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Influence of different sowing and fertilizer application methods on yield, quality and nutrient uptake in cotton

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Abstract : The present investigation was conducted at Cotton Research Area of CCS Haryana Agricultural University, Hisar, during *kharif* 2020 to study the performance of cotton under different sowing and fertilizer application methods. The experiment was laid out in split plot design with three sowing methods in main plot: M_1 (Conventional method), M_2 (Bed planting), M_3 (Furrow planting) and six methods of fertilizer application in sub plot: F_1 (Control), F_2 (100% RDF through broadcasting), F_3 (75% RDF through band placement), F_4 (75% RDF through spot placement), F_5 (75% RDF through band placement + 2% Foliar spray of RDF), F_6 (75% RDF through spot placement + 2% Foliar spray of RDF) and replicated thrice. Bolls/plant (49 and 48), seed cotton yield (3051 and 3086 kg/ha) and nutrient uptake was recorded significantly higher in M_2 (Bed planting) and M_3 (Furrow planting) methods of sowing as compared to M_1 (Conventional method). However, various quality parameters of cotton did not differ significantly among different sowing methods. Maximum gross returns (Rs. 170168/ha), net returns (Rs. 55894/ha) and benefit cost ratio (1.46) were recorded with M_2 (Bed planting) method of sowing followed by M_3 (Furrow planting) and M_1 (Conventional method), respectively. Among different methods of fertilizer application, F_5 (75% RDF through band placement + 2% Foliar spray of RDF) and F_6 (75% RDF through spot placement + 2% Foliar spray of RDF) methods recorded significantly higher number of bolls plant^{-1}, seed cotton yield and nutrient uptake as compared to rest of the treatments and were statistically at par with each other. But, quality parameters did not differ significantly among different methods of fertilizer application. Maximum gross returns (Rs. 193331/ha), net returns (Rs. 70860/ha) and benefit cost ratio (1.58) were recorded under F_6 (75% RDF through spot placement + 2% Foliar spray of RDF) among the various methods of fertilizer application.

Key words: Cotton, foliar spray, methods of fertilizer application, sowing methods

Cotton (*Gossypium* spp) is the most important commercial fiber crop of India and popularly known as "White Gold". It is mainly grown in semi-arid regions of the country. Cotton belongs to the family malvaceae, order Malvales and genus *Gossypium*. India is the world's largest cotton grower in terms of total acreage. Cotton is cultivated on 13.47 million hectares in India, producing 36.06 million bales of seed cotton with an average productivity of 455 kg lint/ha (Indiastat, 2019). Cotton is a major cash crop in Haryana and it contributes significantly to the state's economy by employment generation and export earnings. Cotton is primarily grown in Sirsa, Fatehabad, Hisar, Bhiwani, Rohtak, Jind and Dadri districts of Haryana. The area, production and productivity of cotton in Haryana is 7.37 lakh hectares, 25 lakh bales and 576.66 kg/ha, respectively (Indiastat, 2020). *Gossypium hirusutum* is the most dominant species in Haryana, accounting for roughly 90 per cent of the total cotton area.

Cotton productivity is low in Haryana as compared to the global average productivity (2137.4 kg/ha) (Faostat, 2019). The leading causes of low cotton productivity are the non-availability of canal water on time, which causes a delay in field preparation, resulting in poor germination and plant stand. High cropping intensity is also a major bottleneck in cotton production which results in heavy nutrient

extraction from the soil and the development of secondary and micronutrient deficiencies. Seed cotton yield is also adversely affected by the unpredictable climatic conditions such as prolonged dry spells or heavy rainfall, insect-pest problems and lack of the innovative production technologies. Cotton productivity is affected by numerous factors such as: sowing method, sowing time, plant density, genotype response to fertilizer application, plant protection etc. The method of sowing and fertilizer application are two of the most important aspects in cotton production. Fertilizer supplied during the growing season has a direct impact on growth, yield, and quality of cotton. The uptake of nutrients is increased when nutrients are applied near the plant roots in the soil. Weed populations are also decreased since they can't use fertilizers. Foliar feeding of fertilizers to cotton crops is another novel way of nutrient delivery. In comparison to soil treatment, foliar application of fertilizers to plants gives instant advantages and preserves nutrient elements. Establishing an appropriate plant population is crucial for efficient consumption of natural resource to increasing productivity. The planting method of cotton has a very significant effect on its production since it affects the germination percentage and crop establishment. The appropriate sowing methods enhance the seed yield. The bed and furrow planting method proliferates the water use efficiency and boosts the crop stand, leading to an increase in the seed cotton yield.

