Madras Agric. J. 90 (1-3) : 97-102 January-March 2003

Studies on dry matter production, nutrient uptake and yield as influenced by Chlormequatchloride with pesticides in cotton

C. BHARATHI, R. JAYAKUMAR, M. DAKSHINAMOORTHY, K.P. RAGUNATH AND S. SIVAKAMI
Dept. of Soil Science and Agrl. Chemistry, Tamil Nadu Agrl. Univ., Coimbatore - 641 003, Tamil Nadu.

Abstract: **A field experiment was conducted during 1999-2000 at ARS, Bhavanisagar to find the influence of chlormequatchloride (CMC) with pesticides on dry matter production (DMP), nutrient uptake and yield of cotton var. MCU-5. The treatments tried were two CMC formulations, 10 AS and 50 AS at recommended and double the recommended levels (150 and 300 ml ha^{-1} of 10 AS, 30 and 60 ml of 50 AS) and combined with pesticides. The sprayng of CMC was done during flowering phase of cotton *viz.* 60, 70, 80 and 90 days after sowing (together with pesticides as per treatment schedule). The dry matter production and nutrient uptake were computed for 90, 120 and 150 DAS. The results showed that the application of CMC at recommended level (10 AS 150 ml ha^{-1} and 50 AS 30 ml ha^{-1}) recorded the highest dry matter production and there were no diferences between the treatments which received application of CMC alone and with pesticides in uptake of major nutrients (N, P and K) by plants. Application of CMC at the recommended level recorded seed cotton yield of 17.89 q ha^{-1}, 17.40 q ha^{-1} than double the recommended level. The highest seed cotton yield (19.8 q ha^{-1}) was recorded in CMC 50 AS at recommended level along with endosulfan and carbendazim at 60 DAS and quinalphos and mancozeb at 80 DAS. Among the two formulations (10 AS, 50 AS), 50 AS was found to be the best in enhancing the DMP, nutrient uptake and seed cotton yield.**

Key Words: Chlormequatchloride - Cotton - DMP - Nutrient uptake - Seed cotton yield.

Introduction

From time immemorial, cotton "The White Gold" is an integral part of the socio-economic activities in the Indian sub-continent. Indeterminate growth habit is a characteristic feature of cotton plants. A short duration compact plant type with synchronous flowering, boll bursting and possessing resistance/tolerance to pest and diseases are found to be ideal. Plant Growth Regulators (PGRs) are being increasingly used in modern crop production for enhancing the yield at economic parts and at desired time. These chemicals when applied are readily absorbed, get translocated in plants and thus bring about physical and physiological changes and most of other attributes of economic importance in crop plants.

Application of growth retardant CMC counteracts the tendency for higher vegetative growth and may induce a redistribution of photosynthates in favour of reproductive organs (Scarisbrick *et al.* 1982). Dhope and Lall (1987) reported that the foliar spray of 500 ppm CCC increased the DMP. Nutrient uptake by any crop is a function of dry matter yield and nutrient concentration. The plant growth regulators proved to increase the dry matter production through improved vegetative growth and nutrient absorption through expanded root system. It was proved to increase the nutrient concentration in the plant ultimately resulting in enhanced nutrient uptake. The productivity and yield of cotton was highly decreased in the recent past due to the complexity of pest and diseases. Sundaramoorthy (1985) reported a loss of 50-60% in cotton production due to damage by the insect pests.

Though the efficacy of CCC and the influence of pesticides on cotton have been studied independently, the combined effect of CCC along with pesticides had not been studied so far. The cost of spraying of CCC, insecticides and fungicides can be minimised economically; if they are sprayed together without any ill effects on the crop and hence the present investigation was carried out.

