Karnataka J. Agric. Sci., 22(2) : (289-292) 2009

Effect of growth retardants and nipping on chlorophyll content, nitrate reductase activity, seed protein content and yield in cowpea (*Vigna unguiculata* L.)*

PRASHANT REDDY, B. T. NINGANUR, M. B. CHETTI AND S. M. HIREMATH

Department of Crop Physiology, University of Agricultural Sciences,
Dharwad-580005, Karnataka, India.

(Received : September, 2008)

Abstract : A field experiment was conducted to study the effect of growth retardants and nipping on biochemical parameters viz., chlorophyll content, nitrate reductase activity, seed protein content and yield in cowpea variety, C-152. The application of growth retardants and nipping at 35 DAS increased the chlorophyll content and the seed protein content did not differ significantly, though there was increase in its content. MC @ 500 ppm, MC @ 1000 ppm, lihocin @ 500 ppm and nipping at 1 week after tendril formation significantly increased chlorophyll content and NRA at later stages which in turn increased the yield.

Key words : Growth retardants, nipping, chlorophyll content, nitrate reductase activity, seed protein content

Introduction

Cowpea is one of the important pulse crops grown in India which occupies 3.91 million hectare with production of 2.21 m tons and productivity of 567 kg per ha (Anon., 2005). It is a multi-season short duration crop extensively grown in south India, particularly in Andra Pradesh, Karnataka and Tamil Nadu. The productivity of cowpea in Karnataka is as low as 420 kg per ha as compared to national productivity of 567 kg per ha. This clearly indicates the necessity to identify reasons for such low productivity in India and particularly in Karnataka.

The low productivity of cowpea may be attributed to its cultivation in marginal and low rainfall areas or its cultivation in excess moisture areas resulting into excess vegetative growth. Hence, the regulation of vegetative growth in irrigated / heavy rainfall areas seems to be important for attaining good yields. Growth regulators particularly growth retardants used in appropriate concentrations at appropriate time increase the yield either by altering dry matter distribution in the plant or by regulating growth (Cathey, 1964). With this background, application of different concentrations of lihocin, MC and MH at 35 DAS and nipping at different times after initiation of tendril were imposed to study the effect of growth retardants and nipping on chlorophyll content, nitrate reductase activity, seed protein content and yield.

Material and methods

A field experiment was conducted at Agricultural College Farm, University of Agricultural Sciences, Dharwad during Kharif, 2004-05. It was laid out in Randomised Block Design with three replications. The cowpea variety, C-152 which is widely grown in Karnataka was raised in 3.6 m X 3.0 m with spacing of 45 cm X 10 cm. The recommended dose of fertilizers, i.e., 25 : 50 kg N and P_2O_5 per hectare was applied at the time of sowing and treatments, viz., nipping of tendrils at tendril formation (T_1), nipping of tendrils at one week after tendril formation (T_2), nipping of tendrils at two weeks after tendril formation (T_3), foliar application of lihocin @ 500 ppm (T_4), lihocin @ 1000 ppm (T_5), mepiquat chloride (Chamatkar) @ 500 ppm (T_6), mepiquat chloride (Chamatkar) @ 1000 ppm (T_7), maleic hydrazide @ 250 ppm (T_8), maleic hydrazide @ 500 ppm (T_9) and water spray as control (T_{10}) were imposed at 35 DAS which coincides with onset of reproductive phase. The rainfall received during the cropping period was 536.9 mm.

The biochemical studies were done at different stages. The chlorophyll content and nitrate reductase activity were estimated at 30, 60 & 90 DAS by the method of Arnon (1949) and Saradhambal *et al.* (1978) respectively. The protein content was estimated by modified Kjeldhal's method (Jackson, 1973) and multiplying the nitrogen content with a factor 6.25. Data on yield and yield components were recorded at harvest stage.

Results and discussion

The data on chlorophyll content at different stages is presented in table 1. There was increase in chlorophyll content upto 60 DAS and thereafter it decreased. There was no significant difference for chlorophyll 'a', chlorophyll 'b' or total chlorophyll at 30 days after sowing. There was significant difference for chlorophyll 'a', chlorophyll 'b' and total chlorophyll at 60 DAS. Significantly higher chlorophyll 'a' content (1.963) was obtained in MC 1000 ppm which is on par with MC 500 ppm (1.977) and maximum chlorophyll 'b' content (1.083) was recorded in MH 500 ppm and lowest in control (0.613).

