https://doi.org/10.29321/MAJ.10.A02922

Madras agric. J. 66 (2) : 94 – 100 Feb., 1979

Effect of Plant Population, Soil and Foliar Application of Major Nutrients on the Yield and Other Plant Characters of 'Suvin' Cotton (*Gossypium barbadense Linn.*)

K. SHANMUGHAM [1], H. K. HANUMANTHA RAO [2], V. SESHADRI [3] and P. C. MEENAKSHISUNDARAM [4]

Split plot experiment was conducted at Coimbatore, to determine the optimum spacing and best method of application of the recommended dose of N P and K (60, 30, 30 kg/ha) for obtaining maximum kapas yield in cotton variety, 'Suvin' *(G. barbadense L.)*. The foliar application of 10 : 5 : 5 ka/ha of N P and K respectively at squaring, flowering and boll formation periods with 30 : 15 : 15 N P K as basal dose under 90 × 37 cm spacing gave the maximum kapas yield of 21.8 q/ha. Correlation studies showed that foliar application of major nutrients at critical phases of growth inhibits uneconomic trends in plant growth and improves the relationship between yield attributes. The direct and indirect effects of plant height, boll number and boll weight on kapas yield showed synergestic action based upon the methods of NPK application.

Optimum plant density with adequate nutrients supply at proper times of growth ensure maximum seed cotton yield. Extensive studies on different field crops revealed that negative correlations among yield components were caused by various kinds of environmental stress which develop in a sequential pattern (Adams, 1967). In spacing cum fertilizer studies N showed maximum influence on kapas yield than P and K and row spacings did not affect the yield in any manner (Kanniyan *et al* 1968). Similar studies by Hearn (1972) showed that optimum plant spacings varied with the prevailing soil and climatic conditions but not with varieties and concluded that a reasonable conditions would be 7.4 plants/m^2. Singh *et al* (1969) and Brown (1971) reported that medium spacing (60×45 cm) resulted in better utilization of applied nutrients and in closer spacings there were few fruiting points and bolls, especially in the lower sympodia. Boll size, boll number and plant height increased significantly when 45 kg N/ha was applied through soil followed by 15 kg N foliar sprayed, than 60 kg N application through soil (Singh *et al*, 1970). Foliar application of N and P as urea and triple superphospate respectively increased the boll weight and reduced the boll shedding by improving the plant N and P content (Eaton and Ergle, 1953).

The present studies were carried out to find out the best time and method of application of the recommended dose of N, P and K (60 : 30 : 30 kg/ha) and their influence on different yield attributing characters on 'Suvin' cotton *(Gossypium barbadense Linn.)*

1 - 4 Central Institute for Cotton Research Regional Station, Coimbatore-641003.

MATERIAL AND METHODS

Split-plot experiments with plots of 19.94 m^2 size replicated thrice were laidout during 1973-75 seasons. Three spacings viz. 75×30 cm, 90×30 cm, 90×37 cm were allotted to the main plots and the following six NPK combinations were allotted to sub-plots.

Treatments	N	P_2O_5	K_2O	Stage of growth	method of application
T_1	30	30	30	at sowing	Soil
	30	—	—	at squaring (50)*	,,
T_2	30	30	30	at sowing	Soil
	15	0	0	at squaring	,,
	15	0	0	at first flowering (70)*	,,
T_3	30	15	10	at sowing	Soil
	10	10	10	at squaring	,,
	10	5	5	at first flowering	Foliar
	10	5	5	at boll development (100)*	,,
T_4	30	30	30	at sowing	Soil
	10	0	0	at squaring	Foliar
	10	0	0	at first flowering	,,
	10	0	0	at boll devslopment	,,
T_5	30	15	15	at sowing	Soil
	10	5	5	at squaring	Foliar
	10	5	5	at first flowering	,,
	10	5	5	at boll development	,,
T_6	30	20	20	at sowing	Soil
	10	0	0	at squaring	Foliar
	10	5	5	at first flowering	,,
	10	5	5	at boll development	,,

* No. of days after germination.