Table 1. Effect of treatments on dry matter production (q ha^{-1})

No.	Treatments	90 DAS	120 DAS	150 DAS
T1	Chlormequat chloride 10 AS 150 ml at 60, 70, 80 and 90 DAS	28.7	45.7	51.5
T2	CMC 10 AS 300 ml at 60, 70, 80 and 90 DAS	27.7	45.5	51.3
T3	CMC 10 AS 30 ml at 60, 70, 80 and 90 DAS	29.0	46.1	52.2
T4	CMC 50 AS 60 ml at 60, 70, 80 and 90 DAS	27.9	45.4	51.2
T5	T1 + P1 (Endo 1 lit + Carb 250 g at 60 DAS Quin 2 lit + Manc 2 kg at 80 DAS)	29.6	47.4	53.5
T6	T3 + P1 (Endo 1 lit + Carb 250 g at 60 DAS Quin 2 lit + Manc 2 kg at 80 DAS)	29.7	47.6	53.7
T7	T1 + P2 (Quin 2 lit = Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	29.2	47.0	52.6
T8	T3 + P2 (Quin 2 lit = Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	29.3	47.2	53.2
T9	T1 + P3 (Endo 1 lit = Carb 250 g at 60 DAS Tria 2 lit + Manc 2 kg at 80 DAS)	28.3	46.4	52.0
T10	T3 + P3 (Endo 1 lit = Carb 250 g at 60 DAS Tria 2 lit + Manc 2 kg at 80 DAS)	28.6	46.6	52.4
T11	T1 + P4 (Tria 2 lit + Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	28.8	46.3	52.8
T12	T3 + P4 (Tria 2 lit + Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	28.9	46.8	53.0
T13	T1 + P5 (Tria 2 lit + Carb 250 g at 60 DAS Nimb 0.7 lit + Manc 2 kg at 80 DAS)	28.2	46.2	51.7
T14	T3 + P5 (Tria 2 lit + Carb 250 g at 60 DAS Nimb 0.7 lit + Manc 2 kg at 80 DAS)	28.4	45.9	51.8
T15	Control	26.1	43.5	49.9
	SEd	0.70	0.62	0.52
	CD (P=0.05)	1.44	1.28	1.07

Endo – Endosulfan; Carb – Carbendazim; Quin – Quinalphos; Manc – Mancozeb; Tria – Triazophos; Nimb - Nimbicidine

Table 2. Effect of treatments on uptake of major nutrients (kg ha^{-1})

No.	Treatments	N uptake			P uptake			K uptake		
		90 DAS	120 DAS	150 DAS	90 DAS	120 DAS	150 DAS	90 DAS	120 DAS	150 DAS
T1	Chlormequat chloride 10 AS 150 ml at 60, 70, 80 and 90 DAS	60.2	68.0	74.1	13.8	15.3	16.9	66.3	75.1	81.3
T2	CMC 10 AS 300 ml at 60, 70, 80 and 90 DAS	58.8	67.5	74.0	13.6	15.0	16.7	66.0	74.4	81.0
T3	CMC 10 AS 30 ml at 60, 70, 80 and 90 DAS	59.7	68.1	74.5	13.9	15.4	17.0	66.7	75.2	81.5
T4	CMC 50 AS 60 ml at 60, 70, 80 and 90 DAS	57.4	67.2	73.2	13.5	15.1	16.8	65.8	74.7	80.5
T5	T1 + P1 (Endo 1 lit + Carb 250 g at 60 DAS Quin 2 lit + Manc 2 kg at 80 DAS)	60.9	71.1	77.1	14.7	16.4	18.0	68.7	77.0	83.1
T6	T3 + P1 (Endo 1 lit + Carb 250 g at 60 DAS Quin 2 lit + Manc 2 kg at 80 DAS)	60.7	71.4	77.4	14.8	16.5	18.2	68.4	77.1	83.5
T7	T1 + P2 (Quin 2 lit = Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	59.8	70.8	76.8	14.6	16.0	17.7	68.0	76.5	83.4
T8	T3 + P2 (Quin 2 lit = Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	60.5	71.0	77.0	14.9	16.2	17.8	68.1	76.8	83.0
T9	T1 + P3 (Endo 1 lit = Carb 250 g at 60 DAS Tria 2 lit + Manc 2 kg at 80 DAS)	58.0	69.8	75.8	14.0	15.5	17.3	67.0	75.7	82.1
T10	T3 + P3 (Endo 1 lit = Carb 250 g at 60 DAS Tria 2 lit + Manc 2 kg at 80 DAS)	59.5	70.0	76.0	14.1	15.7	17.2	67.3	76.0	82.4
T11	T1 + P4 (Tria 2 lit + Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	60.4	70.4	76.4	14.3	15.7	17.5	67.6	76.1	82.4
T12	T3 + P4 (Tria 2 lit + Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	59.4	70.5	76.5	14.5	15.8	17.6	67.7	76.3	82.7
T13	T1 + P5 (Tria 2 lit + Carb 250 g at 60 DAS Nimb 0.7 lit + Manc 2 kg at 80 DAS)	58.6	69.1	75.1	14.0	15.3	17.0	67.5	75.0	82.0
T14	T3 + P5 (Tria 2 lit + Carb 250 g at 60 DAS Nimb 0.7 lit + Manc 2 kg at 80 DAS)	58.8	69.6	75.6	14.2	15.5	17.2	66.9	75.4	82.0
T15	Control	52.6	66.3	72.1	12.3	13.0	16.0	64.0	73.0	80.3
	SEd	0.80	0.71	0.50	0.62	0.65	0.47	0.72	0.69	0.64
	CD (P=0.05)	1.65	1.46	1.04	1.28	1.34	NS	1.48	1.43	1.32

