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Different Dates of Sowing and Nitrogen Levels on Growth and Yield Attributes of Irrigated Cotton

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A B S T R A C T

The study was carried out to investigate the effect of sowing dates on the growth and seed cotton yield of three N levels under the climatic condition. The field experiment was conducted at Agricultural College and Research Institute, Madurai as winter irrigated cotton during 2016. The field experiment was laid out in factorial randomized block design with four replications. The experiment details on factor I was considered as two date of sowing (D_1-21st September, D_2-6th October) Factor II was considered as three N levels (N_1-80 kg N ha^{-1}, N_2-60 kg N ha^{-1}, N_3-100 kg N ha^{-1}). Among the dates of sowing D_1 recorded higher growth and yield parameters. The nitrogen level was significantly increased the growth parameters; the higher growth parameters were recorded at N_3 and the yield parameters were higher in N_1. Among the interactions, D_1N_3 and D_1N_1 significantly recorded higher growth and yield parameters.

Introduction

Cotton (*Gossypium spp* L.) the "*white gold* or the *king of fibres"* is one of the most important commercial crops in India. It plays a prominent role in the national and international economy. In India, cotton grown under diverse agro-climatic conditions and its cultivation provides livelihood for over 4 million farm families. It is one of the most sources of textile natural fibre in the world (Brubaker *et al.*, 1999), grown worldwide in the temperate and tropical regions in more than 50 countries (Smith, 1999). There are two cotton species grown for a good quality fibre namely *G. hirsutum* and *G. barbadense* an account of 90% and 5% respectively, of the world cotton fibre production Wu *et al.*, (2005).

Time of sowing has greatest impact on growth, yield and quality parameters of cotton. Soomro *et al.*, (2007) found that cotton sown earlier or later than its optimum time showed adverse effects on yield. Sowing the seeds too earlier than optimum time results in poor stands and too late generally results in reduced yield, increased vulnerability to insects and bad weather (Gormus and Yucel, 2002). Thus, selection of an optimum sowing date can improves yield, promote normal growth and it is significant for maintaining a sustainable local agriculture economy. Globally, the current important concern is to minimize nitrogen use in crop culture under climate change condition. Cotton production is both a contributor to climate change and its impacts. Cotton production contributes between 0.3 per cent and 1 per cent of total global GHG emissions especially nitrous oxide (N_2O) gas.

Plant dry matter is generally composed of approximately 2 and 40 percent of N and carbon respectively (Beevers and Hageman, 1980). Nitrogen is required through all phases of plant development because this essential element is a constituent of both structural (cell membranes) and nonstructural (amino acids, enzymes, protein, nucleic acids and chlorophyll) components of the plant. Without sufficient N deficiency symptoms in cotton include stunting, chlorosis and fewer smaller bolls (Tisdale *et al.*, 1993). Rinehardt *et al.*, (2004) reported that nitrogen has a vital role in growth and development of cotton and beneficial effect of N on growth and yield (seed cotton and lint yield) and fiber quality have been proven by a number of research conducted in various environmental conditions. Nitrogen also prevents abscission of squares and bolls thus increase the number of bolls. Nitrogen also stimulates the mobilization and accumulation of photosynthates in newly formed bolls thus it increase the number of bolls and their weight. The crop like cotton, which have indeterminate growth behavior excess N causes delayed maturity, promote excessive vegetative growth and usually results in lower seed cotton yields of inferior quality.

Nitrogen (N) is the most difficult to properly manage because of its reactivity and mobility in the soil environment. Inadequate N reduces the number of fruiting sites and potential yield, whereas excessive N can create rank growth, actually lower yields and quality, delay maturity, increase problems with pest and disease, defoliation and pollute ground and surface water resources (Robert Lemon *et al.,* 2009).