* Part of M.Sc. (Agri.) thesis submitted by the senior author to the University of Agricultural Sciences, Dharwad-580005, India.

Table 1. Effect of growth retardants and nipping on chlorophyll a, b and total chlorophyll (mg/g fresh weight) at different stages in cowpea

Tr. No.	Treatments	Chlorophyll a			Chlorophyll b			Total Chlorophyll		
		30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1	Nipping at tendril formation stage	1.343	1.370	0.370	0.503	0.597	0.153	1.847	1.967	0.523
T_2	Nipping at one week after tendril formation stage	1.342	1.597	0.597	0.523	0.800	0.300	1.870	1.397	0.897
T_3	Nipping at two weeks aftertendril formation stage	1.367	1.593	0.550	0.523	0.817	0.180	1.890	2.410	0.730
T_4	Lihocin (500 ppm)	1.340	1.550	0.600	0.520	0.817	0.529	1.860	2.367	1.290
T_5	Lihocin (1000 ppm)	1.340	1.713	593.000	0.523	1.003	0.317	1.863	2.800	0.910
T_6	Mepiquat chloride (500 ppm)	1.343	1.877	0.963	0.513	1.070	0.370	1.857	2.947	1.333
T_7	Mepiquat chloride(1000 ppm)	1.347	1.963	0.543	0.503	0.803	0.570	1.850	2.767	1.447
T_8	Maleic hydrazide (250 ppm)	1.383	1.600	0.713	0.530	0.873	0.373	1.913	2.587	1.087
T_9	Maleic hydrazide (500 ppm)	1.360	1.797	0.797	0.523	1.083	0.503	1.883	2.683	1.300
T_{10}	Control	1.353	1.300	0.300	0.537	0.613	0.113	1.890	1.910	0.413
	Mean	1.352	1.636	0.603	0.520	0.848	0.341	1.872	2.484	0.997
	S.Em ±	0.013	0.086	0.023	0.011	0.049	0.027	0.019	0.122	0.069
	CD (5%)	NS	0.255	0.670	NS	0.144	0.080	NS	0.364	0.204

The maximum total chlorophyll was noticed in MC 500 ppm (2.947) followed by lihocin (2.800). At 90 DAS, maximum chlorophyll 'a' content was observed in MC 500 ppm (0.963) followed by MH 500 ppm (0.797) and minimum was observed in control (0.300). There has been significant increase in chlorophyll content in treatments with growth retardants. This finding is in conformity with that of Cathey (1964) who opined that growth retardants in addition to the inhibition of cell division caused induction of grana and initiated the development of chloroplasts.

The maximum chlorophyll 'a', 'b' and total chlorophyll contents were recorded in MC and lihocin at higher concentrations. These results are in accordance with those of Starman *et al.* (1990) in sunflower, Ganiger (1992) in seed potato and similar results were reported by Gasti (1994) in vegetables and Chetti (1991) in groundnut.

The data on nitrate reductase and seed protein content are presented in table 2. The nitrate reductase activity increased upto 60 DAS and then decreased. No significant differences were noticed at 60 and 90 DAS. The treatments, MC @ 1000 ppm, lihocin @ 1000 ppm and MC @ 500 ppm recorded maximum NRA at 60 and 90 DAS. Control plants recorded minimum NRA at these stages. The study revealed that the nitrate reductase activity was maximum at 60 DAS which coincided with the maximum chlorophyll content and decreased thereafter thereby complementing the C:N ratio balance in the plant.

The application of growth retardants increased NRA in all the treatments and the increase was more with an increase

Table 2. Effect of growth retardants and nipping on nitrate reductase activity and seed protein content in cowpea

