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Enhancing Productivity of Summer Irrigated Cotton Through Plant Growth Regulator and Foliar Nutrition

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A field experiment was conducted at Agricultural College and Research Institute, Madurai to study the influence of plant growth regulator (NAA 40 ppm) and foliar nutrition (DAP 2%, KCl 1%) on summer irrigated cotton for enhancing the productivity along with recommended dose of fertilizers 60:30:30 Kg N,P_2O_5,K_2O ha^{-1}. The growth characters of cotton such as plant height, leaf area index and plant dry matter production at various stages crop growth (60,90 and 120 DAS) were greatly influenced by application of RDF NPK with NAA 40 ppm and DAP 2% foliar spray either at peak flowering and boll development stages or at squaring peak flowering stages. Yield attributes of cotton *viz*., number of symbodial branches plant^{-1}, fruiting points plant^{-1}, bolls plant^{-1} and boll weight were increased in the alone promising treatments as compared to control and other treatments. As a result, higher seed cotton yield (19.29 q ha^{-1}) was obtained in cotton receiving RDF and sprayed with NAA 40 ppm and DAP 2% either at square formation and peak flowering or peak flowering and boll development stage. Quality characters of cotton like seed index, lint index, ginning percentage, Bartlett's index, bundle strength and fibre finess were not influenced.

Key words: Summer irrigated cotton, PGR, Foliar nutrition, yield, quality parameters

Cotton "the king of apparel fibres" is the prime commercial textile crop in India, which contributes 85 per cent of the raw material for the manufacture of textile fabrics. India ranks first in area under cotton cultivation with an area about 8.32 million hectare. It ranks fourth in production despite having 24 per cent of the world's cotton cultivated area (Bansil, 1997). Summer irrigated cotton is grown in northern, western and southern zones in India. In Tamil Nadu summer irrigated cotton is grown in Madurai, Virdhunagar and Tirunelveli District. Under assured irrigation with use of plant growth regulator and foliar nutritions there is good scope for increasing productivity of summer cotton. Among the basic criteria for high productivity, adequate and timely supply of nutrients is essential. Fertilizer now days being a costly input, its use and management need a special consideration, which will improve the productivity of crop with higher economic returns without sacrificing the ecological balance. One of the important physiological disorders which reduce the seed cotton yield is boll shedding. To get maximum yield in cotton it is essential to retain more bolls plant^{-1}. Hence improved package of technologies are absolutely necessary to sustain cotton productivity. To overcome yield barriers and to increase the productivity, it is reported that the application of phyto-hormones like Napthaline Acetic Acid (NAA) and foliar nutrients like DAP, KCl are necessary (Srinivasan, 2001).

Material and Methods

Field experiment was conducted at Agricultural College and Research Institute, Madurai to study the influence of plant growth regulator (NAA) and foliar nutrition (DAP 2%, KCl 1%) on summer irrigated cotton for enhancing the productivity. The experiment was conducted in the field D9 of central farm, Agricultural College and Research Institute, Madurai located at 9° 54' N latitude, 78° 50' E longitude at an elevation of 147 m above mean sea level. Experimental farm experienced tropical climate with dry summer extending from March to August. The mean maximum and minimum temperature were 36.8 and 26.6, respectively, recorded during cropping period and relative humidity ranged between 34 to 84 percent. The soil of the experimental field was well drained clay loamy of Madukkur series having pH of 7.3 with 293.6 kg/ha of N, 17.9 kg/ha of P_2O_5, 239.5 kg of K_2O. The experiment was laid out in Randomized block design with three replications. The treatments trial were plant growth regulator (NAA 40 ppm) and foliar nutrition (DAP 2% & KCl 1%) *viz*., NAA 40 ppm at square formation (SF) and peak flowering (PF), DAP 2% foliar spray at squaring and peak flowering stages, DAP 2% at peak flowering (PF) and boll

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development stage (BDS), KCl 1% at square formation (SF) and peak flowering (PF), KCl 1% at peak flowering (PF) and boll development stage (BDS), NAA40ppm + DAP 2% at SF&PF, NAA40ppm + DAP 2% at PF&BDS, NAA40ppm + KCl 1% at SF &PF, NAA40ppm + KCl 1% at PF&BDS. The seeds were sown adopting a spacing of 60 x 30 cm and recommended dose of N, P, and K at 60:30:30 Kg ha-1 was applied uniformly to all the plots. Full dose of P and K were applied as basal at the time of sowing. The N was applied in split application viz; 50 % N at the time of sowing 25 % dose applied at earthing up and other 25 % dose at 45 days after sowing. Plant protection measures were taken as and when necessary. Observations on plant growth and yield factors and quality parameters were recorded. Soil and plant samples were analyzed as per the procedures.

