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Effect of sowing dates on yield of cotton genotypes under Hisar conditions

RENU BALA, SHWETA*, KARMAL MALIK, MEENA SEWHAG AND PRIYANKA
Department of Agronomy, CCS Haryana Agricultural University, Hisar, -125 004
****E-mail : malik.shweta54@gmail.com***

ABSTRACT : A field experiment was conducted during the *kharif, season* of 2017 at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar, India. The experiment was laid out in split plot *desig*n with four sowing dates (S_1- 1st fortnight of April, S_2- 2nd fortnight of April, S_3- 1st fortnight of May and S_4 -2nd fortnight of May) as main plot and four cotton genotypes {G_1- *Bt* hybrid (RCH 650), G_2 - American cotton variety (H 1098i) and G_3- *Desi* cotton variety (HD 432)} in sub plot replicated thrice. The results of the experiment indicated that among the three cotton genotypes, RCH 650 produced significantly higher seed cotton yield (4395 kg/ha) than the rest two genotype [H 1098i (3344 kg/ha) and HD 432 (2488 kg/ha)]. Higher dry matter production, leaf area index, sympodial branch and boll weight might have accounted for the better seed cotton yield of genotype RCH 650. The crop sown on 2nd fortnight of April gave significantly higher seed cotton yield (4556 kg/ha) than the other three sowing dates, owing to improved plant height, dry matter production, leaf area index, bolls/m^2, sympodial branch and boll weight.

Key Words: *Bt* hybrid, *desi* cotton, seed cotton yield, sympodial

Cotton, the 'white gold' or the 'king of fiber' is one of the most important cash crops of global importance and cultivated in tropical and subtropical regions of almost 70 countries of the world. It is the leading fiber crop of the world. Cotton is used as raw material in textile industry and this industry contributes about 14 per cent to the industrial production and 4 per cent of the GDP (Anonymous, 2018). Cotton is used as major raw material in this sector. It is also the source of edible oil, cotton seed oil cake, linters, and huge biomass as dried cotton stalk is used as fuel. There are various meteorological factors such as low and high temperature, moisture deficits and surpluses and solar radiation intensity etc. which play an important role in crop growth and development and ultimately yield potential. For cotton crop, 21-27 °C temperature is required for proper vegetative growth. Temperature significantly effects leaf expansion, internodes elongation, dry matter production and partitioning of assimilates to different plant parts (Sankarnarayanan *et al.,* 2010). Low yield of cotton crop in the country is because of the improper selection of productive cultivars or genotypes (Singh *et al.,* 2018a) and non adoption of improved production technologies (Singh *et al.*, 2019), delayed sowing, inadequate use of fertilizers and water management (Singh *et al.*, 2018b), insect-pest and diseases infestation. To ensure good crop growth and development judicious use of various inputs and proper coordination of different agronomic practices are required and among all these

practices, sowing time is very important to explore the genotypic potential in a particular agro-climatic region. The genotype selection is also an important component in any cropping system.

Sowing time linearly affects the seed cotton yield, because early maturing cultivars start flowering and boll formation much earlier as compared to late ones. The peak flowering and boll development period may coincide with cool day temperature if sowing is delayed after 15th of July in central zone (Singh *et al.*, 2018a). In North India, optimum, sowing recommended for cotton is in the month of April to mid May, (Singh *et al.*, 2011; Kumar *et al.,* 2014). Cotton area in Punjab and Haryana has declined 27 per cent in 2016-2017 cropping year as farmers shifted to other crops after incurring huge losses due to whitefly pest attack (Anonymous, 2018). Keeping the above aspects in view, the present investigation was carried out.