Sowings were dore in the mid August and two plants were grown per hill. Irrigation and plant protections were given as recommended. The same fertilizers were used both for soil and foliar applications. N was applied as Urea (45% N) and partly as diammonium phosphate (DAP 21% N) P as DAP (53% P_2O_5) and K as muriate of potash (60% K_2O). N, P and K were sprayed at 2 per cent, 1 per cent and 0.9 per cent concentrations respectively. Sprayings were done with power sprayer using 1000 litres of water/ha in the cool hours of morning (7.00 AM to 9.00 AM) taking care to see

that the entire foliage was fully drenched with the nutrient solutions. Urea and DAP were mixed and sprayed in a single solution along with regular insecticidal sprays (Dimethoate in the squaring and flowering and Endosulfan in the boll development phases) Muriate of potash was sprayed separately.

Observations on plant height, number of bolls, boll weight, and kapas yield were recorded on ten randomly selected plants in each replication. Good and bad kapas were separated from single plant and plot yields and analysed separately. Correlation coefficients and direct and indirect effects were calculated according to Dewey and Lu (1959). Three types of equations based upon four characters viz., 1) Plant height 2) number of bolls / plant, 3) mean boll weight and 4) single plant yield were fitted for six NPK treatments.

$$r_{14} = P_{14} + r_{12} P_{24} + r_{13} P_{34}$$
$$r_{24} = P_{14} r_{12} + P_{24} + r_{23} P_{34}$$
$$r_{34} = P_{14} r_{13} + r_{23} P_{24} + P_{34}$$

where rij (i≠j, 1234) are correlation coefficients and Pij (i≠j, 1234) are direct effects of the corresponding characters on yield. The variational trends of different effects (direct and indirect effects via other characters) for each character in the six treatments were studied using a bar diagram.

RESULTS AND DISCUSSION

Combined analysis of two seasons data showed that in respect of spacings, there was significant difference for all characters except the yield of bad kapas. Only boll weight and yield per hectare showed significant difference for years. In the case of NPK treatments all characters showed significant difference except bad kapas yield. Plant height, number of bolls and boll weight showed significant difference for interaction effects viz., spacings x NPK (Table I).

Foliar application of NPK at three critical growth phases over a basal dressing of 50 percent of the recommended dose (T_5) significantly influenced the individual plant performance and positively contributed to the development of more number of healthy, bigger bolls and resulted in minimum bad kapas and maximum good kapas yields. This was mainly due to the balancing effect of the applied nutrients through foliage at the critical growth phases when the plant nutrient requirement is high. Bhatt (1975) reported that at reproductive phase the NPK requirement of the crop is high. By foliars praying of 0.5 per cent DAP on rainfed cotton, he obtained increased yields up to 5 q/ha. Similarly, Palmer and Goldsworthy (1971) recorded increased yields with foliar feeding of N and P. Foliar supply of K at reproductive phases improved the boll size and reduced the bad kapas yield. Ashely and Goodson (1972) observed enhanced translocation of photosynthates from the point of production to the developing bolls. The role of K in increasing the general

resistance of the plant against the incidence of pests and diseases has been reported on many crops (Chabonsson, 1972). Foliar spray of N alone (T_4) increased the plant height and bad kapas yield and showed negative influnce on yield attributing factors. NPK sprays at squaring phase alone and N sprays in the remaining two growth phases (T_6) had the same effect and indicated the need for the balanced supply of all the three nutrients for maintaining maximum yield levels. Soil application of NPK in two split doses and foliar application of the same at flowering and boll development phases (T_3) comparatively increased the kapas yield than when N alone was applied through soil in two splits (T_1) or in three splits (T_2). Maximum yield was obtained in T_5 with 90 × 37 cm spacings (12·8 q/ha) followed by T_3 with 90 × 37 cm spacing (21.2 q/ha) and T_5 with 90 × 30 cm spacing (20.8 q/ha.) (Table II).

