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Productivity and profitability of split application of NPK nutrients on hybrid cotton

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Abstract: A field experiment were carried out for two seasons during *kharif* 1999-2000 and 2000-01 at Agricultural Research Station, Siruguppa to study the response of DHH-11 hybrid cotton to split application of NPK nutrients under irrigated condition. The results revealed that split application of NPK has produced significantly more seed cotton yield (1298 kg ha^{-1}) over split application of only N (1172 kg ha^{-1}). The magnitude of increase was 11% and it was on par with split application of N and P nutrients. Further, among the time of applications, application of nutrients 25% at basal, 50% at 30 DAS and 25% at 60 DAS has significantly improved the seed cotton yield (1332 kg ha^{-1}) by 8 to 16% over rest of the times of application and it was followed by split application 0% at basal, 50% at 30 DAS, 25% each at 60 and 75 DAS. This higher seed cotton yield was mainly attributed to higher seed cotton yield per plant, number of bolls harvested per plant, boll weight and number of sympodia per plant. The interaction effects between split application of NPK nutrients and time of application also revealed that, split application of N and P nutrients, 25% at basal, 50% at 30 DAS and 25% at 60 DAS has recorded the maximum seed cotton yield (1407 kg ha^{-1}) as compared to other treatment combinations. Net return per rupee invested was recorded to be higher under split application of either N and P (1.29) or NPK (1.30) as against split application of only N (1.17). From the results, it can be concluded that cotton responds to split application of P and K along with split application of N under irrigated conditions.

Key Words: NPK, Seed cotton yield, Nutrients, Split applications and B:C ratio.

Introduction

Cotton is the most important crop of the world cultivated over an area 32.8 m.ha with production of 18.6 m.t. Though India rank first in the world cotton area (8.5 m.ha) it is relegated to third place in total production (153 lakh bales) and seventeenth place in productivity (333 kg ha^{-1}). Maharashtra, Gujarat, Andhrapradesh, Rajasthan, Punjab, Haryana, Madhyapradesh, Karnataka and Tamilnadu are important cotton growing states which account for nearly 98 to 99 per cent of total cotton cultivated area. Further, hybrids cover an area to the extent of 40 per cent of total cotton cultivated area in the country and 60 per cent in Karnataka. In Karnataka, Tungabhadra Project Area is one of important irrigated cotton belt, playing major role in cotton productivity. Looking at the productivity levels of cotton in our country, it is far below the world average, which indicates that there is an ample scope to boost its productivity by adopting improved technologies. Among the various agronomic practices to increase cotton productivity, fertilizer management especially under irrigated situation is considered a key factor. Generally split application of N is followed in cotton cultivation. Since, cotton being a long duration crop with indeterminate type of growth habit, will benefit the growth and yield. More research is concentrated on N split application than other two major nutrients i.e., P and K because of their relatively lower losses due to volatilization and leaching. However, few studies carried out at Tamil Nadu (Chellamuthu *et al.* 2001) and Karnataka (Patil *et al.* 2001) have indicated the beneficial effects of split application of P and K also. A meagre information is available on split application of N, P and K nutrients in Tungabhadra project area. Hence, the present investigation was laid out to study the response of hybrid cotton to split application of NPK under irrigated condition.

Table 1. Seed cotton yield and yield attributes as influenced by split application of NPK nutrients under irrigated conditions

Treatments	Yield (kg ha^{-1})			Yield/Plant (g)			No.of bolls harvested/plant			Boll weight (g)			No.of sympodia/ plant		
Major nutrients (MN)	1999-2000	2000 2001	Pooled mean	1999-2000	2000 2001	Pooled mean	1999-2000	2000 2001	Pooled mean	1999-2000	2000 2001	Pooled mean	1999-2000	2000 2001	Pooled mean
N split PK	1017	1327	1172	79	81	79	24.0	27.22	25.68	4.13	5.32	4.72	20.7	17.77	19.23
N&P split K basal	1071	1508	1289	83	96	89	27.0	26.83	26.74	4.48	5.32	4.90	21.2	16.97	19.08
NPK split	1037	1559	1298	82	93	88	24.0	28.20	26.29	4.22	5.31	4.76	18.8	19.37	19.07
S.Em+/-	40	19	22	1.38	0.93	0.83	0.60	0.38	0.36	0.08	0.06	0.05	0.55	0.43	0.35
CD at 5%	NS	73	73	NS	3.65	2.71	NS	NS	NS	NS	NS	NS	NS	1.67	NS
Time of application (TA)															
(a) 50 % each at basal & 60 DAS	1071	1383	1227	74	84	79	25.0	26.36	25.53	4.24	5.33	4.78	19.1	17.38	18.26
(b) 50% at basal, 25% each at 30 & 60 DAS	877	1412	1144	78	84	81	23.0	30.16	26.78	4.21	5.33	4.77	21.2	18.38	19.77
(c) 25% at basal, 50% at 30 DAS, & 50% at 60 DAS	1158	1506	1332	85	95	90	26.0	24.82	25.14	4.55	5.09	4.82	20.0	16.80	18.40
(d) 0% at basal, 50% at 30 DAS, 25% each at 60 DAS & 75 DAS	1061	1556	1308	88	97	92	27.0	28.33	27.49	4.10	5.51	4.81	20.6	19.58	20.07
S.Em+/-	36	39	26	1.53	1.15	0.96	0.80	0.99	0.64	0.12	0.09	0.07	0.61	0.58	0.42
CD at 5%	106	115	76	4.54	3.42	2.74	NS	2.96	1.82	NS	0.26	NS	NS	1.74	1.21
Interactions															
S.Em+/-	67	61	45	267	1.96	1.66	1.33	1.54	1.02	0.19	0.15	0.17	1.07	0.97	0.72
CD at 5%	199	182	151	7.94	5.82	5.52	3.94	NS	3.40	3.40	0.57	NS	0.91	NS	NS