Tr.No.	Treatments	Nitrate reductase activity (µmoles/ g fresh weight/hour)			Seed protein content (%)
		30 DAS	60 DAS	90 DAS	
T_1	Nipping at tendril formation stage	84.00	170.60	81.60	22.17
T_2	Nipping at one week aftertendril formation stage	82.00	166.00	85.30	22.50
T_3	Nipping at two weeks aftertendril formation stage	89.00	155.30	84.00	21.80
T_4	Lihocin (500 ppm)	88.00	175.00	91.60	21.90
T_5	Lihocin (1000 ppm)	88.00	176.30	97.60	22.43
T_6	Mepiquat chloride (500 ppm)	80.00	181.00	91.30	21.93
T_7	Mepiquat chloride(1000 ppm)	88.00	185.30	98.30	23.10
T_8	Maleic hydrazide (250 ppm)	84.00	170.00	82.30	21.73
T_9	Maleic hydrazide (500 ppm)	83.00	174.00	87.30	22.63
T_{10}	Control	84.00	114.70	74.70	22.00
	Mean	85.10	166.80	86.50	22.12
	S.Em ±	0.41	7.70	3.93	0.34
	CD (5%)	NS	22.87	11.67	NS

in the concentration of growth retardants. Among the growth retardants, MC and lihocin had the maximum NRA indicating the differential response of cowpea towards the growth retardants. The increase in NRA in the plants with the treatments MC and lihocin could be due to an increase in SLW, photosynthetic activity and RUBP carboxylase activity as has been suggested by Sairam *et al.* (1991).

Even though, there is increase in seed protein content in all the treatments as compared to control, no significant differences among the treatments were noticed. Similarly, Nagarjun *et al.* (1980) observed 0-500 ppm of MH had no effect on seed protein content in groundnut whereas, MH @ 500 ppm and above significantly increased the seed oil content. Hunje *et al.* (1991) also reported that the growth regulators viz., CCC, TIBA and MH did not show any significant difference for seed protein content in vegetable cowpea variety, Pusa Dobasali.

The data on yield and yield components are presented in table 3.

It was observed in the present investigation that the application of growth retardants and nipping significantly increased the number of pods, pod length, number of seeds per pod, 100 seed weight and harvest index (HI), which are the important yield determining components in cowpea. Among various treatments imposed, the per cent increase in the yield

Table 3. Effect of growth retadarnts and nipping on yield and yield components at different stages in cowpea

Tr. No.	Treatments	Leaf thickness (SLW) (g/dm^2)	No.of Pods	Pod length (cm)	No.of seeds per pod	100 seed weight (g)	Total dry matter (g/plant)	Seed yield per plant (g)	Seed yield (q/ha)	Harvest index
T_1	Nipping at tendril formation tendril formation	0.20	18.00	13.17	11.60	12.80	37.77	11.33	11.94	0.30
T_2	Nipping at one week after tendril formation	0.51	26.30	14.67	12.60	12.81	56.45	20.89	12.50	0.37
T_3	Nipping at two weeks after	0.36	18.30	14.68	11.00	12.11	46.82	15.45	12.12	0.33
T_4	Lihocin (500 ppm)	0.45	16.30	13.50	12.00	12.52	48.57	16.51	12.03	0.34
T_5	Lihocin (1000 ppm)	0.48	21.60	15.67	14.00	13.07	53.41	16.56	11.75	0.31
T_6	Mepiquat chloride (500 ppm)	0.53	22.00	16.33	13.30	11.83	66.43	17.62	12.31	0.33
T_7	Mepiquat chloride(1000 ppm)	0.64	23.60	16.00	13.30	13.15	69.49	21.92	13.05	0.33
T_8	Maleic hydrazide (250 ppm)	0.36	13.00	12.67	12.60	12.20	40.51	10.94	11.29	0.27
T_9	Maleic hydrazide (500 ppm)	0.38	16.60	13.83	13.60	12.41	44.14	11.92	11.25	0.27
T_{10}	Control	0.17	10.60	12.33	9.97	11.78	25.15	5.79	11.11	0.23
	Mean	0.41	18.60	14.28	12.30	12.47	48.87	14.89	11.99	0.31
	S. Em ±	0.02	1.04	0.58	0.46	0.68	3.64	0.56	0.33	0.01
	CD (5%)	0.07	3.11	1.71	1.38	NS	10.82	1.68	0.97	0.03

was more with MC (1000 ppm) followed by nipping (at one week after tendril formation) and MC (500 ppm) as compared to control.

However, the per cent increase in yield was least with MH (250 and 500 ppm). The less yield in these treatments is attributed to senescence of reproductive parts. Similarly, Helsel *et al.* (1987) observed significant yield reductions from 30-100 per cent when even low rates of MH were applied at R_3 (pod initiation) and R_4 (full pod formation) growth stages in soybean. Suppression of yield due to MH was also noticed by Sangeetha and Varshney (1992).