The field experiment was conducted at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar, India which is situated at altitude of 215.2 m above mean sea level and 29°10' N latitude, 75°46' E longitude, during the growing season of *kharif*, 2017.The soil of experimented was sandy loam in texture with 73.8 per cent sand, 15.9 per cent silt and 10.3 per cent clay with pH 7.9. The soil was low in organic carbon (0.44), medium in available nitrogen (134 kg/ha) and phosphorus (19 kg/ha) and highly available potassium (366 kg/ha).The experiment was layout in split plot design with four sowing dates (S_1- 1st fortnight of April, S_2- 2nd fortnight of April, S_3- 1st fortnight of May and S_4 -2nd fortnight of May) as main plot and three cotton genotypes {G_1- *Bt* hybrid (RCH 650),G_2- American cotton variety (H 1098i) and G_3- *Desi* cotton variety (HD 432)} as sub plot treatments replicated thrice. Full dose of P, K and $ZnSO_4$ were applied at the time of sowing in all genotypes. Two split of N were applied in H-1098i, first split was given after first irrigation and second at peak flowering stages. In *Bt* cotton three split of N were applied-*i.e* first split at time of sowing while second and third at first irrigation and at flowering stage, respectively. Pre-emergence application of herbicide (pendimethalin, ...), one hand weeding and four mechanical hoeings were done to check weed population. Height of five tagged plants in each plot excluding border rows was measured at maturity from the ground level upto the tip of fully opened leaf at the top and expressed in cm. For the measurement of dry matter accumulation at maturity, the samples were first dried in air and then oven dried at a temperature of 70°C till constant weight was obtained. Dry weight was recorded on per plant basis and expressed in g/plant. Absolute growth rate or crop growth rate (AGR) was recorded by using the formula given by Radford (1967). It is expressed as gram of dry matter produced per day (g/day). It indicates at what rate the crop is growing.

$$AGR = \frac{(W_2 - W_1)}{(t_2 - t_1)}$$

Where,

W_1 and W_2 are the dry weight of plant at time t_1 and t_2, respectively.

Leaf area was measured by using LI-3000 Leaf Area Meter, LICOR Ltd., Nebraska, USA. It is expressed in cm^2 and LAI calculated by

following equation:

$$LAI = \frac{\text{Leaf area/plant}}{\text{Ground area}}$$

Five plants were selected randomly from each plot to estimate yield and yield attributes. The data recorded at harvest included bolls, boll weight (g), monopodial branch, sympodial branches, seed index, and seed cotton yield (kg/ha). Data were analyzed by using analysis of variance (ANOVA). The Duncan's New Multiple Range test (DMRT) at 5 per cent level of probability was used to test the significance of differences.

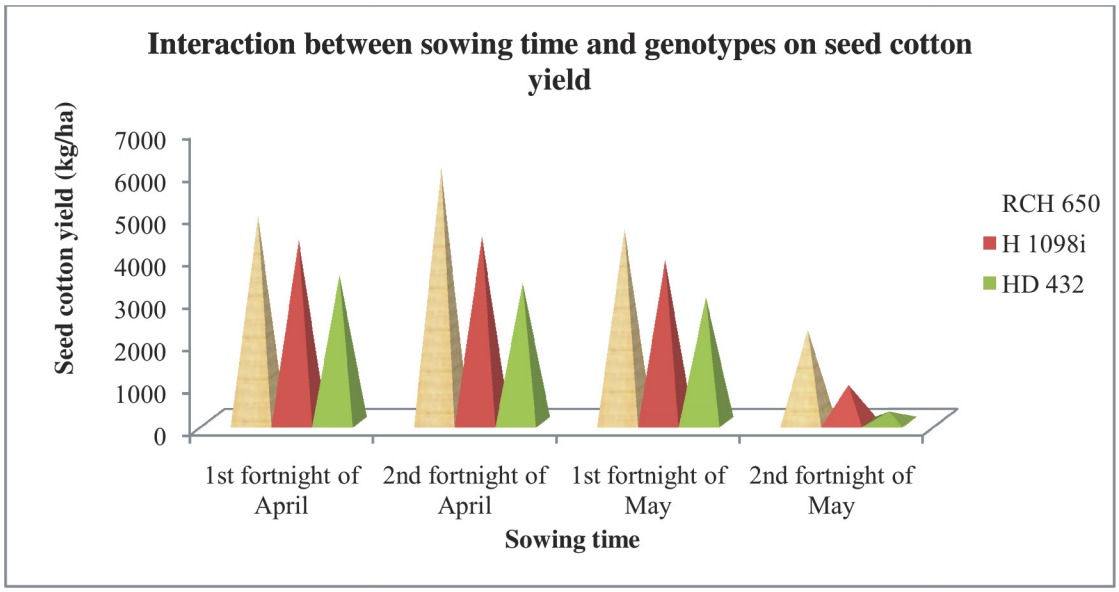
Growth : Data related to plant height of cotton presented in Table 1 indicated that too early (1st fortnight of April) or too late sowing (2nd fortnight of May) of cotton resulted in significantly reduced height. Data also revealed that at maturity stage cotton sown on 2nd fortnight of May produced significantly lowest plant height over all other sowing dates (Table 1). Cotton genotype HD-432 was significantly superior to RCH-650 and H-1098i in term of plant height. Cotton genotype HD-432 recorded 16.31per cent and 14.13per cent higher plant height than H 1098i and RCH 650, respectively.

