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Research Communication

Production potential and economics of cotton (*Gossypium hirsutum*) hybrids under different plant spacing and NPK levels

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ABSTRACT

A field experiment was conducted during the rainy (*kharif*) season of 2008–09 to evaluate the production potential and economics of cotton (*Gossypium hirsutum* L.) hybrids under different plant spacing and NPK levels. A closure spacing (60 cm × 60 cm) exhibited its superiority by recording higher sympodial branches/plant (16.4), lint yield (345 kg/ha) and seed-cotton yield (910 kg/ha), whereas bolls picked/plant (12.9) and seed-cotton yield/plant (38.2 g) were higher under wider spacing (90 cm × 60 cm). Among hybrids, 'MLCH 318' gave significantly higher number of sympodial branches/plant (15.8), bolls picked/plant (14.7), seed-cotton yield/plant (42.1 g), lint yield (407 kg/ha) and seed-cotton yield (1034 kg/ha) than 'PKV Hy2' and 'VBCH 2231'. The maximum values of yield attributes, viz. sympodial branches (16.1), bolls picked/plant (13.3) and seed-cotton yield/plant (39.7 g), which resulted significantly higher lint yield (393 kg/ha) and seed-cotton yield (972 kg/ha) under the highest fertility levels of 62.50, 31.25 and 31.25 kg N, P_2O_5 and K_2O/ha over rest of NPK levels. The higher gross returns and net returns associated significantly with 'MLCH 318' (₹28,238 and ₹14,322/ha) when sown at 60 cm × 60 cm plant spacing (₹24,679 and ₹10,618/ha) with the highest fertility levels of 62.50, 31.25 and 31.25 kg N, P_2O_5 and K_2O/ha (₹24,206 and ₹10,134/ha), respectively, and coincided with the highest benefit: cost ratio. Harvest index did not influence by the plant spacing, hybrids and NPK levels.

Key words : Crop production, Economics, Hybrids, NPK levels, Plant spacing, Yield, Yield attributes

The productivity of cotton depends on genetic potential of hybrids, soil fertility and agronomical practices. It is substantially required to fully exploit the production potential of a hybrids by standardizing some of the agronomic practices particularly an optimum plant spacing with efficient and balanced fertilization of NPK, which not only influence the growth and development, but also affect quality parameter of cotton, because of adequate crop geometry prevents inter-plant competition for resources (Nehra *et al*., 2004). The declines in seed-cotton yield among small-scale farmers is attributed to several production constraints that include poor plant stand, imbalance fertilizer application and low soil fertility. The situation is aggravated by haphazard cropping density and lack and/or inadequate replenishment of nitrogen, phosphorus and potassium. Seed-cotton yield and lint yield varied significantly due to different spacing and fertilizer management (Tomar *et al*., 2002).

Imbalance in fertilizer application and decreasing soil quality could be one of the reasons for yield decline. Usually a balanced optimum nutrient supply ensures optimum growth and ensures plant resistance which leads depletion of nutrients and minimizing long-term mining. An optimum plant density and fertilizer management is quite necessary to harvest good yield. Therefore, present field experiment was planned to study the production potential and economics of cotton hybrids under different plant spacing and NPK levels.

A field experiment was conducted at Cotton Research Unit, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during the rainy (*kharif*) season of 2008. The climatic condition of Akola is semi-arid and located at 22° 42'N and 77° 02'E. The rainfall was very scanty and erratic throughout crop season, particularly from boll formation to first boll opening. The total rainfall received during the crop season was 429.1 mm. The soil was medium black having clayey textural class and was low in organic carbon (0.39%) and available N (193.6 kg/ha), medium in P_2O_5 (14.2 kg/ha), but high in K_2O (492.0 kg/ha). The pH and

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electrical conductivity (ds/m) of the soil was 7.97 and 0.362 respectively.

Eighteen treatment combinations, comprising 2 plant spacing (S_1, 90 cm × 60 cm and S_2, 60 cm × 60 cm) and 3 cotton hybrids (V_1, 'MLCH 318'; V_2, 'VBCH 2231'and V_3,'PKV Hy-2') in main-plots and 3 fertility levels of NPK (F_1, 37.50, 18.75 and 18.75; F_2, 50–25–25 and F_3, 62.50, 31.25 and 31.25 kg N, P_2O_5 and K_2O/ha) in sub-plots were imposed in 3 times replicated splitplot design. Full dose of P_2O_5 and K_2O and half dose of N were applied basal to the cotton at the time of sowing as per treatments and remaining N was applied at square stage 30 (DAE) around the plant. The sowing was done on 22 July as per spacing of the treatments through dibbling with required seed rate of 4.5 kg/ha (hybrid) and plant population was maintained by gap filling and subsequent thinning keeping single plant/hill. Two hoeing and two hand weeding were done to keep crop–weed free and conserve soil moisture. Monocrotophos and Endosulphan (35 EC) plus Copper sulphate were sprayed twice to protect crop from sucking pest. Observations were recorded as per the established norms. Lint yield (kg/ha) was calculated by ginning percentage multiply with seed-cotton yield (kg/ha) and divided by 100. All the data were statistically analyzed to draw a valid conclusion. The correlation and regression studies were done to established cause and effect relationship among yield attributes.