Results and Discussion

Growth, yield attributes and seed cotton yield

Regarding plant height, recommended dose of fertilizer combined with foliar application of NAA 40 ppm and DAP 2% at peak flowering and boll development stages recorded higher plant height (128.61 cm). It was 47.8 percent higher than RDF NPK (87.01 cm) treatment. Combined foliar application of NAA 40 ppm and DAP 2% foliar spray at peak flowering and boll development stages recorded higher leaf area index of 5.05 and it was comparable with foliar application of NAA 40 ppm and DAP 2% foliar spray at squaring and peak flowering stages 5.02. The least LAI of 4.21 was recorded under RDF NPK (Table.1). Hanning *et al.* (1990) reported that foliar application of NAA and DAP increased the plant height and leaf area index

Table 1. Effect of foliar application, plant growth regulator and nutrients on growth and yield and economics of summer irrigated cotton

Treatment	Plant height (cm) (120 DAS)	Leaf Area Index (120 DAS)	No. of symbodial branches plant^{-1} (120 DAS)	Bolls plant^{-1}	Boll weight (g)	Yield (q ha^{-1})	Net return (Rs ha^{-1})	BCR
Recommended NPK(60:30:30)	87.01	4.21	10.32	14.9	3.03	14.90	13446	1.82
Recommended NPK +NAA 40 ppm at SF&PF	109.63	4.44	12.36	15.4	3.06	15.44	14454	1.88
Recommended NPK +DAP 2% at SF&PF	105.66	4.41	13.22	15.7	3.42	15.71	14723	1.88
Recommended NPK +DAP 2% at PF& BDS	109.66	4.44	13.26	16.3	3.49	16.32	15943	1.95
Recommended NPK +KCl 1% at SF&PF	107.8	4.31	12.35	16.7	3.09	16.74	17048	2.04
Recommended NPK +KCl 1% at PF& BDS	106.64	4.24	11.32	15.9	3.11	15.93	15428	1.94
Recommended NPK + NAA40ppm + DAP 2% at SF&PF	112.5	5.02	16.21	18.4	4.05	18.35	19716	2.16
Recommended NPK + NAA40ppm + DAP 2% at PF&BDS	128.61	5.05	18.26	19.3	4.01	19.29	21596	2.27
Recommended NPK + NAA40ppm + KCl 1% at SF&PF	106.14	4.44	12.32	16.1	3.11	16.10	15618	1.94
Recommended NPK + NAA40ppm + KCl 1% at PF&BDS	107.52	4.22	12.24	16.5	3.13	16.54	16498	1.99
S Ed	7.4	0.27	1.2	1.04	0.23	1.03	-	-
CD (p=0.05)	15.5	0.56	2.3	2.17	0.48	2.17	-	-

RDF- Recommended dose of fertilizers, SF-Square formation, PF-Peak flowering, BDS-Boll development stage, NAA- Napthaline Acetic Acid, DAP-Diammonium phosphate, KCl-Potassium chloride,BCR-benefit cost ratio

in cotton due to that the leaf elongation due to application of NAA 40 ppm and DAP 2% spray. Increased number of symbodial branches (18.26 plant^{-1}), number of bolls plant^{-1} (19.3) and boll weight (4.01g) were recorded in the combined application of NAA 40 ppm and DAP 2% at peak flowering and boll development stages but it was comparable with combined application of NAA 40 ppm and DAP 2% foliar spray at squaring and peak flowering stages with the value of 18.4 and this was 29.5 and 23.4 percent higher over recommended dose of fertilizer alone (Table.1). This is in agreement with the findings of Mehetre *et al.* (1990) who reported that combined spray of DAP 2% mixed with NAA 20 ppm at 1:1 ratio recorded increased number of bolls plant^{-1}, average boll weight and seed cotton yield plant^{-1}.