Significantly higher dry matter accumulation at maturity (440.4 g /plant) was recorded in cotton sown on 2nd fortnight of April than crop sown on 1st fortnight of April (382 g/plant) and 2nd fortnight of May (253.3 g/plant), which was *at par* with crop sown on 1st fortnight of May. HD-432 produced significantly lower dry matter accumulation than RCH 650 and H 1098i at all the stages of crop growth. However RCH 650 was *at par* with H 1098i in term of dry matter accumulation at all the crop growth stages.

Cotton sown on 2nd fortnight of May produced significantly lower LAI than other sowing time. LAI of cotton sown on 1st fortnight of April was *at par* with cotton sown on 1st fortnight of May. Genotypes also showed significant differences in LAI at all the growth

Table 1. Effects of different sowing time on growth parameters of cotton genotypes

Treatment	Height at maturity(cm)	Dry matter at maturity ()	LAI	Monopodial branch/plant	Sympodial branch/plant
Sowing time					
1st fortnight of April	158.5	382.0	1.13	2.6	17
2nd fortnight of April	176.8	440.4	1.44	2.7	24
1st fortnight of May	176.9	434.0	1.02	2.6	22
2nd fortnight of May	91.4	253.3	0.71	2.5	6
SEm ±	0.8	5.1	0.88	0.1	1
CD (p=0.05)	2.8	18.1	0.31	NS	2
Genotypes					
RCH 650	144.2	397.3	1.39	2.7	19
H 1098i	140.6	385.0	0.95	2.5	18
HD 432	168	350.1	0.88	2.6	16
SEm ±	0.5	4.9	0.05	0.1	1
CD (p=0.05)	1.6	14.7	0.15	NS	2



stages. Between 75-105 DAS and 105 DAS to maturity stage, RCH 650 recorded significantly higher LAI (2.62 and 1.39) than H 1098i and HD 432 (Table1).

Sowing dates exerted a significant effect on the total bolls/m^2 (Table 2). The crop sown on 2nd fortnight of April produced significantly higher bolls/m^2 (201) than other sowing dates. No. of bolls/m^2 of cotton sown on 1st fortnight of April and 1st fortnight of May was statistically *at par* with each other. Among various genotypes, H 1098i possessed significantly higher bolls/m^2 (185) than RCH 650 (135) and HD 432 (131).

The data indicated that there was non-significant effect of sowing time on boll weight of cotton genotypes (Table 2). In case of genotypes, the boll weight was significantly higher in cotton genotype RCH 650 (4.49g/boll) as compared to H 1098i (3.56 g/boll) and HD 432 (2.05g/boll). Cotton sown on 2nd fortnight of April produced bigger boll size due to the higher accumulation of photosynthates and more time availability for boll development and maturity as compared to later sowing dates. For crop sown on 2nd fortnight of May, much of boll maturation took place under minimum temperature of about 22ÚC or less. Similar findings were reported by Buttar *et al.* (2005).

As evident from the data in Table 1 different sowing dates and genotypes did not affect monopodial branches of cotton. Maximum monopodial branches per plant (2.7) was recorded in 2nd fortnight of April sown crop and minimum (2.5) in 2nd fortnight of May sown crop.

