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EFFECT OF PLANTING DENSITY AND NUTRIENT MANAGEMENT ON GROWTH AND YIELD OF COTTON

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ABSTRACT

An experiment was conducted at Experimental farm, Agronomy Section, College of Agriculture, Nagpur to study the effect of spacing and nutrient management on growth and yield of cotton during *kharif* season of 2016 – 2017. The experiment was laid out in split plot design with three replications. There were twelve treatments combinations comprising of four different spacings viz., S_1- 45 x 10 cm^2,S_2- 45 x 15 cm^2, S_3- 60x10 cm^2 and S_4- 60 x 15 cm^2 with three nutrient management treatments viz., N_1-100% RDF (50:25:25 kg NPK ha^{-1}), N_2-125%RDF(62.50:31.25:31.25 kg NPK ha^{-1}), N_3-150%RDF(75:37.5:37.5 kg NPK ha^{-1}). The different spacing were allotted to main plot and nutrient levels were accommodated in sub plots.

The spacing of 45 x 10 cm^2 recorded significantly higher plant height, seed cotton yield ha^{-1}, while plant spacing of 60 x 15 cm^2 recorded significantly higher number of sympodia plant^{-1}, leaf area plant^{-1} and dry matter plant^{-1}. The number of picked bolls plant^{-1} and seed cotton weight plant^{-1} were significantly higher in spacing of 60 x 15 cm^2. The seed cotton yield ha^{-1} was higher in plant spacing of 45 x 10 cm^2 due to more plant population unit area^{-1} than 45 x 15 cm^2,60 x 10 cm^2 and 60 x 15 cm^2. The Nutrient management treatment N_3-150% RDF(75:37.5:37.5 kg NPK ha^{-1}) recorded more number of picked bolls plant^{-1}, seed cotton yield plant^{-1} , boll weight (g) , seed cotton yield ha^{-1} (1432 kg), also gave higher gross monetary returns (71606), net monetary returns (48827) and B : C ratio (3.14).The treatment combination (S_1N_3) of spacing 45 x 10 cm^2 with nutrient management treatment of 150% RDF(75:37.5:37.5 NPK kg ha^{-1}) produced significantly highest seed cotton yield ha^{-1} (1860 kg).

(Keywords : Cotton,spacing,nutrient management)

INTRODUCTION

Cotton (*Gossypium hirsutum*) is one of the most important fibre crop as well as cash crop of India. It plays a dominant role in its agrarian and industrial economy by providing raw material to the textile industries hence cotton is called as King of fibres and is also called as White Gold because of its higher economical value among cultivable crops for quite a long period.

World Cotton Scenario - World cotton area and production in 2016 - 17 is estimated at 29.24 million hectares and 22.85 million tones respectively. India is the largest cotton growing country in the world with area under cotton around 37% and production around 26% followed by China. In 2016 - 17 India is having area of 105.00 million ha which is 5% less than previous year and production 351 million bales which is more than previous year (Anonymous, 2017).

In India, Maharashtra rank first in averages with 38.28 lakh ha with 71.25 lakh bales production and average productivity of 342 kg lint ha^{-1}, which is lowest as compared to national average of 503 kg lint ha^{-1}. In Maharashtra state, Vidarbha is the largest cotton growing region accounting for 15.23 lakh ha acreage with production of 25 lakh bales and productivity of 279 kg lint ha^{-1} (Anonymous, 2017).

Optimum plant spacing enables to improve the efficiency of individual plants as it is ultimately connected with root development as well as shoot growth. Plant may show better growth and development and give higher yield plant^{-1} but may not give maximum yield unit area^{-1} because of inadequate plant population. Based on the previous evidence, both closer and wider spacing are recommended for cotton with graded levels of NPK fertilizers (Rajendran *et al.,*2010).

Plant spacing is an important agro - technique in realizing optimum crop yield with optimum nutrient dose. Therefore, it is necessary to find out optimum plant density and nutrient management treatment of cotton.