The experiment was carried out during *kharif*, 2020 at Cotton Research Area of CCS Haryana Agricultural University, Hisar (Haryana) which is located in the sub tropical zone of north western India at longitude 75°46' E, latitude 29°10' N and altitude of 215.2 m above mean sea level. The soil of experimental area was sandy loam in texture with 72.9 per cent sand, 14.7 per cent silt and 12.4 per cent clay with pH 7.8. The soil was low in organic carbon (0.35), low in available nitrogen (124 kg/ha), medium in phosphorus (13 kg/ha), available potassium (270 kg/ha) and zinc (1.8 mg/kg). The experiment consisted of three sowing methods in main plots: M_1 (Conventional method), M_2 (Bed planting), M_3 (Furrow planting) and six methods of fertilizer application in sub plots: F_1 (Control), F_2 (100% RDF through broadcasting), F_3 (75% RDF through band placement), F_4 (75% RDF through spot placement), F_5 (75% RDF through band placement + 2% Foliar spray of RDF), F_6 (75% RDF through spot placement + 2% Foliar spray of RDF).

All intercultural operations of experimental crop were carried out in accordance with the package of practices of cotton crop as recommended by the CCS Haryana Agricultural University. To ensure good amount of moisture, a pre sowing irrigation was applied to the field prior to sowing of the seed. The tractor drawn disc harrow performed the primary harrowing tillage operation, which was followed by a cultivator and planker to prepare a fine seed bed. Beds and furrows were also carved out in the plots specified in the layout design. On April 25th, seeds of *Bt* cotton genotype RCH 776 were sown manually by dibbling on flat land (conventional method), on beds (bed planting) and in furrows (furrow planting), with 2-3 seeds/hill at a depth of 3-5 cm. The row to row distance was kept 67.5 cm and plant to plant distance was maintained at 60 cm after thinning. At the time of seed bed preparation, full dose of P, K, Zn and 1/3rd of N were applied through broadcasting method and remaining dose of N was applied in two equal splits at square formation and flowering stage as per the treatments mentioned. Recommended dose of fertilizer for *Bt.* cotton hybrid in Haryana is 175 kg N, 60 kg P_2O_5, 60 kg K_2O and 25 kg $ZnSO_4$/ha. 2 per cent foliar spray of recommended dose of fertilizer was applied at boll formation stage. Two spray of (1%) KNO_3 at flowering and boll development stage were also applied. Pre-emergence application of herbicide (pendimethalin

@ 5kg/ha) and three hoeings were done to keep the field free from weeds.

Observations recorded were as per the standard procedures. The total number of bolls per plant collected was determined by adding the mean number of good and bad opened bolls harvested per plant from five randomly tagged plants in each plot. Seed cotton yield per plot was measured by summing up the total seed cotton harvested from two pickings and then it was converted to kg/ha.

100 g sample of seed cotton was taken from each plot and then ginned to extract the lint and cotton seed. It was calculated by using formula given below:

$$GOT(\%) = \frac{\text{Weight of lint}}{\text{Weight of seed cotton}} \times 100$$

A lint sample of 100 g weight was collected and its micronaire value was measured by Precitronic Digital Mic Tester at CICR, Sirsa. A sample of lint having 100 g weight was drawn to measure span length by Statex Electrospan, which automatically measures span length from sample blowroom, cards, drawframes and combers. The total nutrient uptake at harvest was computed as follows:

$$\text{Nutrient uptake by seed} = \frac{\text{Nutrient content in seed} \times \text{Seed cotton yield (kg/ha)}}{100}$$

The expenditure of individual treatment was calculated using a comprehensive assessment of the fixed and variable costs involved inland preparation, seed, plant protection, fertilizers, herbicide and labour engaged in different operations. Gross income of all the treatments was measured separately by keeping in mind seed and stalk yield of crop. After that, net returns were computed by subtracting expenditure incurred on the individual treatment from the gross income of the individual treatment. The benefit cost ratio was calculated as follows:

$$B:C = \frac{\text{Gross returns (Rs./ha)}}{\text{Cost of cultivation (Rs./ha)}}$$