The plants under closer spacing of 60 cm × 60 cm (S_2) produced significantly more sympodial branches/plant, lint yield and seed-cotton yield, 15.89%, 12.75% and 15.16% higher over wider plant spacing (90 cm × 60 cm) respectively (Table 1). This might be due to less availability of horizontal space and hence plant grows taller in respect of vertical space and produces more sympodial branches/plant (Srinivasan, 2006). However, wider spacing (90 cm × 60 cm) produced approximately 9.79% and 12.92% higher bolls picked/plant and seed-cotton/plant respectively. Marked improvement in yield-attributing character was brought owing to the availability of photosynthates to individual plant under wider spacing results in formation of more fibres, which ultimately increased seed cotton/plant (Nehra *et al*., 2004).

Variation in yield-attributing characters could be ascribed on account of their genetic capabilities to exploit available resources for their growth and development. Significant increase in sympodial branches/plant and bolls picked/plant was recorded by 'MLCH 318' over 'VLCH 2231', it was at par with 'PKV Hy 2'. 'MLCH 318' hybrid gave the highest seed cotton/plant, lint yield (407 kg/ha) and seed-cotton yield, which was 33.58% and 11.50%, 42.26% and 19.16%, 39.26% and 16.73% higher over 'VLCH 2231' and 'PKV Hy 2' respectively. The variations in increase in yield might be due to variation in number of fruiting body (sympodia), cotton bolls and seed-cotton weight/plant. Drought condition was prevailed up to 60 DAE that affected growth and development of fruiting bodies, which was the main cause of low cotton yield during experimental year. However, small amount of rainfall

Table 1. Average values of yield attributes, yield and economics of *hirsutum* hybrids of cotton as influenced by spacing, hybrids and NPK levels

Treatment	Sympodial branches/ plant	Bolls picked/ Plant	Seed-cotton yield (g/plant)	Lint yield (kg/ha)	Seed-cotton yield (kg/ha)	Harvest index (%)	Gross return (× 10^3 ₹/ha)	Net return (× 10^3 ₹/ha)	Benefit : cost ratio
Plant spacing(cm× cm)									
90 × 60	13.7	12.9	38.2	301	772	50.2	20.6	7.3	1.54
60 × 60	16.3	11.7	33.2	345	910	46.2	24.6	10.6	1.74
SEm±	0.30	0.36	0.91	11	27	2.11	0.6	0.6	0.08
CD (P=0.05)	0.95	1.15	2.88	34	84	NS	2.1	2.0	0.17
Hybrids									
'MLCH 318'	15.7	14.7	42.0	407	1034	50.7	28.2	14.3	1.82
'VBCH 2231'	14.0	8.4	27.9	235	628	46.5	16.1	2.6	1.34
'PKV Hy2'	15.3	13.8	37.2	329	861	47.4	22.5	9.9	1.72
SEm±	0.37	0.45	1.12	13	33	2.59	0.8	0.8	0.09
CD (P=0.05)	1.17	1.41	3.53	41	102	NS	2.6	2.5	0.21
NPK level (kg N-P_2O_5-K_2O/ha)									
37.5, 18.7 and 18.7	14.1	11.5	31.5	247	736	46.4	21.1	7.7	1.57
50, 25 and 25	14.8	12.1	36.0	330	815	48.6	22.6	9.0	1.62
62.5, 31.2 and 31.2	16.1	13.3	39.7	393	972	49.6	24.2	10.1	1.76
SEm±	0.41	0.09	0.54	15	32	2.47	0.3	0.2	0.06
CD (P=0.05)	1.20	0.28	1.58	45	92	NS	0.9	0.7	0.14

Table 2. Interaction effect between plant spacing × hybrids on lint and seed-cotton yield of cotton (kg/ha)

S × V	Lint yield (kg/ha)		
	'MLCH 318'	'VBCH 2231'	'PKV Hy2'
90 cm × 60 cm	345	181	377
60 cm × 60 cm	469	288	280
SEm ±	19		
CD (P=0.05)	59		
	Seed cotton yield (kg/ha)		
90 cm × 60 cm	900	643	772
60 cm × 60 cm	1,168	612	948
SEm ±	47		
CD (P=0.05)	145		

received during last week of October, which acted as life saver for plant and enhance the growth and development of fruiting bodies of cotton.

Fruiting bodies, lint and seed-cotton yield increased significantly with successive increase in levels of NPK up to 62.50, 31.25 and 31.25 kg N, P_2O_5 and K_2O/ha (Table 1). Sympodial branches/plant, bolls picked/plant, seed-cotton yield/plant, lint yield and seed-cotton yield were significantly highest with application of 62.50, 31.25 and 31.25 kg N, P_2O_5 and K_2O/ha (F_3) over rest of the NPK levels. Lint and seed-cotton yields recorded under the highest NPK level (F_3) were 37.15% and 24.27% higher over lowest NPK level (F_1); however, there were 16.03% and 16.15% higher over F_2 respectively. This might be owing to macronutrient particularly phosphorus and potassium that increased the efficiency of plant at reproductive stage and involved in the translocation of photosynthates towards boll formation site (Moola and Giri, 2006; Solanke *et al*., 2001). Neither the plant spacing nor the fertilizer level influenced the harvest index of hybrids significantly.