MATERIALS AND METHODS

Afield experiment was conducted at experimental farm, Agronomy Section, Collegeof Agriculture, Nagpur

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during *kharif* season of 2016–2017.The experiment was laid out in split plot design with three replications. There were twelve treatment combinations comprising of four different spacings viz.,S_1 - 45 x 10 cm^2, S_2 - 45 x 15 cm^2, S_3 - 60 x10 cm^2 and S_4 - 60 x 15 cm^2 with three nutrient management treatments viz.,N_1-100% RDF (50:25:25 kg NPK ha^{-1}),N_2-125% RDF(62.50:31.25:31.25 kg NPK ha^{-1}), N_3-150% RDF(75:37.5:37.5 kg NPK ha^{-1}). The different spacings were allotted to main plot and nutrient levels were accommodated in sub plots. The soil of experimental plot was clayey in texture, low in available nitrogen (215.18 kg ha^{-1}) and medium in phosphorus (11.16 kg ha^{-1}) and very high in available potash (305.45 kg ha^{-1}). Organic carbon content was medium (0.54%) and soil reaction was slightly alkaline (7.7).

The crop variety AKH – 081 was used with gross plot size of 7.2 m x 5.1 m and net plot size of 5.4 m X 4.5 m. The quantity of fertilizers to be applied was calculated on gross plot basis. Full dose of nitrogen (N) , phosphorus (P_2O_5) and potash (K_2O) was given as per treatment combinations to all plots after one month of sowing. Appropriate and timely plant protection measures and intercultural operations were undertaken as per need. Observations on plant height, leaf area $plant^{-1}$, dry matter accumulation $plant^{-1}$ (g), number of sympodial and monopodial branches $plant^{-1}$ were recorded at harvest. Similarly observations on number of bolls $plant^{-1}$, seed cotton yield $plant^{-1}$, seed cotton yield ha^{-1},boll weight were recorded at each pickings.

RESULTS AND DISCUSSION

Effect on growth attributes

The data pertaining to various growth parameters viz., plant height, leaf area $plant^{-1}$, dry matter accumulation $plant^{-1}$ (g), sympodial and monopodial branches $plant^{-1}$ as influenced by different treatments are presented in table 1.

Effect of plant spacing

Data in table 1 reveled that plant height, leaf area $plant^{-1}$, dry matter accumulation $plant^{-1}$ (g), sympodial and monopodial branches $plant^{-1}$ significantly influenced due to plant spacing. Plant spacing of 45 x 10 cm^2 recorded higher plant height as compared to spacings of 45 x 15 cm^2, 60 x 10 cm^2 and 60 x 15 cm^2. This might be due to lesser availability of free space might have induced vertical growth in the plant resulting into increased plant height. Mane *et al.*(1999) revealed that the plant height was significantly higher at spacing of 60 cm x 45 cm (129.13 cm) which was at par with spacing of 90 cm x 45 cm (125.97 cm). Hensh *et al.* (2011) recorded highest plant height with the spacing of45 cm x 30 cm which was significantly higher than other plant spacings of 75 cm 30 cm and 60 cm 30 cm.

But leaf area $plant^{-1}$, dry matter accumulation $plant^{-1}$, sympodial and monopodial branches $plant^{-1}$ recorded higher at plant spacing of 60 x 15 cm^2 as compared to spacings of 45 x 10 cm^2, 45 x 15 cm^2 and 60 x 10 cm^2, it might be due to more availability of space, light, moisture and nutrients $plant^{-1}$ which is resulted maximum growth of photosynthetic structure. Bhalerao and Gaikwad (2008) reported that the highest value of growth in respect of dry matter accumulation were observed in wider spacing of 60 x 30 cm^2 as compared to closer spacing of 60 cm x 15 cm. Pradeepkumar *et al.* (2015) recorded that the sowing of cotton at 45 cm x 30 cm (74074 plants ha^{-1}) gave significantly higher monopodial and sympodial branches $plant^{-1}$,functional leaves, leaf area and dry matter accumulation $plant^{-1}$ as compared to 45 15 cm^2, 45 22.5 cm^2 and 60 10 cm^2 spacing.

Effect of nutrient management treatment

Data in table 1 reveled that plant height, leaf area $plant^{-1}$, dry matter accumulation $plant^{-1}$, sympodial and monopodial branches $plant^{-1}$ significantly influenced due to nutrient management treatments. Nutrient management with 150% RDF (75:37.5:37.5 NPK kg ha^{-1}) recorded significantly higher plant height, leaf area $plant^{-1}$, dry matter accumulation $plant^{-1}$, sympodial and monopodial branches $plant^{-1}$ which was significantly superior over rest of the nutrient management treatments of 100%RDF (50:25:25 NPK kg ha^{-1}) and 125% RDF (62.50:31.25:31.25 NPK kg ha^{-1}). Solanke *et al.(*2001) revealed that application of 75:37.5:37.5 NPK kg ha^{-1} recorded significantly higher plant height, sympodial branches and dry matter accumation over application of 50:25:25 NPK kg ha^{-1}. Giri *et al.*(2008) reported that application of highest level of NPK i.e. 100:50:50 NPK kg ha^{-1} produced more height and sympodial branches than lower levels 80:40:40 and 60:30:30 NPK kg ha^{-1}. Dahiphale *et al.*(2012) found that the application of nutrient level i.e. 120:60:60 kg NPK ha^{-1} was recorded superior for enhancing growth parameters viz., plant height, number of leaves, leaf area and dry matter as compared to other fertilizer levels of 80:40:40 kg NPK ha^{-1} and 100:50:50 kg NPK ha^{-1}

