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Response of cotton (*Gossypium hirsutum*) to foliar nutrition and canopy management practices

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Abstract: Field experiment was carried out during summer seasons of 2000 and 2001 to evaluate the response of summer irrigated cotton to foliar nutrition of two rounds of DAP 2% and KCI 1% at 50th and 70th days after sowing and topping at 12th node alone and in combination with two rounds of NAA at 40 ppm on 45th and 60th days after sowing. The results revealed that the dry matter accumulation by cotton and seed cotton yield were the highest with the application of NAA 40 ppm twice at 45 and 60 days after sowing in combination with KCI 1% at 50 and 70 days after sowing with a cost benefit ratio of 2.93 and 3.05, respectively in 2000 and 2001.

Key words: Cotton, Foliar nutrition, NAA, Topping

Introduction

Application of optimum N is essential in cotton for maximum yield. Excessive or inadequate fertilization reduce cotton yield. High N fertilizers induces excessive vegetation that delays maturity and harvest and these conditions may reduce yield and quality of lint due to early drought or excess rainfall in different cotton growing regions. Besides, Excess N results in auxin imbalance in plant system thus resulting in bud and boll shedding. Nitrogen deficiency causes pre mature senescence and reduce yield. Loss of N occurs due to volatilization under high temperatures, when urea is applied to soil surface. Under such conditions, to meet out the peak demand for N at flowering and boll formation, foliar spray of urea or DAP at flowering and 15-20 days later is beneficial (Venugopal, 2001). Potassium offers strength to cotton to withstand biotic stresses and improves lint quality. Besides, it minimises the ill effects of excessive N applied to cotton. Extensive work has been carried out on the beneficial effect due to foliar application of nutrients in cotton through All India Coordinated Cotton Improvement Project. Exogenous applications of growth regulations can modify the growth there by alleviate several problems in cotton (Bear *et al.* 2000). However, research on combined use of nutrients and exogenous application of growth regulator in summer irrigated cotton is limited. Hence, The present investigation was carried out to evaluate the response of cotton to foliar nutrition in combination with NAA application.

Materials and Methods

Field experiment was carried out during summer season of 2000 and 2001 at Cotton Research Station, Srivilliputhur to evaluate the response of cotton to foliar nutrition of Di Ammonium Phosphate (DAP) and Potassium Chloride (KCI) and NAA application. The experimental field was sandy clay loam with a pH of 8.2 . The soil was low in available nitrogen, medium in available phosphorus and available potassium. The treatments included T_1: 40 ppm NAA, T_2: 1% KCI, T_3: Topping, T_4: 2% DAP, T_5: 40 ppm NAA + 1 KCI, T_6: 40ppm NAA + 2% DAP, T_7: 40ppm NAA + topping and T_8: recommended dose of fertilizers alone. For the treatment schedule, two rounds of NAA were sprayed on 45th and 60th day after sowing in morning between 0700 – 0730 hours and DAP and KCl were sprayed on 50th and 70th day after sowing using high volume sprayer with a spray fluid of 450 lit/ ha. The experiment was carried out in randomized block

Table 1. Dry matter production and nitrogen uptake by cotton as influenced by treatments

		Square initiation stage				Peak flowering stage				Boll bursting stage			
		2000		2001		2000		2001		2000		2001	
		DMP	N	DMP	N	DMP	N	DMP	N	DMP	N	DMP	N
T_1	NAA 40 ppm*	1070	13.9	1360	17.7	3240	57.0	3693	65.0	6981	89.3	8103	103.7
T_2	KCl 1%**	1114	14.5	1410	18.3	3165	55.7	3546	62.4	7240	92.5	8410	107.6
T_3	Topping***	1017	13.2	1421	18.4	3074	54.1	3460	60.8	7255	92.8	8430	107.9
T_4	DAP 2%**	1062	13.8	1465	19.1	3189	56.1	3590	63.2	7485	95.8	8700	111.3
T_5	NAA+KCl	1084	13.7	1475	19.2	3872	68.1	4518	79.2	8060	103.1	9370	119.9
T_6	NAA + DAP	1041	13.4	1401	18.3	3794	66.8	4415	77.8	7700	98.5	8959	114.6
T_7	NAA+topping	1101	14.0	1480	19.0	3820	67.2	4057	76.7	7251	99.2	8839	113.1
T_8	RD alone	1045	13.5	1375	17.9	2965	52.2	3439	60.5	6015	78.1	7004	89.6
	SEd	80	1.0	95	1.2	240	4.2	320	4.8	485	8.2	557	7.1
	CD (P=0.05)	NS	NS	NS	NS	479	8.4	639	9.7	969	16.4	1114	18.1

* - Applied on 45th and 60th days after sowing; ** - Applied on 50th and 70th day after sowing; *** - topping done at 12th node
DMP : Dry matter production (kg ha^{-1}), N: Nitrogen uptake (kg ha^{-1}), NS : Non significant

Table 2. Growth characters, yield attributes and seed cotton yield as influenced by treatments

