

Influence of N, P and K Application on the Yield of Dry Matter and Seed Cotton, Nutrient Concentration and Uptake at Various Stages of Cotton Growth

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A field experiment was conducted to study the effect of N, P and K application on dry matter yield, nutrient concentration and uptake at different stages of cotton growth using MCU 8 as test crop. The dry matter yield significantly increased with advanced in the age of the crop, final picking stage of the plant samples recorded the maximum dry matter yield. The uptake of N, P and K also followed the same trend. The concentrations of N, P and K decreased from seedling to final picking stage. The nutrient concentrations were maximum in the seedling stage. The different treatments did not have any influence on the seed cotton yield, ginning per cent, lint index, seed index and Halo length.

Reports on dry matter production of cotton date back to that by McBryde and Beale as early as 1896. White (1914) studied dry matter accumulation and reported that 12.2 per cent of total seasonal production was accumulated at first square, 28.8 per cent at first bloom and 48.5 per cent at first open boll. Olson and Bledose (1942) found large differences in total dry matter and accumulation pattern in the cotton plant. Up to 72 days from emergence, 15 per cent of the total dry matter was produced, from 112 days until picking, 10 per cent; and during the 40 day period from 72-112 days, 75 per cent (Halevy 1976). Information on dry matter production of cotton in Tamil Nadu at different stages

of growth is limited. Hence the present study was taken up to investigate the effect of N P K on the dry matter production as well as nutrient uptake of cotton at different stages of crop growth.

MATERIAL AND METHODS

A field experiment was conducted in the black soil area of Cotton Research Station, Srivilliputtur during 1976-77. The experiment was laid out in a randomized block design and replicated twice. The test crop was MCU 8 cotton variety. Four levels of N (0, 30, 60 and 90 kg N/ha) and four levels of P₂O₅ (0, 20, 40 and 60 kg/ha) and K₂O (0, 20 and 40 kg/ha) were tried. Nitrogen was applied in two equal splits at the time of sow-

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ing and 30 days after sowing. The entire quantities of P_2O_5 and K_2O were applied as basal dressing at the time of sowing. All other cultural practices were followed for the proper growth of cotton crop as per the recommended package of practices. Plant samples were collected from each plot at four stages viz., seedling stage, square formation stage, first picking stage and final picking stage. The samples were

dried, dry matter recorded and analysed for N, P and K as per the standard methods of Jackson (1967).

RESULTS AND DISCUSSION

The mean dry matter yield at different stages of growth of cotton crop is furnished in Table I. The mean nutrient concentration, uptake values for N, P and K are furnished in Table II and III.

TABLE I. Effect of levels of N, P and K on the yield of dry matter and seed cotton (kg/ha)

Treatment	Seedling stage	Flowering stage	First Picking stage	Final picking stage	Seed cotton yield
$N_0 P_0 K_0$	264.0	478.0	966.0	1312.0	1158.0
$N_{30} P_0 K_0$	276.0	494.0	1228.0	1918.0	1130.0
$N_{30} P_{20} K_0$	284.0	542.0	1472.0	2112.0	1066.0
$N_{30} P_{20} K_{20}$	270.0	486.0	1384.0	1984.0	994.0
$N_{60} P_0 K_0$	292.0	564.0	1524.0	2334.0	1023.0
$N_{60} P_{20} K_0$	298.0	570.0	1618.0	2478.0	1230.0
$N_{60} P_{20} K_{20}$	282.0	534.0	1388.0	2292.0	1030.0
$N_{60} P_{40} K_0$	276.0	498.0	1412.0	2368.0	873.0
$N_{60} P_{40} K_{40}$	258.0	462.0	948.0	1378.0	952.0
$N_{90} P_0 K_0$	312.0	602.0	1798.0	2814.0	1057.0
$N_{90} P_{20} K_0$	322.0	628.0	1912.0	2692.0	927.0
$N_{90} P_{20} K_{20}$	296.0	566.0	1604.0	2866.0	928.0
$N_{90} P_{40} K_0$	308.0	598.0	1578.0	2604.0	1076.0
$N_{90} P_{40} K_{40}$	288.0	548.0	1448.0	2448.0	861.0
$N_{90} P_{60} K_0$	272.0	478.0	982.0	1802.0	950.0
$N_{90} P_{60} K_{60}$	294.0	558.0	1492.0	2706.0	1141.0
Stage mean	287.68	539.31	1422.93	2258.25	—
% accumulation of dry matter over total dry matter	12.73	23.88	63.01	100.0	—

	Dry matter yield	S.E.D.	C.D. (0.05)
i. Stages		0.97	1.98
ii. Treatment		1.93	3.96
iii. Stages x treatment		3.87	7.94

TABLE II. Effect of levels of NPK on the nutrient composition in cotton (MCU 8) at different stages of growth (per cent dry matter)