Yield and quality parameters:

Data given in Table 1 revealed that the maximum bolls/plant (49) were recorded in M_3 (Furrow planting) method of sowing which were statistically *at par* with M_2 (Bed planting) and significantly higher than M_1 (Conventional method). Similar results were reported by Nasrullah *et al.*, (2011) and Dhillon *et al.* (2019). Similarly, different methods of fertilizer application had a significant effect on bolls/plant and maximum bolls/plant (54) were recorded in F_6 (75% RDF through spot placement + 2 per cent Foliar spray of RDF) which was statistically *at par* with F_5 (75% RDF through band placement + 2% Foliar spray of RDF) and was significantly higher than all other methods of fertilizer application. These results were in accordance with Aladakatti *et al.*, (2011) and Jamro *et al.*, (2016). The variation in the seed cotton yield was found to be significant under different sowing and fertilizer application methods. Maximum seed cotton yield ha^{-1} (3086 kg/ha) was obtained with M_2 (Bed planting) method of sowing which was statistically at par with M_3 (Furrow planting) (3051 kg/ha) and significantly higher than M_1 (Conventional method) (2768 kg/ha). Similar findings were also reported by Nasrullah *et al.*, (2011), Paslawar *et al.*, (2015), Dhillon *et al.*, (2019) and Meena *et al.*, (2019). Among different methods of fertilizer application, F_6 (75% RDF through spot placement + 2 per cent Foliar spray of RDF) registered highest seed cotton yield (3505 kg/ha) which was statistically *at par* with F_5 (75% RDF through band placement + 2 per cent Foliar spray of RDF) and significantly higher than rest of all methods of fertilizer application. Similar findings were unveiled by Shah *et al.*, (2002), Aladakatti *et al.*, (2011) and Jamro *et al.*, (2016).

The assessment of data displayed in Table 1 disclosed that different sowing methods had no considerable effect on ginning out turn,

Table 1: Physico-chemical properties of soil of experimental field

Component	Values	Method of determination
Sand	72.9%	International pipette method (Piper, 1996)
Silt	14.7%	
Clay	12.4%	
pH	7.8	Glass electrode pH metre (Jackson, 1973)
Organic carbon (%)	0.35%	Walkley and Black wet oxidation method (Jackson, 1973)
Available N (kg/ha)	124 kg/ha	Alkaline permanganate method (Subbiah and Asija, 1956)
Available P (kg P2O5/ha)	13 kg/ha	Olsen's method (Olsen *et al.*, 1954)
Available K (kg K2O/ha)	270 kg/ha	Flame photometric method (Richards, 1954)

Table 2: Effect of different sowing and fertilizer application methods on various yield and quality paramenters of cotton

Treatments	Bolls/ plant	Seed cotton yield (kg/ha)	GOT (%)	Span length (mm)	Micronaire value(µg/inch)
Methods of sowing					
M_1 - Conventional method	44	2768	36.39	26.88	4.72
M_2 - Bed planting	48	3086	36.81	26.88	4.66
M_3 - Furrow planting	49	3051	36.73	26.85	4.67
SE (m) ±	0.58	55.54	0.18	0.20	0.04
CD (p = 0.05)	2.34	223.92	NS	NS	NS
Methods of fertilizer application					
F_1 - Control	32	1359	35.84	26.33	4.76
F_2 - (100%) RDF (Broadcasting)	47	3181	36.65	26.80	4.69
F_3 - (75%) RDF (Band placement)	48	3174	36.61	26.79	4.69
F_4 - (75%) RDF (Spot placement)	47	3164	36.50	26.78	4.71
F_5 - (75%) RDF (Band placement) + **2%** Foliar spray of RDF	53	3425	36.95	27.03	4.66
F_6 - (75%) RDF (Spot placement) + (2%) Foliar spray of RDF	54	3505	37.33	27.09	4.62
SE (m) ±	1.12	82.88	0.37	0.26	0.04
CD (p = 0.05)	3.27	240.55	NS	NS	NS

span length and micronaire value of cotton. Previous research findings of Khan *et al.*, (2021) also demonstrated that various quality parametrs of cotton remained unaffected by different sowing methods. However, the highest ginning out turn (36.81%) and the longest span length (26.88 mm) was recorded in M_2 (Bed planting) method of sowing followed by M_3 (Furrow planting) and M_1 (Conventional method).