Endo – Endosulfan; Carb – Carbendazim; Quin – Quinalphos; Manc – Mancozeb; Tria – Triazophos; Nimb – Nimbicidine

Materials and Methods

A field experiment was conducted during 1999-2000 at Agricultural Research Station, Bhavanisagar to find ou the influence of CMC with pesticides on DMP, nutrient uptake and yeld of cotton cultivar MCU 5. The treatments tried were two of CMC formulations 10 AS and 50 AS at recommended and double the recommended levels (150 and 300 ml of 10 AS; 30 and 60 ml of 50 AS) and combined with pesticides *viz.* endosulfan (350 g a.i. ha^{-1}), quinalphos (500 g a.i ha^{-1}), triazophos (900 g a.i ha^{-1}), carbendazim (125 g a.i ha^{-1}), mancozeb (1500 g a.i ha^{-1}) and nimbicidine (0.21 g a.i ha^{-1}). The treatment combinations are give in Table 1. The spraying of CMC was don during flowering phase of cotton *viz.* 60, 7(80 and 90 days after sowing alone and alon with pesticides as per treatment schedule. Adoptin all the recommended practices the crop wa grown to maturity and harvested.

Five plants at random were cut at groun level at 90, 120, 150 DAS for DMP and converte to kg ha^{-1}. The N, P and K were analyse using micro kjeldahl, colorimeter and flam photometer methods respectively. The uptak values were computed by multiplying the content with that of the DMP.