However, sowing dates significantly differed for the sympodial branch (Table 1). The sympodial branches/plant decreased as sowing was delayed from 2nd fortnight of April to 2nd fortnight of May. The crop sown on 2nd fortnight of April produced maximum sympodial branches per plant (24), which was statistically *at par* with the crop sown on 1st fortnight of May (22) and significantly higher than the crop sown on 2nd fortnight of May (6). In case of genotypes, the sympodial branches/plant were significantly higher in RCH 650 (19) as compared to HD 432

Table 2. Effects of different sowing time on yield attributes and yield of cotton genotypes

Treatment	Bolls/m^2	Boll weight (g)	Seed cotton yield (kg/ha)	Seed Index ()
Sowing time				
1st fortnight of April	178	3.32	4203	6.09
2nd fortnight of April	201	3.48	4556	6.58
1st fortnight of May	175	3.35	3775	5.69
2nd fortnight of May	47	3.31	1103	5.54
SEm ±	2	0.07	66	0.15
CD (p=0.05)	8	NS	233	0.51
Genotypes				
RCH 650	135	4.49	4395	7.12
H 1098i	185	3.56	3344	6.28
HD 432	131	2.05	2488	4.52
SEm ±	2	0.07	183	0.08
CD (p=0.05)	6	0.21	555	0.24

(16) though statistically *at par* with H 1098i (18). The higher sympodial branches under 2nd fortnight of April and 1st fortnight of May was due to favorable mean air temperature of 32-33ÚC during 40-120 DAS (Table 1). The decrease in sympodial branches in 2nd fortnight of May sown crop was due to poor growth and development as evident from less plant height , lower LAI and dry matter accumulation.

Seed cotton yield ; A thorough look on data presented in Table 2 indicated that sowing dates and genotypes had significant effect on seed cotton yield and it was significantly higher (4555 kg/ha) in 2nd fortnight of April sown crop than all other sowing dates. Among the cotton genotypes, RCH 650 produced significantly higher seed cotton yield (4395 kg/ha) followed by H 1098i (3344 kg/ha) and HD 432 (2488 kg/ha). All interaction effects between sowing time and genotypes were non-significant but RCH 650 produced higher seed cotton yield among all the sowing dates while genotype HD 432 during sowing of 1st fortnight of April and genotype H1098i during sowing of 1st fortnight of April to 2nd fortnight of April (fig 1). Higher seed cotton yield during crop sown on 2nd fortnight of April might be due to the higher bolls/m^2, boll weight and sympodial branches. Cotton yield decreased with late sowing due to the reduction in season length (Singh *et al.*, 2018 b) which reduced the fruiting branches and bolls. Yield reduction due to late sowing may be attributed to shortening of crop period which adversely affected the reproductive process of crop (Prakash *et al.,* (2010) and Braunack *et al.,* (2012).

Sowing dates and genotypes studied also differed significantly among themselves for seed index (Table 2). The crop sown on 2nd fortnight of April showed a seed index of 6.58 which was statistically *at par* with the crop sown during 1st fortnight of April (6.09), but significantly higher than sown on 1st fortnight of May (5.69) and 2nd fortnight of May (5.54). The genotype RCH 650 recorded maximum seed index (7.12) which was significantly higher than the genotypes H 1098i (6.28) and HD 432 (4.52). A lower value of seed index indicates more immature seeds. Crop

sown on 2nd fortnight of May recorded lower seed index which might be attributed to the poor development of seeds and bolls under delayed sowing condition (Singh *et al.*, 2019)

CONCLUSION

Sowing of cotton on 1st 2nd fortnight of April was found better as compared to rest of sowing dates in terms of yield attributes and yield of cotton. Among various cotton genotype, RCH 650 produced highest seed cotton yield irrespective of sowing date; however highest bolls/m^2 was recorded with H 1098i. However, in case of genotype HD 432 highest seed cotton yield was obtained when sown on 1st fortnight of April. While genotype H1098i produced higher seed cotton yield when sown from 1st fortnight of April to 2nd fortnight of April.

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