In T_3, T_4, T_5 and T_6, the number of bolls per plant and boll weight showed negative correlation with plant height. Correlation between plant height and kapas yield was low. Number of bolls per plant and boll weight showed significant positive correlation in all the treatments except T_4. Due to the fertilizer responsiveness of this variety, increased boll number per plant did not reduce the mean boll weight. Evaluation of the correlation between number of bolls per plant and kapas yield showed that soil or foliar application of N, P and K at flowering phase was essential to enhance the yield capacity of the crop. This corroborates with the findings of Burhan (1972) that N utilization was more efficient when it was split applied at 6 to 10 weeks after sowing. Similar relations were observed between boll weight and kapas yield (Table III).

The direct and indirect effects of three characters viz., plant height, boll number and boll weight on kapas yield under the six fertilizer treatments showed a synergistic action based on the methods of fertilizer application. The direct effect of plant height was more pronounced in T_5 and showed negative effect in T_1. It was mainly due to the split application of nutrients at critical growth phases in T_5. Supply of N through soil in T_1 and through foliage in T_4 did not contribute much to the yield factors. The correlation between plant height and yield was highly influenced by the negative indirect effect in T_5 and positive indirect effect via number of bolls in T_6.

The direct effect of number of bolls on yield in all the treatments showed that foliar application of NPK (T_2) was better than soil application of N at one critical growth phase (T_1) or at two critical growth phases (T_2). Application of nutrients at squaring and flowering phases alone did not contribute much towards the development of bolls. The negative indirect

effect via plant height in T_5 and positive indirect effect via boll weight in T_6 were due to the differential rate of nutrients supply through soil and foliage.

Boll weight showed maximum direct effect on yield in T_6 due to the foliar supply of P and K at later stages of growth which directly acted on the metabolic functions of boll development. The negative indirect effect in T_5 via plant height, positive indirect effect in T_2 and T_5 and negative indirect effect in T_6 via boll number were due to the oscillatory input of these nutrients at critical phases of growth.

The encouragement and suggestions given by Dr. K. V. Srinivasan, Director, Central Institute for Cotton Research, Nagpur and Dr. J. G. Bhatt, Head, CICR Regional Station, Coimbatore are gratefully acknowledged.

REFERENCES

ADAMS, M.W., 1967. Basis of yield compensation in crop plants with special reference to the field bean. *Crop Sci.* 7: 50-510

ASHLEY, D.A., and R.D. GOODSON, 1972. Effect of time and Plant K status on C^{14} labelled photosynthate movement in cotton. *Crop Sci.* 12: 686-90.

BHATT, J.G., 1975. For rainfed Cotton low concentration sprays of diammonium phosphate. *Indian Farming* 25:20.

BROWN, J.K. 1971. Plant density of Cotton in Northern Nigeria. *Cotton Grow Rev.* 48: 255-66.

BURHAN, H.O., 1972. Post sowing application of fertilizer nitrogen to Cotton in the Sudan Gezina. *Cotton Grow Rev.* 49:216-23.

CHABONSSON, F., 1972. The role of Potassium and Cation equilibrium in the resistance of plant towards diseases. *Potash Review.* 23 3?.

DOUGLAS, R. DEWEY., and K.H.LU. 1959. A Correlation and path Coefficient analysis of Components of erested wheat grass seed production. *Agric. J.* 51: 515-18.

EATON, F.M., and D.R. EEGLE, 1953. Nutrition by foliar application. *Ann. Rev. Plant Physiol.* 5: 48-49.

HEARN, A.B., 1972. Cotton Spacing experiments in Uganda. *J. Agric. Sci. Comb.* 78: 13-25.

KANNYIAN, K., A. DAMODARAN, and M. KADAMBAVANASUNDARAM, 1968. Response of Cotton to fertilizer application and spacing in rice fallows. *Indian J. agril. Sci.* 38: 781-89.

PALMER, J.L., and R.R. GOLDSWORTHY, 1971. Fertilizer trial with sprayed and unsprayed Cotton in Nigeria. *Expt. Agric.* 7: 281-87.