Table 3. Effect of treatments on seed cotton yield

No.	Treatments	Yield (q ha^{-1})	Increase over control(%
T1	Chlormequat chloride 10 AS 150 ml at 60, 70, 80 and 90 DAS	17.4	15.2
T2	CMC 10 AS 300 ml at 60, 70, 80 and 90 DAS	16.9	11.9
T3	CMC 10 AS 30 ml at 60, 70, 80 and 90 DAS	17.8	17.8
T4	CMC 50 AS 60 ml at 60, 70, 80 and 90 DAS	17.3	14.5
T5	T1 + P1 (Endo 1 lit + Carb 250 g at 60 DAS Quin 2 lit + Manc 2 kg at 80 DAS)	19.4	28.4
T6	T3 + P1 (Endo 1 lit + Carb 250 g at 60 DAS Quin 2 lit + Manc 2 kg at 80 DAS)	19.8	31.1
T7	T1 + P2 (Quin 2 lit = Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	18.9	25.1
T8	T3 + P2 (Quin 2 lit = Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	19.2	27.1
T9	T1 + P3 (Endo 1 lit = Carb 250 g at 60 DAS Tria 2 lit + Manc 2 kg at 80 DAS)	17.6	16.5
T10	T3 + P3 (Endo 1 lit = Carb 250 g at 60 DAS Tria 2 lit + Manc 2 kg at 80 DAS)	18.0	19.2
T11	T1 + P4 (Tria 2 lit + Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	18.3	21.1
T12	T3 + P4 (Tria 2 lit + Carb 250 g at 60 DAS Endo 1 lit + Manc 2 kg at 80 DAS)	18.6	23.1
T13	T1 + P5 (Tria 2 lit + Carb 250 g at 60 DAS Nimb 0.7 lit + Manc 2 kg at 80 DAS)	17.9	18.5
T14	T3 + P5 (Tria 2 lit + Carb 250 g at 60 DAS Nimb 0.7 lit + Manc 2 kg at 80 DAS)	18.0	19.2
T15	Control	15.1	-
	SEd	0.45	-
	CD (P=0.05)	0.93	-

Endo – Endosulfan; Carb – Carbendazim; Quin – Quinalphos; Manc – Mancozeb; Tria – Triazophos; Nimb - Nimbicidine

tesults and Discussion

)ry matter production

The application of CMC at recommended :vel (150 ml ha^{-1} of 10 AS, 300 ml ha^{-1} of 50 AS) recorded the highest DMP irrespective f the formulations (Table 1). While considering ıe treatments which received the combined pplication of CMC and pesticides, the higher)MP of 29.7, 47.6, 53.7 q ha^{-1} at 90, 120 nd 150 DAS recorded by the application of :MC 50 AS 300 ml ha^{-1} along with endosulfan - carbendazim at 60 DAS and quinalphos + Aancozeb at 80 DAS (T_6) respectively. The)west dry matter was recorded by control in ll the 3 stages.

The increase in dry matter might be ıe reuslt of increased strength, girth, thickness f leaves, larger leaf area and higher number f sympodial branches. The effect of CMC ı enhancing the dry matter production is in onformity with Rao and Reddy (1982) who eported that the foliar spray of 75, 100 and 25 µg g^{-1} of CMC recorded higher DMP. Dhope nd Lall (1987) reported that the foliar spray f 500 µg g^{-1} CCC increased the DMP.

Jutrient uptake

The uptake of N, P and K as influenced)y CMC application are presented in Table :. At 90 DAS, the uptake of N (60.9 kg ıa^{-1}) was more in the plot (T_5) treated with :MC 10 AS 150 ml ha^{-1} along with endosulfan - carbendazim at 60 DAS and quinalphos + nancozeb at 80 DAS. The T_6 recorded the ighest N uptake (71.4-77.4 kg ha^{-1}) at 120 ınd 150 DAS the highest K uptake was recorded)y T_6 (68.7-83.5 kg ha^{-1}) (Table 2).

Application of CMC in general increased the N, P and K uptake in plants. The PGRs proved to increase the dry matter production through improved negative growth and nutrient absorption through expanded root system. It was proved to increase the nutrient concentration in the plant, ultimately resulting in enhanced nutrient uptake.

The foliar spray of CMC enhanced the nutrients uptake and thus might minimize the nutrient depletion of leaves during the critical stages. This higher status of N and P uptake is believed to be responsible for more chlorophyll, more palisade cells per unit area of leaf tissue and the combination of these factors accounted for the darker green foliage (Dean Knavel, 1969). N and P uptake were increased by CMC and the highest was 13 kg P ha^{-1} in groudnut (Kandalam Giridhar and Gajendra Giri, 1999).