The lint and seed-cotton yields were affected significantly by the interaction effect of hybrids and plant spacing (Table 2). The results revealed that higher lint yield and seed-cotton yield were given by 'MLCH 318', when sown at closure plant spacing (60 cm × 60 cm). 'MLCH 318' could give significantly lint and seed-cotton yield 38.59% and 47.60% higher then 'VBCH 2231', while 40.29% and 18.83% higher over 'PKV Hy 2'. Although closer plant spacing recorded 12.75% and 15.16% higher lint and seed-cotton yield over wider plant spacing respectively (Anand, 2006).

Gross returns, net returns and benefit: cost ratio were significantly higher under closer plant spacing of 60 cm × 60 cm than that of wider spacing (Table 1). Our results confirm the findings of Reddy and Gopinath (2008). Among hybrids, significantly the highest gross returns, net returns and benefit: cost ratio were obtained in 'MLCH 318'.

Among NPK levels, higher gross returns and net returns were the highest with 62.50, 31.25 and 31.25 kg N, P_2O_5 and K_2O/ha being 12.80% and 6.32% higher in gross returns, 23.47% and 11.14% higher in net returns over 37.50, 18.75 and 18.75 kg/ha (F_1) and 50, 25 and 25 kg N, P_2O_5 and K_2O/ha (F_2) respectively (Table 1). Similar trend was observed with respect to benefit: cost ratio. The results confirms the findings of Reddy and Gopinath (2008).

Association among traits measured by correlation coefficient revealed a significant and positive correlation (Table 3). Sympodial branches/plant, boll picked/plant and seed-cotton yield/plant were significantly and positively correlated with lint yield and seed-cotton yield. Gross returns and net returns also showed significant and positive correlation with all yield and yield-attributing traits, viz. sympodial branches/plant, bolls picked/plant, seed-cotton yield/plant lint yield and seed-cotton yield respectively. However, boll picked/plant and seed-cotton/plant was positively correlated, but did not show significant correlation. Further, correlation and regression analysis accomplished with regression equation, which showed that yield

Table 3. Correlation coefficient among yield attributes, yield and economics of cotton

	Sympodial branches/ plant	Bolls picked/ plant	Seed-cotton yield (g/plant)	Lint yield (kg/ha)	Seed-cotton yield (kg/ha)	Gross returns (×10³ ₹/ha)	Net returns (×10³ ₹/ha)	Benefit: cost ratio
Sympodial branches/plant	1.000**							
Bolls picked/plant	0.469	1.000**						
Seed cotton yield (g/plant)	0.445	0.946**	1.000**					
Lint yield (kg/ha)	0.812**	0.799**	0.865**	1.000**				
Seed cotton yield (kg/ha)	0.844**	0.828**	0.830**	0.971**	1.000**			
Gross returns (× 10³ ₹/ha)	0.768**	0.824**	0.780**	0.896**	0.959**	1.000**		
Net returns (× 10³ ₹/ha)	0.734*	0.871**	0.800**	0.876**	0.946**	0.991**	1.000**	
Benefit: cost ratio	0.808**	0.852**	0.757*	0.874**	0.939**	0.963**	0.977**	1.000**

*P, 0.05; **P, 0.01

Table 4. Correlation coefficient (r) and regression equations (R^2) showing relationship between independent variables and dependent variables (** shows that correlation coefficient is significant at 0.01 level of significance).

Dependent variable	Independent variable	r	R^2	Response equation
Seed-cotton yield (kg/ha)	Sympodial branch/plant	0.844**	0.712	Y= 0.006x+9.689
	Boll picked/plant	0.828**	0.685	Y= 0.012x+2.249
	Seed cotton weight (g/plant)	0.830**	0.688	Y= 0.029x+11.29
	Gross return (× 10^3 ₹/ha)	0.959**	0.919	Y= 0.025x+1.072
	Benefit: cost ratio	0.939**	0.926	Y= 0.001x+0.685
Sympodial branchs/plant	Seed-cotton weight (g/plant)	0.445	0.198	Y= 2.061x+4.695
Lint yield (kg/ha)	Seed-cotton yield (kg/ha)	0.971**	0.942	Y= 2.076x+169.5
Lint yield (kg/ha)	Seed-cotton weight (g/plant)	0.865**	0.679	Y= 1.514x+3.852
Boll picked/plant	Gross returns (× 10^3 ₹/ha)	0.824**	0.747	Y=0.064x+14.78

attributes, yield and economics was positively correlated with each other (Table 4).

The gross returns and seed-cotton yield were positively correlated with correlation co-efficient of 0.919. This was further supported by the regression analysis. Thus, unit increase in seed-cotton yield caused increase in gross returns by 0.025 (× 10^3 ₹/ha) (Table 4). Each unit increase in seed cotton results in an increment in gross monetary return was also reported by Katkar *et al*. (2000).

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