Indian Journal of Agronomy **46** (3) : 557–562 (September 2001)

Production potential and nitrogen-use efficiency of inter-specific and intra-*hirsutum* cotton hybrids under graded levels of nitrogen and weed-control methods

P. NALAYINI[1], O.S. KANDASAMY AND A. BALASUBRAMANIYAN

Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore 641 003

Received : June 2000

ABSTRACT

A field study was conducted during the winter season of 1997 and 1998 at Tamil Nadu Agricultural University, Coimbatore. Two hybrids (inter-specific 'TCHB 213' and intra-*hirsutum* 'Surya') were evaluated for their production potential under 3 N levels (90, 120, and 150 kg/ha) and 4 weed-control methods (Pendimethalin 1.0 kg + 1 hand-weeding, glyphosate 1.0 kg + 1 hand-weeding, hand-weeding twice and unweeded control). The hybrids were grown following the recommended spacing of 90 cm x 60 cm for 'Surya' and 120 cm x 60 cm for 'TCHB 213'. Among the hybrids, 'TCHB 213' gave better yield attributes and yield on per plant basis. But 'Surya' gave significantly more yield than 'TCHB 213' on unit area basis. The response to applied N was increasing at increasing rate up to the highest level (150 kg/ha) of N. But the N-use efficiency decreased with increase in N level. Among the weed-control treatments, hand-weeding twice recorded significantly higher seed-cotton yield and N-use efficiency which was closely followed by glyphosate + hand-weeding.

Key words : Interspecific, Intra-*hirsutum*, Seed-cotton, N uptake, Weed control, N-use efficiency

Hybrids in general have the potentiality to yield more *kapas* than varieties because of hybrid vigour. The hetrosis for high yield itself may quantitatively and qualitatively differ among the hybrids (Joshi, 1997). Nitrogen management is an important component in maximizing yield of hybrid cotton. Due to the indeterminate nature of cotton crop, the number of leaves, internodes and flower buds increase exponentially. Consequently, the demand exceeds the supply and thereby the organs compete for the nutrients. As the nutritional demands can ultimately decide the seed-cotton yield, a careful planning of schedule and quantity of nitrogen is needed for enhancing the yield of hybrid cotton. Ganjaxi *et al.* (1996) reported yield

Present address : [1]Regional Station, CICR, Coimbatore, Tamil Nadu 641 003

response up to 225 kg in 'DCH 32' and 'HB 224', While Palaniappan and Balasubrama niyan (1989) obtained 3.7 tonnes/ha in 'DCH 32' hybrid cotton under Tamil Nadu condition with 240, 120 and 120 kg N, P and K. However, Mannikar and Pundarika- shadu (1990) in Maharashtra obtained yield response with hybrids up to 320 kg/ha. Cotton is very sensitive to weed infestation due to its slow initial growth as well as wider spacing gives better chance for weed infestation. Information on effect of crop cultivars, fertilizer rates, particularly N and production potential and N-use efficiency of inter-specific and intra-*hirsutum* hybrids are limited. Hence the present investigation was carried out.

MATERIALS AND METHODS

The study was conducted under irrigated condition at Tamil Nadu Agricultural University, Coimbatore. The soil was sandy clay loam with low (152.5, 191.5 kg/ha), medium (17.6, 19.2 kg) and high (430.5, 645.6 kg/ha) available N, P and K during the winter 1997 and 1998 respectively. Two cotton hybrids (intra-*hirsutum* 'Surya' and interspecific 'TCHB 213') having similar crop duration (165–175 days) and fertilizer recommendation (120, 60 and 60 kg N, P and K/ha) but differing in plant geometry and density (90 cm × 60 cm for 'Surya', 120 × 60 cm for 'TCHB 213') were chosen to study their growth variations and yield potential under graded N levels and 4 different weed-control methods. Three levels of N (90, 120 and 150 kg/ha) with 4 weed-management methods, viz. pre-emergence Pendimethalin 1.0 kg (3 days after sowing) + 1 hand-weeding (45 days after sowing), post-emergence Glyphosate 1.0 kg (20 days after sowing) and unweeded control were studied in split-plot design, replicated thrice. The fertilizers were applied in 2 splits with 50% N and full dose of P_2O_5 and K_2O as basal application and the remaining 50% N on 50 days after sowing. The non-selective, non-residual, broad-spectrum herbicide, glyphosate was applied as directed spray using plastic shield (attached with the nozzle, WFN 40) so as to direct the herbicide to fall only on weeds. Care was taken to avoid any drift towards cotton crop.

A total of 612.4 mm rainfall was received in 45 rainy days during the first year and relatively higher rainfall of 676.8 mm in 21 rainy days was received in the second year. The crop was irrigated at 0.4 IW : CPE during vegetative phase (up to 55 days) and at 0.6 IW : CPE during reproductive phases. The irrigation was stopped at 150 th day.