Seed cotton yield

Application of CMC at the recommended level (150 ml ha^{-1} of 10 AS, 50 ml ha^{-1} of 50 AS) recorded the highest yield irrespective of formulations tried. Between the two formulations (10 AS, 50 AS) 50 AS recorded higher seed cotton yield than 10 AS formulation irrespective of doses. Among the 4 treatments T_3 (50 AS 300 ml ha^{-1}) recorded the highest seed cotton yield of 17.8 q ha^{-1}. Regarding the treatments which received the combined application of CMC with pesticides, the highest yield (19.8 q ha^{-1}) was recorded in T_6 (Table 3). The lowest yield (15.1 q ha^{-1}) was recorded in control (T_{15}). The reason for the increased yield might be due to the increased photosynthetic efficiency through stabilization of chlorophyll, higher production of photosynthates resulting in increased translocation of organic material from source to sink in the treated plants. Thus the partitioning of photosynthates move towards the development of reproductive parts than to the vegetative growth and would have resulted in more flowers, sympodial branches, bolls and boll weight plant^{-1}. These results are in close agreement with Khandage *et al.* (1992) who reported that the application of 0.08 per cent CMC at flowering stage gave the maximum yield of 2.16 t ha^{-1} in cotton. Foliar application of 80 µg g^{-1} CMC increased the seed cotton yield from 1.00 to 1.40 t ha^{-1} as against 1.06 t ha^{-1} in control (Ishwar Singh and Chouhan, 1993).

To conclude, higher dry matter production at 90, 120 and 150 DAS was recorded by the combined application of CMC and pesticides than the application of CMC alone. The dry matter accumulation was increased spectacularly as the stages advanced. The uptake of major nutrients at different growth stages was found to be significantly higher in proportion to dry

matter accumulation with the spraying of CMC. Application of CMC at the recommended level increased the seed cotton yield than double the recommended level. Between the two formulations, 50 AS recorded the highest seed cotton yield irrespective of levels while considering the combined application of CMC along with pesticides T_6 recorded the highest seed cotton yield of 19.8 q ha^{-1}.

References

Dean Knavel, E. (1969). Influence of growth retardants on growth, nutrient content, and yield of tomato plants grown at various fertility levels. *J. Amer. Soc. Hort. Sci.* **94**: 32-35.

Dhope, A.M. and Lall, S.B. (1987). Growth regulating properties of leaf extracts of *Ipomoea aquatica* in upland cotton. *Ann. Pl. Physiol.* **1**: 221-224.

Ishwar Singh and Chouhan, G.S. (1993). Manipulation of cultural practices to correct boll shedding in upland cotton (*Gossypium hirsutum*). *Indian J. Agri. Sci.* **63**: 499-500.

Kandalam Giridhar and Gajendra Giri (1999). Dr matter accumulation and nutrient uptak of groundnut varieties as influenced b chlormequat and phosphorus doses. *An Agric. Res.* **20**: 30-34.

Khandage, C.B., Suriyawanshi, A.P., More, P.R Waclkow, D.V. and Changok, R.B. (1992 Effect of cycocel, NAA and nutrient o growth and yield of *hirsutum* cotton unde rainfed conditions. *Ann. Pl. Physiol.* **6**: 202 206.

Rao, M.V. and Reddy, P.J. (1982). Effect of lihocii (CMC) on growth and yield of cotton. *Andhr Agric. J.* **29**: 230-232.

Scarishbrick, D.H., Daniels, R.W. and Rawi, A.B.N (1982). The effect of 2-chloroethyl- trimethy ammonium chloride on the yield and yield components of oil seed rape. *J. Agric. Sci* **99**: 453-455.

Sundaramoorthy, V.T. (1985). Integrated insects management systems for cotton-training-cum workshop on integrated cotton productivit technology field at CKR, Nagpur, Nov.2C December-10, pp. 220-229.

(Received : January 2002; Revised : July 2002)