Materials and Methods

A field experiment was carried out for two seasons of *kharif* 1999-2000 and 2000-01 at Agricultural Research Station, Siruguppa, to study the response of hybrid cotton to split application of NPK nutrients under irrigated condition. Cotton intra hirsutum hybrid DHH-11 was sown with 90 x 60 cm spacing with recommended fertilizer level of 120:60:60 kg NPK ha^{-1}. The experiment consisted of 12 treatment combinations, comprising of split application of NPK nutrients as main plots (M_1: N split, P and K basal, M_2: N, P split and K basal, M_3: N, P and K split) and time of application of nutrients as sub plots (A: 50% each at basal and 60 DAS, B: 50% at basal, 25% each at 30 DAS and 60 DAS, C: 25% at basal, 50% at 30 DAS, 25% at 60 DAS, D: 0% at basal, 50% at 30 DAS, 25% each at 60 and 75 DAS. The experiment was laid out in split plot design with three replications. The soil of the experimental plot was deep black with pH 8.10 and the available N, P and K status were 285, 38, 390 kg ha^{-1} respectively. The fertilizers were applied as per the treatments through urea (46.4%), DAP (N-18% & P-46%), single super phosphate (16% water soluble P_2O_5) and muriate of potash (60% K_2O). The crop was raised by adopting the common recommended package of practices. The incidence of boll worms was more during 1999-2000 as compared 2000-2001 and the control of these insects was monitored as per the package of practices.

Results and Discussion

Effect of NPK nutrients

The data on seed cotton yield and yield-attributing parameters are presented in Table 1. Pooled results of the two seasons indicated that split application of either N and P or NPK produced significantly maximum seed cotton yield of 1289 and 1298 kg ha^{-1}, respectively over split application of only N (1172 kg ha^{-1}). The magnitude of increase in yield was 10 to 11 per cent. This higher seed cotton yield was due to more seed cotton yield per plant, more number of bolls harvested per plant and boll weight. These results are in conformity with Chellamuthu *et al.* (2001), who observed that maximum seed cotton yield was obtained with recommended dose of N + extra P and K each @ 20 kg ha^{-1} on 45 and 60 DAS. Similar results have also been reported by Mehetre *et al.* (1990) and Pothiraj *et al.* (1995) i.e. foliar application of DAP also increased the seed yield in cotton (Vanangamudi *et al.* 1987). Among the two seasons the cotton yields were relatively lower during 1999-2000 mainly due to higher incidence of boll worms hence the seed cotton yield was not significantly different among the split applicatin of NPK nutrients. However, split application of N and P has registered higher seed cotton yield (1071 kg ha^{-1}) as against the split application of N only (1017 kg ha^{-1}). Whereas, during 2000-01, split application of either N and P or NPK recorded significantly highest seed cotton yield of 1508 and 1559 kg ha^{-1} respectively as compared to split application only N (1327 kg ha^{-1}). The extent of increase in seed cotton yield was upto 14 to 17 per cent over split applicatio of only N.

