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Effect of high plant density and fertilizer levels on performance of *Hirsutum* cotton under rainfed condition

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Abstract
The field experiment was conducted at Agronomy Farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidypeeth, Akola during *Kharif* season 2014 to evaluate the Effect of high plant density and fertilizer levels on performance of *hirsutum* cotton under rainfed condition. The experiment was laid out in split plot design consisting three levels of plant densities *viz*., S_1- 1,66,666 plants ha^{-1} (60 x 10 cm^2), S_2- 1,11,111 plants ha^{-1} (60 x 15 cm^2) and S_3- 55,555 plants ha^{-1} (60 x 30 cm^2) in main plots and three fertilizer doses *i.e.* F_1- 100% RDF (50:25:25 N:P_2O_5:K_2O kg ha^{-1}), F_2- 150% RDF (75:37.5:37.5 N:P_2O_5:K_2O kg ha^{-1}) and F_3- 200% RDF (100:50:50 N:P_2O_5:K_2O kg ha^{-1}) in sub plots. The results revealed that the plant density of 1,66,666 plants ha^{-1} produced significantly superior seed cotton yield (kg ha^{-1}) over plant density of 55,555 plants ha^{-1} (kg ha^{-1}) and it was at par with plant density of 1,11,111 plants ha^{-1}. Among the fertilizer levels application of 200% N:P_2O_5:K_2O kg ha^{-1} produced higher seed cotton yield over 100% N:P_2O_5:K_2O kg ha^{-1} but at par with application of 150% N:P_2O_5:K_2O kg ha^{-1}. In case of yield contributing character viz., number of harvested bolls plant^{-1}, seed cotton weight per plant (g), 50 % Flowering were recorded significantly superior by plant density of 55,555 plants ha^{-1} over the higher plant density of 1,66,666 plants ha^{-1}. The application of 200% RDF produced the maximum number of harvested bolls per plant, weight of seed cotton per plant and 50 % flowering than 150% RDF and 100% RDF.

Keywords: *Hirsutum* cotton, plant density, fertilizer levels, yield

Introduction
In Indian agriculture, Cotton (*Gossypium hirsutum* L.) possesses a position of major fiber and cash crop, which plays vital role to sustain national economy. It is an important cash crop of Vidarbha region mostly under rainfed situations. In Vidarbha it is grown on area of about 14.00 lakh hectares with productivity of 305 kg lint ha^{-1}, which is too low than other cotton growing states. There is need to increase the production of cotton for improving financial status of farmers and strengthen national economy by increasing the productivity of cotton not only by increasing the area under production but also plant population per hectare. Plant may show better growth and development and give higher yield per plant but may not give maximum yield per unit area because of inadequate plant population. The adoption of HDPS, along with good fertilizer management and better genotypes, ideal viable approach to break the current trend of stagnating yields under primarily rainfed *hirsutum* cotton growing areas. Hence the present investigation was undertaken.

Methodology
An experiment was conducted at Agronomy farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif* 2014. The experiment was conducted in split plot design having nine treatment combinations with four replications. The experiment site uniform in topography with clayey in texture slightly alkaline in reaction. The cotton variety AKH-081 was sown on July 11, 2014. Full dose of phosphorus and potassium were applied as basal dose through Di-ammonium phosphate and muriate of potash. Nitrogen was applied through urea in two equal splits i.e. 50% at the time of sowing and second half at 30 DAS. All other agronomic practices were followed as per recommendations.

Results and Discussion
Effect of plant density
A perusal of data on (Table 1) revealed that the yield attributing character like Number of harvested boll plant^{-1} and seed cotton yield plant^{-1} were found significantly higher with the plant density of 55,555 plants ha^{-1} (60 x 30 cm^2) over 1,11,111 plants ha^{-1} (60 x 15 cm^2) and