Effect on yield attributes

Number of bolls $plant^{-1}$ and boll weight

Effect of plant spacing

Data in table 1 reveled that wider plant spacing of 60 x 15 cm^2 produced higher total number of picked bolls $plant^{-1}$, boll weight and seed cotton yield $plant^{-1}$ as compared to spacings of 45 x 10 cm^2, 45 x 15 cm^2 and 60 x 10 cm^2. It might be due to more availability of space, light, moisture and nutrients $plant^{-1}$ which is resulted in maximum number of bolls $plant^{-1}$, boll weight and seed cotton yield $plant^{-1}$. Karle *et al.*(2015) reported that the sowing of cotton at spacing of 45cm x 30 cm recorded significantly higher number of squares, picked bolls $plant^{-1}$ as compared to spacings of 45 cm x 15 cm, 45 cm x 22.5 cm and 60 cm x 10 cm. Parlawar *et al.* (2017) observed that plant spacing of 60 x 15 cm^2 recorded significantly more number of harvested bolls $plant^{-1}$ than spacings of 45 x 10 cm^2 and 60 x 10 cm^2.

Table 1.Growth and yield contributing characters and yield influenced by spacing and nutrient management treatments

Treatments	Growth attributes					Yield attributes		Yield	
	Plant height at harvest (cm)	Leaf area plant^{-1}at harvest (dm^2)	Dry matter accumulation plant^{1}at harvest(g)	No. of monopodial branches plant^{-1} at harvest	No. of sympodial branches plant^{-1} at harvest	No.of picked bolls plant^{-1} at harvest	Bollweight at harvest (g)	Seed cotton yield plant^{-1} at harvest (g)	Seed cotton yield at harvest kg ha^{-1}
Spacing (S)									
S_1 - 45 x 10 cm ^{2}(2,22,222 plants ha^{-1}	**90.89**	**32.13**	**56.46**	**1.33**	**3.61**	**4.46**	**1.65**	**9.13**	**1432**
S_2– 45 x 15 cm^2 (1,48,148 plants ha^{-1})	**80.89**	**28.42**	**54.35**	**1.19**	**3.34**	**4.74**	**1.65**	**9.91**	**1343**
S_3– 60 x 10 cm^2 (1,66,666 plants ha^{-1})	**74.56**	**38.55**	**62.18**	**1.69**	**3.90**	**5.38**	**2.04**	**10.39**	**1241**
S_4– 60 x 15 cm^2 (1,11,111 plants ha^{-1}	**73.11**	**44.23**	**65.35**	**1.87**	**4.04**	**5.98**	**2.20**	**10.91**	**1008**
SE(m)±	**1.40**	**0.84**	**0.73**	**0.002**	**0.08**	**0.72**	**0.05**	**0.76**	**33.00**
CD at 5%	**4.17**	**2.50**	**2.17**	**0.005**	**0.23**	**-**	**0.14**	**-**	**98.34**
Nutrient management (N)									
N_1– 100% RDF (50:25:25 NPK kg ha^{-1})	**72.85**	**30.13**	**54.49**	**1.50**	**3.31**	**4.36**	**1.89**	**8.61**	**1060**
N_2– 125% RDF (62.5:31.25:31.25 NPK kgha^{-1})	**77.58**	**34.70**	**59.28**	**1.52**	**3.78**	**5.13**	**1.96**	**10.40**	**1184**
N_1– 150% RDF (75:37.5:37.5 NPK kg ha^{-1})	**89.17**	**42.66**	**64.97**	**1.54**	**4.08**	**5.93**	**2.00**	**11.25**	**1525**
SE(m)±	**1.54**	**0.36**	**0.63**	**0.001**	**0.07**	**0.11**	**0.06**	**0.02**	**28.00**
CD at 5%	**4.58**	**1.07**	**1.87**	**-**	**0.20**	**0.32**	**-**	**0.05**	**83.44**
Interaction (S x N)									
SE(m)±	**3.08**	**0.72**	**1.27**	**0.003**	**0.15**	**0.22**	**0.66**	**1.33**	**57**
CD at 5%	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**170**
GM	**79.86**	**35.83**	**59.58**	**1.52**	**3.73**	**5.16**	**1.95**	**10.08**	**1256**