	Seedling stage			Flowering stage			First picking stage			Final picking stage			Treatment mean		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
N ₀ P ₀ K ₀	3.04	0.42	2.00	2.70	0.43	1.93	2.00	0.36	1.88	1.65	0.35	1.40	2.35	0.39	1.80
N ₃₀ P ₀ K ₀	3.24	3.44	2.00	2.82	0.45	2.10	2.21	0.41	1.96	1.71	0.37	1.53	2.50	0.42	1.89
N ₅₀ P ₃₀ K ₀	3.42	0.44	2.40	2.88	0.44	2.45	2.33	0.41	2.22	1.80	0.45	1.61	2.51	0.44	2.17
N ₃₀ P ₃₀ K ₃₀	3.42	0.45	2.45	2.87	0.47	2.52	2.38	0.45	2.11	1.83	0.41	1.45	2.63	0.45	2.13
N ₆₀ P ₀ K ₀	3.67	0.51	2.96	2.99	0.51	2.79	2.43	0.39	2.15	1.88	0.27	1.41	2.73	0.45	2.32
N ₂₀ P ₆₀ K ₀	3.68	0.55	3.01	3.13	0.59	2.65	2.50	0.47	2.35	1.94	0.43	1.49	2.81	0.51	2.38
N ₆₀ P ₂₀ K ₃₀	3.79	0.59	2.91	3.34	0.60	2.71	2.41	0.44	2.07	1.84	0.42	1.50	2.85	0.51	2.30
N ₆₀ P ₆₀ K ₀	3.97	0.61	2.97	3.49	0.58	2.65	2.50	0.40	2.15	1.90	0.37	1.39	2.97	0.49	2.29
N ₆₀ P ₄₀ K ₄₀	3.86	0.55	2.78	3.44	0.55	2.53	2.37	0.39	2.05	1.85	0.36	1.47	2.88	0.46	2.21
N ₆₀ P ₀ K ₀	4.05	0.57	2.89	3.53	0.58	2.42	2.67	0.34	2.20	1.96	0.30	1.45	3.05	0.45	2.24
N ₆₀ P ₂₀ K ₀	4.25	0.63	2.56	3.62	0.59	2.39	2.73	0.34	2.26	1.99	0.27	1.54	3.15	0.46	2.19
N ₆₀ P ₂₀ K ₂₀	3.99	0.57	2.94	3.46	0.53	2.45	2.61	0.34	2.20	1.77	0.39	1.41	2.96	0.46	2.25
N ₆₀ P ₄₀ K ₄₀	3.80	0.64	2.71	3.14	0.65	2.20	2.57	0.39	2.15	1.70	0.42	1.46	2.80	0.53	2.13
N ₆₀ P ₄₀ K ₆₀	3.66	0.56	2.94	3.02	0.54	2.35	2.41	0.45	2.04	1.67	0.42	1.40	2.69	0.37	2.18
N ₆₀ P ₆₀ K ₀	3.53	0.66	2.81	2.96	0.63	2.31	2.35	0.39	2.13	1.63	0.46	1.31	2.62	0.54	2.14
N ₆₀ P ₆₀ K ₆₀	3.32	0.58	2.97	3.00	0.54	2.44	2.30	0.46	2.01	1.55	0.48	1.30	2.54	0.52	2.18
Stages Mean	3.67	0.55	2.70	3.15	0.54	2.43	2.42	0.40	2.12	1.79	0.39	1.45	—	—	—

Nitrogen S.E.D. C.D. (0.05)

- i. Stages 0.026 0.052
- ii. Treatment 0.052 0.105
- iii. Stages x treatment 0.104 0.209

Phosphorus

- i. Stages 0.004 0.008
- ii. Treatment 0.008 0.017
- iii. Stages x treatment 0.017 0.034

Potassium

- i. Stages 0.006 0.013
- ii. Treatment 0.013 0.026
- iii. Stages x treatment 0.020 0.052

TABLE III. Effect of levels of NPK on the nutrient uptake of cotton (MCU 8) at different stages of growth (kg/ha)