The increase in yield due to growth retardants and nipping could be attributed to an increase in per cent distribution of pod dry weight, increase in leaf thickness (SLW), increase in pod length, 100 seed weight and total dry matter production. It was also observed that there was an increase in the chlorophyll content and nitrate reductase activity due to growth retardants, which also might have contributed for increase in yield and yield components. Increase in yield in nipping (one week after tendril formation stage) might be due to increase in number of productive branches, leaf thickness, number of pods per plant, number of seeds per pod and total dry matter. Similarly, increase in yield due to nipping was also observed by Reddy (1977) in groundnut. Arjun Sharma *et al.* (2003) noticed the increase in seed yield due to significant reduction in plant height and increase in the number of primary and secondary branches and pods per plant in pigeon pea. Similar results were also obtained by Himayatullah *et al.* (1989) and Aurangzeb *et al.* (1996) in chickpea.

The results indicated that MC @ 500 and 1000 ppm and nipping of tendrils at one week after tendril formation increased chlorophyll content, nitrate reductase activity and seed yield significantly by regulating plant growth which is clearly manufactured by increased HI.

References

Anonymous, 2005, A survey of Indian Agriculture. The Hindu, pp. 10-15.

Arjun Sharma, Potdar, M.P., Pujari, B.T. and Dharmaraj, P. S., 2003, Studies on response of pigeon pea to canopy modification and plant geometry. Karnataka J. Agric. Sci., 16: 1-3.

Arnon, D.I., 1949, Copper enzymes in isolated chloroplast polyphenoloxidase in *Beta vulgaris* L. Pl. Phys., 24 : 1-15.

Aurangzeb, M., Naeem-Ur-Rehman and Ikramullah, A., 1996, Causes of low gram productivity in rainfed D.I. Khan : results from a farm level survey. J. Rural Dev. Admin., 28 : 91-98.

Cathey, H.M., 1964, Physiology of growth retarding chemicals. Ann. Rev. Pl. Phys., 15 : 271-302.

Chetti, M.B., 1991, Evaluation of *Chamatkar* on groundnut. Pestology, 15: 43-50.

Ganiger, V.M., 1992, Use of growth retardants in potato (*Solanum tuberosum* L.) production. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).

Gasti, V.D., 1994, Response of commercial vegetables to growth retardants. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).

Helsel, Z.R., Ratliff, E. and Rudolph, W., 1987, Maleic hydrazide effect on soybean reproductive development and yield. Agron. J., 79: 910-912.

Himayatullah, Samina-Praveen and Munir-Ahmed, 1989, Factors related to low chickpea productivity in rainfed Bannu : results from farm level survey. Sharhad J. Agric., 5 : 29-32.

Hunje, R.V., Vyakaranahal, B.S., Kulkarni, G.N. and Shashidhara, S.D., 1991, Effect of growth regulators on seed quality of vegetable cowpea. Curr. Res., 20: 236-237.

Jackson, M.L., 1973, Soil Chemical Analysis. Prentice Hall of India, Pvt. Ltd, New Delhi, pp. 183-192.

Nagarjun, P., Radder, G. D. and Patil, V.S., 1980, Effect of foliar application of maleic hydrazide on seed quality and seedling vigour in bunch groundnut. Seed. Res., 8: 121-126.

Reddy, S.C., 1977, Agronomic investigations on irrigated groundnut (*Arachis hypogaea* L.) under black clay soils. Indian J. Agron., 22: 117-118.

Sairam, R.K., Deshmukh, P.S. and Shukla, D.S., 1991, Influence of mepiquat chloride on photosynthesis and nitrate assimilation in wheat genotypes under water stress. Indian J. Pl. Phys., 34: 222-227.

Sangeetha and Varshney, K.A., 1992, Effect of growth regulators on chlorophyll contents and yield attributes in *Avena sativa* L. Bharatiya Krishi Anusandhan Patrika, 7: 215-219.

Saradhambal, K.V., Singh, S.P., Prakash, S. and Naik, M.S., 1978, Effect of bacterial blight on the activities of nitrate reductase and peroxidase in rice plants. Indian J. Biochem. Biophys., 15: 105-107.

Starman, T.W., Kelly, J.W. and Pemberton, H.E., 1990, The influence of ancymidol on morphology, anatomy and chlorophyll levels in developing and mature *Helianthus annuus* leaves. Pl. Growth Reg., 9: 193-200.