Effect of nutrient management treatment

Number of picked bolls plant^{-1},boll weight and seed cotton yield plant^{-1}significantlyinfluenced due to nutrient management treatments. Nutrient management with 150% RDF (75:37.5:37.5 NPK kg ha^{-1}) recorded maximum number of picked bolls plant^{-1}, boll weight and seed cotton yield plant^{-1} which was significantly superiorover rest of the nutrient management treatments of 100%RDF (50:25:25 NPK kg ha^{-1}) and 125% RDF (62.50:31.25:31.25 NPK kg ha^{-1}). Mane *et al*.(1999) observed that the fertilizer dose of 100:50:50 kg of NPK ha^{-1} recorded significantly higher number of bolls plant^{-1}, boll weight and seed cotton yield (1619 kg ha^{-1}) over application of 60:30:30 kg NPK ha^{-1} (1251 kg ha^{-1}) and was at par with fertilizer dose of 80:40:40 kg NPK ha^{-1}(1428 kg ha^{-1}).

Effect on yield

Effect of plant spacing

Seed cotton yield ha^{-1} significantly influenced due to various plant spacings. Data in table 1 reveled that plant spacing of 45 x 10 cm^2 produced maximum seed cotton yield ha^{-1} (1432 kg ha^{-1}) which was significantly superior over spacings of 60 x 10 cm^2 and 60 x 15 cm^2 but at par with plant spacing of 45 x 15 cm^2 (1343 kg ha^{-1}). The increase in seed cotton yield ha^{-1} in closer plant spacing was due to significantly higher plant population unit area^{-1} as compared to wider spacing. Lower plant population is the major cause for its low seed cotton yield. Brar *et al.* (2008) observed that the highest yield (1224 kg ha^{-1}) was recorded under 67.5 cm x 30 cm spacing which was at par with 67.5 cm x 45 cm spacing and significantly better than all other spacings viz., 67.5 cm x 60 cm, 100 cm x 30 cm, 100 cm x 45 cm and 100 cm x 60 cm. Basavanneppa *et al*.(2012) reported that the closer plant spacing of 90 x 45 cm^2 produced significantly superior seed cotton yield (2243 kg ha^{-1}) over wider plant spacing of 90 cm x 90 cm (1867 kg ha^{-1}). Singh *et al*.(2012) reported that significantly higher seed cotton yield was recorded under closer plant geometry of 67.5 cm x 45 cm (2613 kg ha^{-1}) than wider plant geometry of 67.5 cm x 60 cm (2460 kg ha^{-1}). Pradeepkumar *et al*. (2015) recorded that the seed cotton yield was highest (1944 kg ha^{-1}) in 45 cm x 15 cm plant spacing as compared to wider spacing of 45 cm x 30 cm (1523 kg ha^{-1}).

Effect of nutrient management treatment

It was observed that the nutrient management with 150% RDF (75:37.5:37.5 NPK kg ha^{-1}) produced highest seed cotton yield ha^{-1} (1525 kg) which was significantly superior over the nutrient management treatments of 100% RDF (50:25:25 NPK kg ha^{-1}) and 125% RDF(62.50:31.25:.3125 NPK kg ha^{-1}). Mane *et al*.(1999) observed that the fertilizer dose of 100:50:50 kg of NPK ha^{-1} recorded significantly higher number of bolls plant^{-1},boll weight and seed cotton yield (1619 kg ha^{-1}) over dose of 60:30:30 kg NPK ha^{-1} (1251 kg ha^{-1}) and was at par with fertilizer dose of 80:40:40 kg NPK ha^{-1}(1428 kg ha^{-1}). Singh *et al*. (2014) observed that the application of 150 % RDF (75:37.5:37.5 NPK kg ha^{-1}) produced significantly higher seed cotton yield (2825.9 kg ha^{-1}) than 100 % RDF (50:25:25 NPK kg ha^{-1}) (2374.9 kg ha^{-1}) and 125 % RDF (62.50:31.25:.3125 NPK kg ha^{-1}) (2677.6 kg ha^{-1}).

Interaction effect

Interaction effects between spacing and nutrient management were found to be non significant in case of growth , yield attributes and yield of cotton.

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