	Seedling stage			Flowering stage			First picking stage			Final picking stage			Treatment mean		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
N ₀ K ₀	8.02	1.19	5.69	12.90	2.05	9.22	19.32	3.48	18.15	21.64	4.59	18.36	15.47	2.83	12.85
N ₃₀ P ₀ K ₀	9.68	1.41	6.44	13.92	2.22	10.37	27.14	5.03	24.06	32.79	7.09	29.35	20.88	3.94	17.55
N ₆₀ P ₂₀ K ₀	10.72	1.50	8.25	15.60	2.38	13.27	34.30	6.03	32.67	38.01	9.50	34.00	24.65	4.85	22.05
N ₃₀ P ₂₀ K ₂₀	9.23	1.53	8.38	13.94	2.28	12.25	32.94	6.22	29.20	36.30	8.53	28.76	23.10	4.64	19.64
N ₆₀ P ₀ K ₀	10.70	1.66	8.55	16.69	2.82	15.73	37.03	6.94	32.76	43.88	8.63	32.90	27.07	4.78	22.48
N ₆₀ P ₂₀ K ₀	10.94	1.83	8.96	17.86	3.36	15.10	40.45	7.60	38.02	48.06	10.65	36.92	29.33	5.86	24.75
N ₆₀ P ₂₀ K ₃₀	10.68	1.66	8.28	17.83	3.20	14.46	33.45	6.10	28.75	42.17	9.62	34.38	26.03	5.15	21.46
N ₆₀ P ₄₀ K ₀	10.95	1.68	8.19	17.38	2.88	13.19	35.30	5.64	30.35	44.98	8.75	32.91	27.15	4.74	21.16
N ₆₀ P ₁₀ K ₁₀	9.96	1.42	7.17	15.89	2.53	11.68	22.47	3.69	19.43	25.49	4.95	20.25	18.45	3.15	14.63
N ₃₀ P ₀ K ₀	12.63	1.77	9.01	21.25	3.49	14.56	48.00	6.11	39.55	55.15	8.43	40.80	34.25	4.95	25.98
N ₂₀ P ₂₀ K ₀	13.68	2.02	8.23	22.73	3.70	15.00	52.19	6.49	43.20	53.56	7.26	41.45	35.54	4.87	26.97
N ₆₀ P ₂₀ K ₂₀	11.80	1.68	8.70	19.58	2.99	13.86	41.86	5.45	35.28	49.58	12.03	41.84	30.70	5.54	24.92
N ₆₀ P ₀ K ₀	11.70	1.97	8.34	18.77	3.88	13.15	40.55	6.15	33.92	44.26	10.93	38.01	28.82	5.73	23.35
N ₃₀ P ₂₀ K ₁₀	10.53	1.53	8.46	16.54	2.95	12.88	34.89	6.51	29.53	40.87	10.28	34.27	25.71	5.34	21.28
N ₃₀ P ₂₀ K ₀	9.61	1.52	7.64	14.14	3.00	11.03	23.07	3.82	20.91	29.87	8.28	23.60	19.17	4.23	15.79
N ₆₀ P ₂₀ K ₆₀	9.75	1.53	8.73	16.74	3.01	13.61	34.31	6.76	29.98	41.94	12.98	35.17	25.68	6.14	21.87
Stages mean	10.66	1.65	8.06	16.98	2.92	13.08	34.82	5.69	30.36	40.50	8.90	32.68	-	-	-

	N uptake	S.E.D.	C.D. (0.05)	P uptake	S.E.D.	C.D. (0.05)	K uptake	S.E.D.	C.D. (0.05)
i. Stages	0.19	0.39	0.76	0.07	0.14	0.28	0.10	0.20	0.40
ii. Treatment	0.38	0.76	1.56	0.14	0.28	0.56	0.20	0.40	0.84
iii. Stages x treatment	0.78	1.56	3.12	0.28	0.56	1.12	0.42	0.84	1.68

The data on dry matter showed that there was significant increase in the dry matter production due to stage of the crop. Plant samples drawn at the time of final picking stage recorded higher dry matter yield compared to other stages of crop growth. This may be due to the size of the cotton plant. The interaction effect between stage and treatment was also found to be significant. In all treatments, final picking stage plant samples recorded significantly higher dry matter yield compared to other stage of plant samples. The accumulation of dry matter was 12.73 per cent at seedling stage, 23.83 per cent at the flowering, 63.01 per cent at first picking stage and 36.99 per cent at final picking stage. The results are comparable with those reported by White (1914) and Halevy (1976). The significant effect of uptake of N P K was not felt with regard to yield of seed cotton. This may be due to any one of the following reasons : (i) The absorbed nutrients might have been utilized for the vegetative growth, (ii) the nutrients might have been locked up i.e. translocation was not much for the production of reproductive parts. Because of this the yield differences between treatments were not statistically significant. However, numerically the highest yield of seed cotton (1230 kg/ha) was recorded by plots receiving 60:20:0 kg/ha of N P K. This resulted in an increase of 6.2 per cent seed cotton compared to control.

Nitrogen : The N concentration was maximum at the seedling stage and became reduced as the crop advanced till maturity. Similar results were

also observed by Vivekanandan *et al.* (1970), Bassett *et al.* (1970), Thompson *et al.* (1976), and Halevy (1976). Among the different treatments tried, treatment 90:20:0 kg/ha N P K recorded higher N concentration than other treatments. In other words application of N fertilizer has significantly increased the N concentration in the plant at all stages of sampling. This is in accordance with the results reported by Mohamed Ghouse and Muthusamy (1967), Vivekanandan *et al.* (1970) and Halevy (1976). The interaction between stages and treatment was also found to be significant. Among all the treatments tried, seedling stage of plant growth recorded higher N concentration than other stages of crop growth. In all stages of crop growth highest level of N (90 kg/ha) with or without P recorded higher N concentration in the plants than other treatments.

