SL (162.5 g a.i/ha)	32.48	169.46	287.87	413.32	453.27
Chlormequat Chloride 50% SL (187.5 g a.i/ha)	36.45	164.95	296.35	401.20	492.93
Chlormequat Chloride 50% SL (375 g a.i/ha)	34.02	156.42	256.90	389.97	450.94
Alpha naphthyl acetic acid (NAA) (20 ppm)	30.54	174.21	320.92	435.65	531.93
Mepiquat Chloride 5% AS (5%)	31.58	185.90	289.58	459.66	510.05
Brassinosteroid (20 ppm)	28.80	167.80	308.75	473.02	524.82
Water	29.88	153.14	265.24	394.02	448.62
Control	28.68	146.08	254.34	372.86	427.05
Mean	32.23	163.80	283.83	417.66	480.55
S.E.±	1.84	19.87	16.02	16.15	21.09
C.D. (P=0.05)	--	NS	36.95	37.24	47.71

*Growth regulators were sprayed on 38 DAS NS=Non-significant

Table 2: Effect of different growth promoting and retarding substances on nodule number per plant in greengram

Treatments	Before spraying of growth regulators	15days after spraying of growth regulators	At maturity
Chlormequat Chloride 50% SL (137.5 g a.i/ha)	22.8	27.0	8.0
Chlormequat Chloride 50% SL (162.5 g a.i/ha)	23.3	28.6	10.0
Chlormequat Chloride 50% SL (187.5 g a.i/ha)	27.6	29.3	8.0
Chlormequat Chloride 50% SL (375.0 g a.i/ha)	31.6	34.2	10.0
Alpha naphthyl acetic acid (NAA) (20 ppm)	30.0	35.6	12.0
Mepiquat Chloride 5% AS (5%)	27.6	34.0	7.0
Brassinosteroid (20 ppm)	23.6	31.3	10.0
Water	21.0	26.3	7.0
Control	22.0	30.0	6.0
Mean	26.0	31.5	8.6
S.E.±	9.6	9.5	1.7
C.D. (P=0.05)	NS	NS	NS

*Growth regulators were sprayed on 38 DAS NS=Non-significant

photosynthetic rate between treatments. NAA (20 ppm) recorded significantly higher photosynthetic rate at pod setting stage (23.47 µ mol m^{-2} s^{-1}) and maturity stage (19.18 µ mol m^{-2} s^{-1}) (Table 3). The maximum photosynthetic rate in NAA 20 ppm treatment can be attributed to more SCMR values and more leaf area index values than in other treatments. The increase in rate of photosynthesis with application of growth regulators was reported in soybean (Kumar, 1998).

SCMR values were maximum at flowering stage and declined thereafter. The application of chlormequat chloride (375.0 g a.i ha^{-1}), brassinosteroid (20ppm) and mepiquat chloride (5% AS) resulted significantly higher chlorophyll content. Higher SCMR values at maturity (32.13) were recorded by NAA 20 ppm was attributed due to prevention of photooxidation of chlorophyll (Table 4). These results are in accordance with Jeyakumar and Thangaraj (1998) who explained that the application of mepiquat chloride to groundnut resulted in high chlorophyll content without the modification of leaf anatomy and delayed chlorophyll degradation. The delay in leaf senescence could also be attributed to higher chlorophyll content.

Though there were significant differences for total protein content in plant and seeds, nitrogen harvest index did not differ significantly higher protein values (0.9 g in seeds and 5.44 g in plant) NAA 20 ppm can be attributed to more fixation by the root nodules in this treatment. However, the nitrogen harvest index was low in control (15.62) and more in chlormequat chloride @ 187.5 g a.i ha^{-1} (17.31) (Table 5).

In any crop the grain yield not only depends on the accumulation of photo assimilates but also on the ability of the crop to partition more photosynthates into the

Table 3: Photosynthetic rate (µ mol $m^{-2}s^{-1}$) values at different physiological stages due to effect of growth regulators in greengram

Treatments	Days after sowing		
	At flowering	15DAF	At maturity
Chlormequat Chloride 50% SL (137.5 g a.i/ha)	8.60	17.58	16.45
Chlormequat Chloride 50% SL (162.5 g a.i/ha)	12.54	20.52	17.58
Chlormequat Chloride 50% SL (187.5 g a.i/ha)	10.46	21.95	14.95
Chlormequat Chloride 50% SL (375 g a.i/ha)	9.25	16.65	15.45
Alpha naphthyl acetic acid (NAA) (20 ppm)	15.67	23.47	19.18
Mepiquat Chloride 5% AS (5%)	13.60	20.23	18.35
Brassinosteroid (20 ppm)	9.70	19.70	12.61
Water	7.55	17.15	13.92
Control	7.15	16.50	15.96
Mean	10.49	19.32	16.08
S.E.±	1.31	4.12	2.16
C.D. (P=0.05)	3.03	NS	NS