The data on yield attributing characters and seed cotton yield as affected by different treatment combinations *viz*., plant growth regulator and foliar nutrition are summarized in the table 1. The result revealed that combination of plant growth regulator and foliar nutrition had positive effect on the production during the summer irrigated condition. Among the various treatments, RDF NPK + NAA40ppm + DAP 2% at PF&BDS recorded the highest seed cotton yield (19.29 q ha^{-1}) and was on par with RDF NPK + NAA 40ppm + DAP 2% at SF&PF (Table.1). This increase in yield was mainly due to increased plant height and LAI which has resulted in increased photosynthetic activity and thereby increased plant DMP which has reflected in increase yield attributes such as increased number of symbodial branches, number of fruiting points, number of bolls plant^{-1}. This is in agreement with the findings of Jaganathan and Irudhayaraj (1980) and Sawan and Sakar (1988). They reported that the metabolic functions of boll development with DAP 2% foliar spray and the effect of NAA 40 ppm

was optimum in preventing the formation of abscission layer leading to low shedding of bolls in cotton.

Quality parameters and Economics

Seed index, lint index, Bartlett's index and ginning percentage was not significantly influenced by either spraying of NAA 40 ppm and DAP 2 % spray or NAA 40 ppm and KCl 1% spray. However, RDF NPK + NAA40ppm + DAP 2% at PF&BDS registered higher Bartlet index (0.6878), lint index (5.09) and seed index (10.15) (Table.2) than the other treatments. The quality characters were mostly governed by genetic make up of the cotton plant and they were not changed by spraying of chemicals. Higher net returns (Rs. 21596), and benefit cost ratio (BCR) (2.27) (Table.2) were observed with RDF NPK application with NAA 40 ppm and DAP 2% spray at peak flowering and boll development stages. Higher income in this two combination was due to higher seed cotton yield obtained which resulted in increased gross income, net income and BCR.

Table 2. Effect of foliar application, plant growth regulator and nutrients on quality of parameters and soil available nutrients of summer irrigated cotton

Treatment	Ginning (%)	Bartlett index	Lint index	Seed index	Soil available nutrients (kg ha^{-1})		
					Nitrogen	Phosphorus	Potassium
Recommended NPK(60:30:30)	33.37	0.6788	4.75	9.48	213.1	16.34	234.1
Recommended NPK +NAA 40 ppm at SF&PF	33.39	0.6754	4.71	9.39	214.3	14.25	233.3
Recommended NPK +DAP 2% at SF&PF	33.37	0.6745	4.75	9.48	213.1	14.32	232.2
Recommended NPK +DAP 2% at PF& BDS	33.41	0.6753	4.66	9.29	214.3	14.36	234.3
Recommended NPK +KCl 1% at SF&PF	33.42	0.6784	4.69	9.37	214.1	15.32	233.2
Recommended NPK +KCl 1% at PF& BDS	33.38	0.6874	5.08	10.12	212.1	12.68	220.9
Recommended NPK + NAA40ppm + DAP 2% at SF&PF	33.41	0.6878	5.09	10.15	208.3	12.36	222.6
Recommended NPK + NAA40ppm + DAP 2% at PF&BDS	33.38	0.6752	4.73	9.45	215.1	14.54	235.1
Recommended NPK + NAA40ppm + KCl 1% at SF&PF	33.39	0.6755	4.7	9.38	213.0	15.36	231.3
S Ed	1.72	0.03	0.26	0.53	10.2	0.67	11.5
CD(p=0.05)	NS	NS	NS	NS	21.4	1.39	24.2

Soil available nutrients

RDF NPK with application of NAA 40 ppm and DAP 2% significantly influenced the post harvest soil available nutrients status. Low soil available nutrients such as nitrogen (208.3 kg ha^{-1}), phosphorus (12.36 kg ha^{-1}) and potassium (220.9 kg ha^{-1}) (Table.2) were recorded under application of NAA 40 ppm and DAP 2% at peak flowering and boll development stages. The lesser amount of soil available nutrients was due to removal of more amount of nutrients during the growth and maturity stages of cotton which reflected in increased plant height, LAI, DMP and increased yield attributes and seed yield of cotton. The increased soil available nutrients recorded with the application of RDF NPK treatment was due to lesser uptakes of nutrients by cotton plants.

Conclusion

Application of recommended dose of fertilizer to summer irrigated cotton along with spraying of NAA at 40 ppm and DAP 2% either at square formation and peak flowering or peak flowering and boll development stage was promising to increase the yield and revenue.

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