RESULTS AND DISCUSSION

Performance of genotypes

'Surya' accumulated significantly more dry matter than 'TCHB 213' (Table 2). As the number of plants per unit area was more in 'Surya' (18, 518 plants), early canopy coverage was achieved and the light energy was utilized to the maximum extent for the production of assimilates and thus resulted in significantly more dry matter. The nutrient removal by 'Surya' was also more than 'TCHB 213' (Table 2) due to higher amount of dry-matter production. While the widely spaced (120 cm × 60 cm) 'TCHB 213', with the population of 13, 888 plants/

ha, could not utilize the light energy fully and resulted in lower dry-matter accumulation and N uptake. Further, the N-use efficiency decreased with increasing N level (Table 2).

Higher dry matter and nutrient uptake by 'Surya' resulted in partioning of more assimilates towards development of reproductive parts and resulted in 10.5 % higher seed-cotton yield in 'Surya' than 'TCHB 213' (Table 2). The lint yield was also significantly higher in 'Surya' than 'TCHB 213'. The significant increase in seed-cotton yield and lint yield resulted in significantly higher N-use efficiency in 'Surya' than in 'TCHB 213'.

Nitrogen

Every increae in N level from 90 to 150 kg/ha increased the dry matter appreciably and the highest dry matter was recorded with N at 150 kg/ha, being superior to other lower levels (Table 2). The nitrogen uptake kept pace with N application and significantly higher uptake was recorded with higher N level and was on a par with medium N level but was significantly superior to lower level of N. However, the N-use efficiency decreased with increasing N level. Similar observation of higher N-use efficiency at lower level of applied N was reported by Raniperumal *et al.* (1985).

Increasing the level of N significantly enhanced the number of sympodia/plant. Also, high N level produced the highest number of bolls/plant and was on par with medium N, but was found superior to lower N. Hybrids responded favourably to increasing N levels. The seed-cotton yield increased from 1,683 kg with 90 kg N to

Table 1. Number of sympodia/plant, bolls/plant, bolls/unit area and boll weight of cotton as influenced by N levels and weed-control methods (pooled mean)

Treatment	Sympodia/ plant	Bolls/ plant	Bolls/unit area (100 m^2)	Boll weight (g/boll)
Hybrid				
'Surya'	16.56	29.04	5,373	4.520
'TCHB 213'	18.57	33.18	4,608	4.609
CD (P=0.05)	0.5	0.7	124.2	0.02
N (kg/ha)				
90	16.81	29.06	4,653	4.504
120	17.67	31.34	5,044	4.568
150	18.37	32.89	5,276	4.621
CD (P=0.05)	0.6	0.9	152.1	0.04
Weed-control method				
Pendimethalin 1 kg/ha + HW	18.18	32.01	5,133	4.629
Glyphosate 1kg/ha + HW	18.85	34.23	5,495	4.669
HW twice	19.33	36.03	5,794	4.684
Unweeded control	14.09	22.18	3,542	4.274
CD (P=0.05)	0.3	1.1	193.4	0.05

HW, Hand-weeding

Table 2. Dry matter, N uptake, seed-cotton yield and N-use efficiency of cotton hybrids as influenced by graded N levels and weed-control methods (pooled mean)

Treatment	Dry matter (kg/ha) at 120 DAS	N uptake (kg/ha) at 120 DAS	Seed-cotton yield (kg/ha)	Lint yield (kg/ha)	N-use efficiency (kg lint/ kg N)
Hybrid					
'Surya'	4,972	159.6	1,915	700.1	6.051
'TCHB 213'	4,077	136.1	1,735	551.4	4.774
CD (P = 0.05)	103.6	7.1	74.8	30.9	0.2
N (kg/ha)					
90	4,274	128.5	1,683	600.9	6.674
120	4,563	153.8	1,820	628.3	5.236
150	4,737	161.8	1,972	648.0	4.326
CD (P = 0.05)	126.9	8.7	91.6	NS	0.3
Weed-control method					
Pendimethalin 1 kg/ha + HW	4,707	159.3	1,827	627.3	5.406
Glyphosate 1 kg/ha + HW	5,045	178.5	2,153	739.7	6.379
HW twice	5,345	192.4	2,377	817.5	7.091
Unweeded control	3,000	61.84	942	318.5	2.775
CD (P=0.05)	168.6	9.8	86.9	37.6	0.3

DAS, Days after sowing

Table 3. Seed-cotton yield (kg/ha) of cotton hybrids as influenced by interaction between N levels and weed-control methods (pooled mean)

Weed-control method	N (kg/ha)				
	90	120	150	Mean	CD (P=0.05)
Pendimethalin HW	1,648	1,819	2,014	1,827	161
Glyphosate HW	1,949	2,149	2,362	2,153	
HW twice	2,209	2,393	2,529	2,377	
Unweeded control	925	919	983	942	
Mean	1,683	1,820	1,972		
CD (P = 0.05)	150				

1,972 kg at 150 kg N/ha. Brar *et al.* (1992) also obtained the highest seed-cotton yield with 150 kg N/ha. The N-use efficiency range obtained under the present study was in agreement with the findings of Morrow and Krieg (1990), Mullins and Burmester (1990) and Gerik *et al.* (1993).