Different fertilizer application methods also failed to influence various quality parameters of cotton. Among various fertilizer application methods, highest ginning outturn (37.33%) and longest span length (27.09 mm) was recorded in F_6 (75% RDF through spot placement + 2 per cent Foliar spray of RDF). These results were in conformity with Aladakatti *et al.*, (2011), Das *et al.*, (2016) and Kumar *et al.*, (2017) where different doses, methods and sources of fertilizers failed to influence the fiber quality parameters of cotton. This could be mainly due to the fact that fiber quality traits are genetically inherited characters and these did not differ much with variations in external environment.

Nutrient uptake:

A careful interpretation of the data portrayed in Table 2 shows that maximum nutrient uptake in cotton seed i.e. N (77.24 kg/ha), P (11.58 kg/ha), K (55.33 kg/ha) and Zn (98.45 g/ha) was found in M_2 (Bed planting) method of sowing which was statistically *at par* with M_3 (Furrow planting) and significantly higher than M_1 (Conventional method). Meena *et al.*, (2019) also observed significantly higher uptake of N, P and K under raised bed sowing method in cotton.

Among different methods of fertilizer application, highest nutrient uptake *i.e.* N (92.73

Table 3: Effect of different sowing and fertilizer application methods on N, P, K and Zn uptake by cotton

Treatments	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	Zn uptake (g/ha)
Methods of sowing				
M_1 - Conventional method	62.34	8.87	45.92	75.58
M_2 - Bed planting	77.24	11.58	55.33	98.45
M_3 - Furrow planting	75.65	11.33	54.52	96.13
SE (m) ±	1.28	0.18	0.88	2.28
CD at 5% level of significance	5.14	0.74	3.55	9.20
Methods of fertilizer application				
F_1 - Control	20.79	3.07	20.10	19.82
F_2 - (100%) RDF (Broadcasting)	76.98	10.46	54.35	94.35
F_3 - (75%) RDF (Band placement)	76.46	10.53	54.04	90.20
F_4 - (75%) RDF (Spot placement)	76.16	10.84	53.80	88.63
F_5 - (75%) RDF (Band placement) + (2%) Foliar spray of RDF	87.33	13.88	63.40	120.30
F_6 - (75%) RDF (Spot placement) + (2%) Foliar spray of RDF	92.73	14.78	65.85	129.01
SE (m) ±	2.13	0.37	1.31	3.41
CD (p = 0.05)	6.17	1.07	3.79	9.90

Table 4: Effect of different sowing and fertilizer application methods on economics of cotton cultivation

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C
Methods of sowing				
M_1 - Conventional method	109680	152643	42963	1.36
M_2 - Bed planting	114274	170168	55894	1.46
M_3 - Furrow planting	113853	168299	54446	1.45
Methods of fertilizer application				
F_1 - Control	81516	74943	-6573	0.92
F_2 - (100%) RDF (Broadcasting)	117562	175438	57877	1.49
F_3 - (75%) RDF (Band placement)	116330	175071	58740	1.50
F_4 - (75%) RDF (Spot placement)	117448	174519	57071	1.49
F_5 - (75%) RDF (Band placement) + (2%) Foliar spray of RDF	120287	188919	68632	1.57
F_6 - (75%) RDF (Spot placement) + (2%) Foliar spray of RDF	122471	193331	70860	1.58

kg/ha), P (14.78 kg/ha), K (65.85 kg/ha and Zn (129.01 g/ha) was exhibited by F_6 (75% RDF through spot placement + 2 per cent Foliar spray of RDF) followed by F_5 (75% RDF through band placement + 2 per cent Foliar spray of RDF). Similar results were reported by Shah *et al.*, (2002) and Aladakatti *et al.*, (2011). The higher uptake could be related to better nutrient availability from the soil to the plant because fertilizer was placed close to the root zone area and foliar application of nutrients at boll formation stage delivered nutrients directly to the desired portion which reflected into quick results.