		Plant height (cm)		Monopodia (no/plant)		Sympodia (no/plant)		Bolls (no/plant)		Boll weight (g)		Yield (kg ha^{-1})		BC ratio	
		2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
T_1	NAA 40 ppm*	103.3	120.1	1.6	2.0	12.4	14.5	22.1	24.5	3.0	3.1	1859	2158	2.48	2.59
T_2	KCl 1%**	99.8	116.1	1.2	1.4	12.1	14.3	20.6	23.9	3.2	3.3	1927	2241	2.49	2.65
T_3	Topping***	93.0	104.2	1.2	1.5	13.5	15.7	21.2	24.7	3.1	3.2	1932	2246	2.59	2.67
T_4	DAP 2%**	92.7	112.9	1.0	1.3	12.0	13.9	20.6	24.0	3.3	3.4	1994	2319	2.61	2.79
T_5	NAA+KCl	105.3	120.0	0.9	1.2	12.8	14.9	22.0	25.1	3.4	3.5	2147	2496	2.93	3.05
T_6	NAA + DAP	94.3	110.4	1.1	1.3	13.1	15.0	21.3	24.7	3.2	3.5	2051	2386	2.64	2.94
T_7	NAA+topping	94.7	105.9	1.2	1.4	15.2	15.9	21.9	25.1	3.1	3.3	2065	2354	2.67	2.95
T_8	RD alone	104.1	120.7	1.3	1.5	10.9	12.5	19.0	21.1	3.0	3.1	1600	1859	2.47	2.61
	SEd	4.0	4.8	0.3	0.4	0.6	0.7	0.9	1.4	0.2	0.2	129	149		
	CD (P=0.05)	8.1	9.5	NS	NS	1.2	1.4	1.8	2.8	0.3	NS	258	300		

* - Applied on 45th and 60th days after sowing; ** - Applied on 50th and 70th day after sowing; *** - topping done at 12th node
DMP : Dry matter production (kg ha^{-1}), N: Nitrogen uptake (kg ha^{-1}), NS : Non significant

design with four replications. Observations on dry matter production at square initiation, peak flowering and boll development stages, growth characters, yield attributes and seed cotton yield at harvest were recorded. The data were subjected to statistical analysis using Gomez and Gomez (1984).

Results and Discussion

Dry matter production

The dry matter production of cotton at square intimation stages was not influenced by the various treatments imposed. This was due to the fact that the various treatments were initiated at this stage only. At peak flowering, application of 40ppm NAA at 45 and 60 days after sowing (DAS) in combination with KCl 1% at 50 and 70 DAS (T_5) registered the highest dry matter accumulation by cotton and was comparable with 40ppm NAA at 45 and 60 DAS + 2% DAP at 50 and 70 DAS (T6). At boll bursting stage, in addition to T_5 and T_6, application of 40 ppm NAA at 45 and 6 DAS + topping at 12th node (T_4) registered higher dry matter production (Table. 1). The increased dry matter production with the combined use of NAA and foliar nutrition suggested a definite increase in the formation of carbohydrates by increased photosynthetic activity. As the demand for nitrogen is high at flowering and boll formation, foliar application of 2% DAP at this might have met out the demand there by resulting in a balance between N and carbohydrate (Gururaj Hunsigi and Krishna (1998) there by reduced bud and boll shedding (Venugopal, 2001). Topping resulted in arresting of apical dominance increased the number of fruiting branches (Venkatakrishnan and Pothiraj, 1994) ultimately in increased dry matter production.

Growth characters

Application of 2% DP at 50 and 70 DAS registered the lowest plant height in the year 2000 and was comparable with topping and application of NAA in combination with DAP (T_6) and Topping (T_7). The reduction in plant height in the treatments involving DAP was due to the setback in growth observed in these treatments following application. This was due to the high temperature prevailed during that period coupled with lack of adequate moisture in the soil. In the year 2001, topping at 12th node (T_3) registered the lowest plant height followed by NAA + topping. Brar *et al.*(2000) also reported significant reduction in plant height due to topping. The number of monopodia per plant was not influenced by the treatments (Table. 2).

Yield attributes and yield

The number of sympodia / plant increased significantly with topping in the year 2000 and was followed by the treatment involving NAA spray while in the year 2001, NAA spray + topping recorded more number of sympodia / plant. The favourable response to topping. NAA and its combination with foliar nutrient was due to the reason that topping breaks apical dominance and leads to increased number o sympodial branches. Significant increase in the number of bolls / plant was observed with NAA in combination with KCl and was comparable with most of the treatments involving NAA and foliar nutrition. This was due to the better retention of bolls in these treatments as compared to the application of recommended dose of fertilizers alone. Application of NAA might have increased the reducing sugar content of the reproductive parts for the development of flowers and bolls (Dastur *et al.* 1960), met out the heavy demand for carbohydrates and ultimately prevented the boll shedding. Application of NAA in combination with KCl resulted in increased boll weight followed by other treatments involving NAA, topping and foliar nutrition and were significantly superior than control (T_8) in the year 2000 while the boll weight was not influenced by the treatments in 2001. The differential response was due to the mild stress observed in the year 2000, corroborating the findings of Patel (1993). Application of 40ppm NAA at 45 and 60 DAS in combination with 1% KCl at 50 and 70 DAS registered the highest seed cotton yield of 2147 and 2496 kg ha^{-1} respectively, in 2000 and

001. It was due to the cumulative effect of CI and NAA on yield attributing characters iz. number of sympodia, boll number and oll weight. This was followed by other treatments nvolving combined use of NAA, foliar nutrition nd topping.

Nitrogen uptake

The nitrogen uptake at square initiation tage was not influenced by the treatments. The results indicated that the N uptake up o this stage was almost similar in all the reatments. At peak flowering stage, N uptake vas the highest with the application of NAA n combination with KCI and was comparable vith NAA + DAP and NAA + topping (Table 1) At boll bursting stage, N uptake was higher n most of the treatments as compared to appli- ation of recommended dose of fertilizers alone. he higher N uptake as influenced by the eatments in peak flowering and boll bursting tage was reflected in increased seed cotton ield indicated the heavier nitrogen demand t these two stages (Krishnan and Christoper ourduraj, 1997).

From the above study it can be concluded hat cotton yield can be improved by the application of 40ppm NAA twice at 45th and 60th DAS in combination with 1% KCI or 2% DAP at 50th and 70th DAS.

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