SINGH, C., R.C. JOSHI, and G.V. KALLI, 1970. Soil and foliar application of nitrogen to rainfed Cotton. *Indian J. Agron.* 15 : 269-71.

KHAN, M.S. and D.G. SOWANI, 1969. Effect of sowing time, spacing and nitrogen levels on irrigated Cotton in Nimar tracter of M. P. *Indian J. Agron.* 14: 142-46.

TABLE I Mean values and results of the combined analysis of the Seasons data of different characters of Cotton, variety 'Suvin' (*G. barbadense L.*)

Source	Plant ht. gms.	Number of bolls/plant	Mean boll wt. gms.	Kapas yield kg/ha	Yield of kapas/plant gms.	Yield of good kapas/ plant gm.	Yield of bad kapas/plant gms.	Bad kapas kg/ha.
Blocks	NS	NS	*	NS	NS	NS	NS	NS
Spacing(s)	**	**	**	**	NS	**	**	NS
Years	NS	NS	**	**	NS	NS	NS	NS
Treatments (T)	**	**	**	**	**	**	NS	NS
Interaction S × T	**	**	**	NS	NS	NS	NS	NS
Spacing (Cm)								
S_1 75 × 30	138.7	14.4	3.2	1904	32.9	25.3	7.6	463
S_2 90 × 30	136.5	15.2	3.0	1970	33.0	27.2	6.0	357
S_3 90 × 37	134.9	16.0	3.6	2081	33.2	28.8	4.4	395
Treatments								
T_1	141.3	16.5	3.0	1930	32.0	25.4	6.6	419
T_2	140.4	16.9	3.0	1938	33.3	26.4	6.9	429
T_3	140.1	18.9	3.3	2028	33.9	28.1	5.8	310
T_4	139.9	16.6	3.2	1967	32.2	26.2	6.0	401
T_5	127.4	20.3	3.7	2077	37.1	32.1	5.0	350
T_6	131.3	17.0	3.2	1970	32.3	25.9	6.4	400

* Significant at 5%

** Significant at 1%

TABLE II Mean kapas yield of 'Suvin' Cotton (*G. barbadense L.*) in 3 spacings with 6 NPK treatments.

Treatments	Yield kg/ha			Mean	
	75 × 30 cm	90 × 30 cm	90 × 37 cm		
1.	1877.2	1894.5	2018.0	1929.9	F = Significant (1%)
2.	1871.0	1913.5	2030.5	1938.3	SE ± 7.53
3.	1946.0	2016.5	2121.5	2028.0	CD = 15 (5%)
4.	1870.5	1962.5	2068.0	1967.0	20 (1%)
5.	1977.5	2076.0	2178.5	2077.3	
6.	1880.0	1958.0	2071.0	1969.6	
Mean	1903.7	1970.2	2081.3		

F = Significant (1%)
SE ± 9.13
CD = 19.9 (5%), 27.9 (1%)

TABLE III Correlation coefficient between 4 characters under 6 treatments in Cotton variety Suvin (*G. barbadense L.*)

Characters	Treatments					
	1	2	3	4	5	6
Plant height × No. of bolls	0.0559	0.04351	0.12548	$\bar{0}.04068$	$\bar{0}.77689^{**}$	$\bar{0}.66182^{**}$
Plant height × Boll weight	0.09292	0.02500	$\bar{0}.14875$	$\bar{0}.11700$	$\bar{0}.73637^{**}$	$\bar{0}.56232^{*}$
Plant height × Kapas yield	$\bar{0}.53941^{*}$	0.14208	0.17906	0.04334	$\bar{0}.15208$	0.26228
No. of bolls × Boll weight	0.72824^{**}	0.80610^{**}	0.51445^{*}	0.17384	0.72462^{**}	0.83774^{**}
No. of bolls × Kapas yield	0.00722	0.57405^{*}	$\bar{0}.05047$	$\bar{0}.59457^{**}$	0.53692^{*}	$\bar{0}.32446$
Boll weight × Kapas yield	0.15021	0.31309	0.21095	0.13245	0.33245	$\bar{0}.06867$

** Significant at 1%
* Significant at 5%