Economics:

Cost of cultivation, gross returns, net returns and benefit cost ratio differed due to different methods of sowing and fertilizer application. Highest value of all these were obtained in M_2 (Bed planting) method of sowing followed by M_3 (Furrow planting) and M_1 (Conventional method) respectively. Similar results were demonstrated by Nasrullah *et al.*, (2011), Paslawar *et al.*, (2015) and Meena *et al.*, (2019). Among different methods of fertilizer applcation, highest value of all these were obtained in F_6 (75% RDF through spot placement + 2 per cent Foliar spray of RDF) and lowest in F_1 (control). Aladakatti *et al.*, (2011) also illustrated the similar results.

CONCLUSION

Bed and furrow sowing methods resulted in

significantly higher seed cotton yield and nutrient uptake than conventional method of sowing. Application of 75 per cent of RDF through band and spot placement along with 2% Foliar spray of RDF at boll formation stage were the most effective fertilizer application methods that resulted into the highest seed cotton yield and nutrient uptake as compared to rest of the methods of fertilizer application.

REFERENCES

Aladakatti, Y. R., Hallikeri, S. S. and Nandagavi, R. A. 2011. Yield and fiber qualities of hybrid cotton (*Gossypium hirsutum*) as influenced by soil and foliar application of potassium. *Karnataka J. Agri. Sci.* **24:** 133-36.

Das, A., Prasad, M., Gautam, R. C. and Shivay, Y. S. 2006. Productivity of cotton (*Gossypium hirsutum*) as influenced by organic and inorganic sources of nitrogen. *Ind. J. Agri. Sci.*, **76:** 354-57.

Dhillon, B. S., Brar, J. S. and Singh, H. 2019. Influence of different planting methods on growth, productivity and root characteristics of *Bt.* cotton in south-west Punjab. *J. Pharma. Phytochem.* **8:** 1680-83.

Faostat 2019: http://www.fao.org/ faostat/en/# data/ QC.

Indiastat 2019: https://www.indiastat.com /table/agriculture/area-%C2%A0production%C2%A0and%C2%A0productivity %C2%A0of%C2%A0cotton%C2%A0in% C2%A0ind/17400.

Indiastat 2020: https://www.indiastat.com /table/agriculture/selected-state-wise-area-production-productivity-c/1409030.

Jamro, S. A., Shah, A. N., Ahmad, M. I., Jamro, G. M., Khan, A., Siddique, W. A., Sher, A. and Bugti, G. A. 2016. Growth and yield response of cotton varieties under different methods of fertilizer application. *J. Biodiv. Envi. Sci.* **9:** 198-206.

Khan, B., Ishfaq, M., Murtza, K., Batool, Z., Ali, N., Aslam, M. S., Khan, I. and Anjum, S. A. 2021. Effect of varying plant density on weed infestation, crop phenology, yield and fiber quality of cotton under different sowing methods. *Pure Appl. Bio.*, **10:** 676-91.

Kumar, R., Jakhar, D. S., Panghaal, D. and Devraj. 2017. Response of seed cotton yield to potassium fertilization under cotton-wheat cropping system. *Internat. J. Curr. Micro. Appl. Sci.* **6:**1252-1258.

Meena, M. K., Meena, R. N., Meena, B. R., Meena, A. K. and Singh, Y. V. 2019. Effect of land management options and manurial application on growth, yield and quality and nutrient uptake of American cotton (*Gossypium hirsutum* L.) cultivation. *J. Pharma. Phytochem.* **8:** 549-54.

Nasrullah, M., Khan, M. B., Ahmad, R., Ahmad, S., Hanif, M. and Nazeer, W. 2011. Sustainable cotton production and water economy through different planting methods and mulching techniques. *Pakistan J. Bot.* **43:** 1971-83.

Paslawar, A. N. and Deotalu, A. S. 2015. Impact of soil moisture conservation practices and nutrient management under high density planting system of cotton. The *Internati. J. Engine. Sci.* **4:** 34-36.

Shah, K. H., Memon, Y. M. and Siddiqui, S. 2002. Effect of Placement and broadcast application of N and P in cotton-mungbean intercropping system. *Asian J. Pl. Sci.* **1:** 34-36.

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