Weed-management practices

Among the weed-control methods, hand-weeding twice recorded significantly higher dry matter and N uptake, which ultimately caused higher seed-cotton yield, lint yield and N-use efficiency. This might be due to efficient weed control (Table 4)

Table 4. Weed density/m² and relative density at 45 days after sowing in the experimental sites

Weed species	1997		1998	
	Density/ m²	Relative density	Density/ m²	Relative density
Grass weed				
Cynodon dactylon (L.) Pers.	74.3	28.6	73	24.8
Chloris barbata SW.	4.66	1.67	5.33	1.81
Bracharia reptans (L.) Gard & Hubbard			7.33	2.57
Dactyloctenium aegyptium Beauv.	4.33	1.65		
Pennisetum hohenckeri Hochst. ex Steud.			6.0	2.06
Total grasses		31.9		31.3
Sedge weed				
Cyperus rotundus L.	54.3	20.9	70.7	23.9
Total sedges	20.9	23.9		
Broad-leaved weed				
Amaranthus viridis L.	9.33	3.63	7.66	2.63
Boerhaavia erecta L.	10.0	3.91	19.33	6.81
Corchorus tridens L.	4.00	1.55	7.66	2.57
Datura metal L.	9.33	3.71		
Digera muricata (L.) Mart.			6.0	2.08
Flaveria trinervia (Spreng.) Mohr.	5.33	2.06	6.66	2.28
Parthenium hysterophorus L.	17.3	8.06	4.66	1.60
Trianthema portulacastrum L.	61.3	23.9	59.67	20.5
Vernonia cinerea (L.) Less			18.33	6.36
Total broad-leaved weeds		46.8		44.8
Total		100		100

and associated benefits like better root-zone aeration due to hoeing and weeding. The glyphosate + hand-weeding stood next only to Pendimethalin + hand-weeding. Santaram and Shivshankar (1982) and Yadav *et al.* (1986) reported increased efficiency of fertilizers to crop plants through weed control.

Interaction effect

The interaction between N levels and weed-control methods on seed-cotton yield (pooled mean for 1997 and 1998) indicated that the seed-cotton achieved at 150 kg under Pendimethalin + hand-weeding could be achieved either at 120 kg N under Glyphosate + hand-weeding or at 90 kg N under hand-weeding twice (Table 3). This might be due to ineffective control of dominant perennial weeds such as *Cynodon dactylon* and *Cyperus rotundus* in the experimental plot (Table 4) by the Pendimethalin + hand-weeding. The Glyphosate being translocated herbicide controlled perennial weeds like *Cynodon dactylon* and *Cyperus rotundus* than Pendimethalin and thus found superior to Pendimethalin.

REFERENCES

Brar, A.S., Singh, Rajinder, Tiwana, V.S. and Singh, T.H. 1992. Response of cotton cultivars to nitrogen application at two population levels. *Journal of Indian Society of Cotton Improvement,* September 154–158.

Ganjaxi, K.K., Math and Hunsagi, Gururaj. 1996. Effect of nitrogen and potash levels on yield of biomass and seed-cotton of two cotton hybrids. *Karnataka Journal of Agricultural Sciences* **9** (3) : 516–519.

Gerik, T.J., Oosterhuis, D.M. and Baker. 1993. Cotton Monitoring; Crop Nutrition and fertilizer Management. *Beltwide Cotton Conference,* pp. 1,184–1,186.

Joshi, M. 1997. *Hybrid Cotton in India,* 190 pp. Indian Council of Agricultural Research, New Delhi.

Mannikar, N.D. and Pundarikashadu, R. 1990. Soil fertility and fertilizer management in cotton (In) *Cotton Scenario in India*–A Souvenir. Indian Council of Agricultural Research, p. 81–87.

Morrow, M.R. and Krieg, D.R. 1990. Cotton management strategies for a short growing seasons environment : water – nitrogen considerations. *Agronomy Journal* **82** : 52–56.

Mullins, G.L. and Burmester, G.H. 1990. Dry-matter, phosphorus and pottasium accumulation by cotton varieties. *Agronomy Journal* **82** : 729–736.

Palaniappan, Sp. and Balasubramanyan, P. 1989. Maximum yield research in Tamil Nadu, (In) : *Proceedings of Symposium on Maximum Yield Research,* held at New Delhi, during 16–18, 1988, pp. 43–56.

Raniperumal, P., Ramanathan, A., Chandrasekaran, J.S., Manickam and Kothaandaraman, G.V. 1985. Influence of N levels on the yield and uptake by cotton crops and their impact on N use efficiency and recovery. *Madras Agricultural Journal* **72** (8) : 421–428.

Santaram, S. and Shivshankar, K. 1982. Effect of weed control in enhancing fertilizer use efficiency in soybeans. *Indian Journal of Weed Science* **14** : 89–95.

Yadav, S.K., Kumar, A. and Bhan, V.M. 1986. Nutrient uptake in wheat as influenced by herbicides. *Indian Journal of Weed Science* **18** (1) : 60–62.