The uptake of N was significantly increased with advance in the age of the crop. Concentration of N and uptake of N in the present experiment were similar to those found by Bassett *et al.* (1970) but because of much higher dry matter yields the total uptake of nitrogen was higher in our experiment. Higher rates of N application significantly increased the N uptake also. This may be due to increased vegetative growth because of application of larger quantities of N. The uptake of N was more pronounced at final picking stage and at higher rates of (90 kg/ha) N application. Similar findings were also reported by Halevy (1976) who revealed that the total uptake of N increased with increase in dry matter yield.

Phosphorus : Concentration of P was higher during the earlier stages of

crop growth and decreased as the crop advanced till maturity. The results are in agreement with the findings of Halevy (1976) who reported the concentrations of N P and K in all plant parts of cotton decreased as the growth and maturation processes progressed. Among the levels of P_2O_5 tried, 60 kg P_2O_5 /ha registered significantly higher concentration of P in the plant than other levels of P_2O_5 tried. In the interaction between stage and treatment no consistent result was obtained. However, in all treatments, seedling stage of cotton crop growth recorded higher concentration of P in the plants than other stages of crop growth.

The same trend was noticed in the case of P uptake also with regard to stage i.e. the final picking stage recorded significantly higher P uptake values compared to other stages. With regard to levels of P_2O_5 also a similar trend was noticed as that of nitrogen i.e. highest level tried (60 kg P_2O_5 /ha) recorded higher uptake values. In the interaction between stages and treatments also no consistent result or conclusion could be drawn. The general trend was that in all the treatments tried, uptake of P increased with advance in the age of the crop.

Potassium : The concentration of K was more at the seedling stage and decreased as the crop advanced in age till maturity. The drop in K concentration was more pronounced than N. Treatment 60:20:0 kg/ha N:P:K recorded significantly higher K concentration than the other treatments tried. These observations were similar to those reported by Halevy (1976). In the interaction

between stages and treatments, treatment 60:20:0 kg/ha NPK recorded higher K concentration in the seedling and first picking stage; whereas treatment 60:0:0 kg/ha NPK in the case of flowering and treatment 30:20:0 in the final picking stage recorded higher K concentration in plants. In all treatments tried, concentration of K decreased as the crop advanced till maturity.

TABLE IV. Effect of treatments on the qualities of cotton fibre

Treatment	Ginning per cent	Lint index	Seed index	Halo length (m.m)
N ₀ P ₀ K ₀	34	42	85	28.2
N ₃₀ P ₀ K ₀	32	31	90	27.2
N ₃₀ P ₂₀ K ₀	34	38	84	24.1
N ₃₀ P ₂₀ K ₂₀	34	44	86	27.7
N ₆₀ P ₀ K ₀	35	41	79	26.4
N ₆₀ P ₂₀ K ₀	34	45	88	28.0
N ₆₀ P ₂₀ K ₂₀	35	45	87	28.7
N ₆₀ P ₄₀ K ₀	33	43	88	27.6
N ₆₀ P ₄₀ K ₂₀	34	46	91	26.9
N ₉₀ P ₀ K ₀	34	46	89	28.6
N ₉₀ P ₂₀ K ₀	34	44	86	27.9
N ₉₀ P ₂₀ K ₂₀	34	43	84	27.2
N ₉₀ P ₄₀ K ₀	34	44	87	27.2
N ₉₀ P ₄₀ K ₂₀	34	39	85	28.5
N ₉₀ P ₆₀ K ₀	36	45	82	28.5
N ₉₀ P ₆₀ K ₂₀	28	45	87	28.5
S.E.	1.15	2.41	2.28	1.54
C.D. (5 per cent)	—	—	—	—

Similar to N and P uptake, the uptake of K significantly increased with advance in the age of the crop. Among the treatments, 90 : 20 : 0 kg/ha NPK

recorded higher uptake values for K than other treatments. Significant interaction was observed between stages and treatments. The results showed that those plots which have not received any K application or 20 kg/ha K application alone registering higher K uptake values, perhaps due to the high available K status (368.4 kg/ha) of the soil and at times high doses of N would have released fixed K from soil colloids. The uptake of K was maximum in the final picking stage of the crop compared to other stages of growth.

Effect of treatments on the qualities of cotton fibre: The different treatments did not have any influence on ginning per cent, Lint index, seed index and halo length of cotton.

Application of N @ 60 kg/ha, P_2O_5 @ 20 kg/ha and no potash treatments recorded higher seed cotton yield compared to other treatments.

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