*Growth regulators were sprayed on 38 DAS NS=Non-significant

Table 4 : The SCMR values at different physiological stages due to effect of growth regulators in greengram

Treatments	Days after sowing		
	At flowering	15DAF	At maturity
Chlormequat Chloride 50% SL (137.5 g a.i/ha)	43.26	40.08	31.53
Chlormequat Chloride 50% SL (162.5 g a.i/ha)	43.30	40.02	31.86
Chlormequat Chloride 50% SL (187.5 g a.i/ha)	43.13	40.72	31.78
Chlormequat Chloride 50% SL (375 g a.i/ha)	43.73	39.40	30.12
Alpha naphthyl acetic acid (NAA) (20 ppm)	41.30	39.70	32.13
Mepiquat Chloride 5% AS (5%)	43.40	41.62	30.73
Brassinosteroid (20 ppm)	41.63	39.14	31.60
Water	42.43	38.30	27.20
Control	42.06	37.64	26.83
Mean	42.69	39.62	30.42
S.E.±	1.84	3.56	2.54
C.D. (P=0.05)	3.91	NS	5.39

*Growth regulators were sprayed on 38 DAS NS=Non-significant

Table 5: Effect of different growth promoting and retarding substances on nitrogen harvest in greengram

Treatments	Total protein content in seed (g plant^{-1})	Total protein content in plant (g plant^{-1})	Nitrogen harvest index
Chlormequat Chloride 50% SL (137.5 g a.i/ha)	0.82	4.60	17.20
Chlormequat Chloride 50% SL (162.5 g a.i/ha)	0.85	5.01	17.06
Chlormequat Chloride 50% SL (187.5 g a.i/ha)	0.80	4.80	17.31
Chlormequat Chloride 50% SL (375 g a.i/ha)	0.84	4.92	16.49
Alpha naphthyl acetic acid (NAA) (20 ppm)	0.90	5.44	16.78
Mepiquat Chloride 5% AS (5%)	0.77	4.36	17.05
Brassinosteroid (20 ppm)	0.84	5.20	16.66
Water	0.66	4.05	16.44
Control	0.52	3.85	15.62
Mean	0.77	4.69	16.73
S.E.±	0.44	0.87	1.26
C.D. (P=0.05)	0.12	0.33	NS

*Growth regulators were sprayed on 38 DAS NS=Non-significant

Table 6: Effect of different growth promoting and retarding substances on yield and yield attributes in greengram

Treatments	Pods per plant	Seeds per pod	Seeds per plant	Test weight (g)	Yield (kg/ha)	HI
Chlormequat Chloride 50% SL (137.5 g a.i/ha)	21.9	6.0	128.6	35.1	1209	36.71
Chlormequat Chloride 50% SL (162.5 g a.i/ha)	21.5	6.8	143.4	32.2	1081	36.23
Chlormequat Chloride 50% SL (187.5 g a.i/ha)	23.9	6.5	155.6	35.6	1094	36.90
Chlormequat Chloride 50% SL (375 g a.i/ha)	21.9	6.1	133.6	32.3	1170	34.77
Alpha naphthyl acetic acid (NAA) (20 ppm)	25.1	7.0	176.9	37.1	1310	34.93
Mepiquat Chloride 5% AS (5%)	21.3	6.6	137.9	35.1	1272	36.94
Brassinosteroid (20 ppm)	20.4	6.9	138.2	32.5	1234	34.59
Water	19.8	5.9	115.4	31.8	1094	33.63
Control	19.4	5.7	109.5	31.4	1107	32.48
Mean	21.7	6.3	137.8	33.7	1175	35.24
S.E.±	2.8	1.1	19.9	0.2	104	5.12
C.D. (P=0.05)	6.8	2.6	NS	0.3	221	NS

*Growth regulators were sprayed on 38 DAS NS=Non-significant

reproductive parts. The yield attributing characters like number of pods per plant, number of seeds per pod and test weight was significantly influenced by the application of growth regulators. Among the treatments highest seed yield of 1310 kg ha^{-1} was recorded in NAA 20 ppm followed by mepiquat chloride (5% AS) and brassinosteroid (20 ppm) with a yield of 1272 and 1234 kg ha^{-1}, respectively. The highest seed yield with NAA 20 ppm application can be attributed to more value for the number of pods per plant (25.1), seeds per pod (7.0) and test weight (37.1 g) as compared to other treatments (Table 6).

Though there was significant difference among the treatments for grain yield, no significant difference was observed in harvest index indicating that the increase in the yield was due to increase in the total dry matter rather than harvest index. Similar results with application of growth regulators were also reported by Chaplot *et al.,* (1992) in blackgram and soybean.

From the present investigation it is evident that application of NAA @ 20 ppm at flower initiation stage was significantly superior and was more effective in increasing the yield in greengram.

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