1,66,666 plants ha^{-1} (60 x 10 cm^2). This might be due to availability of more photosynthates to individual plant in lower plant density that led to overall improvement in growth attributes and its positive effect on number of harvested bolls plant^{-1} was more to produce maximum seed cotton weight plant^{-1} as compared to higher plant density. The above results are in conformity with the findings of Ram and Giri (2006) [3] and Chavan *et al*., (2011) [2]. As regard of seed cotton yield increase the plant density of 1,66,666 plants ha^{-1} produced significantly higher seed cotton yield (kg ha^{-1}) over plant density of 55,555 plants ha^{-1} (kg ha^{-1}) and it was at par with plant density of 1,11,111 plants ha^{-1}. The higher plant density of 1,66,666 plants ha^{-1} recorded lower value of yield parameters and also observed a decreased in number bolls plant^{-1} but an increase seed cotton yield in elevated population per unit area. These results are in conformity with the findings Basavanneppa *et al*., (2012) [1].

The significant differences were found in 50% flowering was delayed significantly under wider plant population of (55,555 plant ha^{-1}) as compared to (1,66,666 plant ha^{-1}). due to lower plant population per unit area.

Effect of fertilizer dose

The data in Table 1 showed that the application of different doses of fertilizer found significant impact on seed cotton yield kg ha^{-1}, number of harvested boll plant^{-1} and seed cotton yield plant^{-1} with Application of 100:50:50 kg N:P_2O_5:K_2O ha^{-1} (i.e., 200% RDF) recorded higher number of harvested boll plant^{-1} and seed cotton weight plant^{-1}, which was significantly superior over 50:25:25 kg N:P_2O_5:K_2O ha^{-1} (100% RDF) but found to be at par with 75:37.5:37.5 kg N:P_2O_5:K_2O ha^{-1} (150% RDF). Thus due to increasing level of fertilization, increased yield attributes and ultimately increased seed cotton weight plant^{-1}. Similar findings were reported by Shah *et al* (2012) [4].

Application of 200 % RDF kg N:P_2O_5:K_2O ha^{-1} required more days to 50% flowering than the fertilizer application of 100 % RDF and at par with 150% RDF kg N:P_2O_5:K_2O ha^{-1}.

Table 1: Seed cotton yield (kg ha^{-1}), Number of bolls harvested plant^{-1} and Seed cotton weight plant^{-1}(g), 50 % Flowering as influenced by different treatments.

Treatment	Seed cotton yield (kg ha^{-1})	Number of harvested bolls plant^{-1}	Seed cotton weight per plant (g)	50 % Flowering
Main plot treatment				
A) Plant density (spacing)				
S_1- 60 x 10 cm^2 (1,66,666 plant ha^{-1})	1807	5.61	12.14	57.83
S_2- 60 x 15 cm^2 (1,11,111 plant ha^{-1})	1764	7.02	17.00	58.91
S_3- 60 x 30 cm^2 (55,555 plant ha^{-1})	1355	9.58	26.44	60.16
SE(m)±	34.37	0.11	0.48	0.31
CD at 5%	118.96	0.38	1.67	1.10
Sub plot treatment				
B) Fertilizer level N:P_2O_5:K_2O kg ha^{-1}				
F_1 –100 % RDF (50:25:25 N:P_2O_5:K_2O kg ha^{-1})	1445	7.03	16.26	57.91
F_2 –150 % RDF (75:37.5:37.5 N:P_2O_5:K_2O kg ha^{-1})	1718	7.61	19.23	59.25
F_3 –200 % RDF (100:50:50 N:P_2O_5:K_2O kg ha^{-1})	1764	7.62	20.07	59.75
SE(m)±	18.52	0.12	0.39	0.24
CD at 5%	55.04	0.36	1.18	0.72
Interaction				
S x F				
SE(m)±	32.08	0.21	0.69	0.42
CD at 5%	95.33	NS	NS	NS
GM	1642.1	7.42	18.52	58.97

Conclusion

On the basis of one year data, it can be concluded that the higher plant density of 1,11,111 plants ha^{-1} with higher fertilizer dose of 75:37.5:37.5 N:P_2O_5:K_2O kg ha^{-1} (150% RDF) for obtaining higher seed cotton yield and found productive and profitable of *hirsutum* cotton under rainfed condition of Vidarbha region.

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