Effect of time of application of nutrients

Time of application of nutrients has significant effect on seed cotton yield and its yield attributing parameters (Table 1). The pooled data of two seasons clearly showed significant differences in the seed cotton yield. Application of nutrients, 25% at basal, 50% at 30 DAS and 50% at 60 DAS produced maximum seed cotton yield (1332 kg ha^{-1}) as compared to application of nutrients, 50% each at basal and 60 DAS (1308 kg ha^{-1}). The per cent increase in seed cotton yield was to the tune of 16 per cent over rest of the time of applications. The higher seed cotton yield was greatly influenced by seed cotton yield per plant, number of bolls harvested per plant, boll weight and number of sympodial branches per plant. Patil *et al.* (2001) reported that out of recommended NPK, application of 10% as basal and remaining 90% through fertigation in 19 equal splits at five days interval resulted in higher kapas yield as compared to soil application of 25% N and 75% P and K as basal and remaining 75% N in three equal splits at 50, 80 and 110 DAS. Chellaiah and Gopaiaswamy (2000) observed that foliar spray of DAP 2% + KCl 1% solution on 60 and 75 DAS produced the

Table 2. Seed cotton yield as influenced by split application of NPK nutrients under irrigated conditions (Pooled data of two years 1999-2000 and 2000-01) Kapas yield (kg ha^{-1})

Time of application of nutrients	Major nutrients			
	N split PK basal	N and P split, K basal	N, P & K split	Mean
(a) 50% each at basal & 60 DAS	1206	1309	1167	1227
(b) 50% at basal, 25% each at 30 & 60 DAS	1068	1034	1331	1144
(c) 25% at basal, 50% at 30 DAS, & 50% at 60 DAS	1230	1407	1359	1332
(d) 0% at basal, 50% at 30 DAS, 25% each at 60 DAS & 75 DAS	1185	1407	1335	1309
Mean	1172	1289	1298	1253
For comparing means of	*SEM +/-*	*CD at 5%*	*CV %*	
Major nutrients	22.0	73.0	8.7	
Time of application	26.0	76.0	8.9	
Major nutrients x Time of application	45.0	151		

Table 3. Economics as influenced by split application of NPK nutrients under irrigated condition

Treatments	Gross returns (Rs.)	Net returns (Rs.)	B:C ratio
Nutrients			
N split, PK basal	23,440	3,440	1.17
N and P split, K basal	25,780	5,780	1.29
NPK split	25,960	5,960	1.30
Time of application			
(a) 50% each at basal & 60 DAS	24,540	4,540	1.23
(b) 50% at basal, 25% each at 30 & 60 DAS	22,880	2,580	1.13
(c) 25% at basal, 50% at 30 DAS, & 50% at 60 DAS	26,640	6,340	1.31
(d) 0% at basal, 50% at 30 DAS, 25% each at 60 DAS & 75 DAS	26,180	5,730	1.28

highest seed cotton yield and this might be due to better absorption and utilization of foliar applied nutrients at critical stages of cotton growth. During 1999-2000, the seed cotton was not significantly influenced due to time of application but, application of nutrient, 25% at basal, 50% at 30 DAS and 50% at 60 DAS produced maximum seed cotton yield (1158 kg ha^{-1}) as compared to rest of the time of application. Whereas in 2000-01, seed cotton yield was significantly different due to time of application. Application of nutrients, 0% at basal 50% at 30 DAS, 25% each at 60 and 75 DAS registered significantly more seed cotton yield (1556 kg ha^{-1}) as against to 50% each at basal and 60 DAS and it was at par

with 25% at basal, 50% at 30 DAS and 50% at 60 DAS (1506 kg ha^{-1}).

Interaction effect of NPK and time of application

The interaction effects between split application of NPK and time of application (Table 2) clearly indicated more beneficial effect on seed cotton yield under irrigated condition. The experimental results showed that split application of N and P nutrients in three splits i.e., 25% at basal, 50% at 30 DAS and 25% at 60 DAS recorded the maximum seed cotton yield (1407 kg ha^{-1}) as compared to other treatment combinations.

Economics

The total receipts, net returns and B:C ratio were presented in Table 3. Higher total receipt of Rs. 25,960 and net returns of Rs. 5,960 ha^{-1} were recorded under splilt application of N, P and K nutrients as compared to split application of only N (Rs. 23,440), which was followed by split application of N and P (Rs. 25,780). Among the time of application, application of nutrients, 25% at basal, 50% at 30 DAS and 25% at 60 DAS produced maximum total receipts and net returns of Rs. 26,640 ha^{-1} and Rs. 6,340 ha^{-1} respectively and it was followed by application of nutrients, 0% at basal, 50% at 30 DAS and 25% each at 60 and 75 DAS.

The net return per rupee invested was recorded to be the higher under split application of either N and P (Rs. 1.29) or NPK (Rs. 1.30) as against only split application of N (Rs. 1.17). Among the time of application, application of nutrients 25% at basal, 50% at 30 DAS and 25% at 60 DAS recorded the highest benefit : cost ratio (1.31) which was closely followed by split application of nutrients, 0% at basal, 50% at 30 DAS, 25% at 60 DAS and 25% at 75 DAS (1.28). Chellaiah and Gopalaswamy (2000) reported foliar spray of DAP @ 2% + KCl 1% (1:1) solution o 60 and 75 DAS was found to be more economic under irrigated cotton. From the results, can be concluded that cotton also respond to split application of P and K along wit split application of N under irrigated condition

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