Materials and Methods

The experiment was conducted in field no. C.46 of the Central Farm, Agricultural College and Research Institute, Madurai, as winter irrigated crop during 2016-17. The experimental site is geographically situated at 9^{o} 54'N latitude and 78^{o} 54'E longitude at an altitude of 147 m above mean sea level. The farm is situated in the Southern agro-climatic zone of Tamil Nadu. The location falls under the climate of semi-arid with the mean annual rainfall of 713.3 mm and the mean maximum and minimum temperature of 33.66˚C and 20.81˚C, respectively. The mean daily pan evaporation and relative humidity recorded during the first crop season were 4.90 mm and 62.91 per cent, respectively. An amount of 539 mm was received during the experimental period. The soil of the experimental fields was well drained and sandy clay loam in texture. The soil was neutral in reaction and low in available nitrogen (234.4kg ha^{-1}), medium in available phosphorus (14.88kg ha^{-1}) and available potassium (198.50 kg ha^{-1}). Cotton variety SVPR 4 with duration of 150-160 days belonging to the species of *G. hirsutum* was chosen for this study. The prime objective of the experiment was to study the effect of Nitrogen levels under various dates of sowing influences cotton crop growth and yield parameters.

The field experiment was laid out in Factorial randomized block design with four replications. The Treatment details factor I was considered as Dates of sowing: D_1-21th September – 2016, D_2-6th October – 2016. The factor II was 3 Nitrogen levelsN_1- Normal 80 Kg N ha^{-1} (100 %), N_2-Lesser than normal 60 Kg N ha^{-1} (-25 %), N_3-Higher than normal 100 Kg N ha^{-1} (+25 %). Nitrogen, phosphorus and potassium were applied in the form of urea (46 per cent N), single super phosphate (16 per cent P_2O_5) and muriate of potash (60 per cent K_2O), respectively at 80:40:40 kg NPK ha^{-1}. Entire dose of phosphorous, 50 per cent of N and K were applied as basal. The balance dose of N and K was applied in two splits, at the time of square initiation (45 DAS), and peak flowering (75 DAS).

The observations on growth parameters *viz.*, plant height and leaf area index were measured at 30, 60, 90 and 120 days after sowing. The yield parameters of number of monopodia and sympodia branches, fruiting points and number of bolls per plant were recorded.

Results and Discussion

Plant height (Table 1)

The three different nitrogen levels had significantly influence on plant height of cotton during all the stages of observation. Among the three different nitrogen levels, maximum plant height (cm) of 38.1, 105.5, 150.9, 169.0 at 30, 60, 90 and 120 DAS, respectively was recorded in N_3-100 kg N ha^{-1}, followed by N_1- 80 kg Nha^{-1}. Plants grown under N_2-60 kg Nha^{-1} produced significantly shorter plants.

Among the different dates of sowing, significantly higher plant height (cm) of 36.93, 98.90, 145.9, 164.0 at 30, 60, 90 and 120 DAS respectively observed with sowing of 21st September (D_1), which was followed with sowing of 6th October D_2. In interaction effect of 21st September (D_1) sown crop 100 kg N ha^{-1} (N_3) produced significantly taller plants 42.10, 111.40, 158.2, 175.2 at 30, 60, 90, 120 DAS respectively over other combinations (Table 1).

The results are in accordance with (Soler *et al.,* 2007); (Pettigrew and Adamezyk, 2008); (Gwathmey and Clement, 2010) Timely planting of crops is essential for root penetration, proliferation and vegetative growth for optimum harvesting of available soil nutrients and solar radiation. Early planted crops may experience some challenges of seedling establishment due to low temperatures and high insect pest incidence. Late planting in contrast usually reduces cotton yield due to delayed physiological maturity and carbohydrate deficiency. These results are in agreement with those of Rochester *et al.,* (2001) that plant height in cotton is related to nitrogen application. Subsequent increase in N levels from 50 to 150 kg ha^{-1} resulted in proportionate increase in the plant height. The taller plants were recorded in the treatments where 150 kg N ha^{-1} was applied. It is well known fact that nitrogen application boosts crop growth and development. The increased plant height is the result of flamboyant and vigorous plant growth.

Leaf area index (LAI) (Table 2)

The plants grown under 100 kg Nha^{-1} (N_2) had significantly higher LAI at all stages of observation. This was followed by the plants grown under 80 kg Nha^{-1} (N_1), whereas significantly the lowest LAI was registered with the plants grown under 60 kg Nha^{-1} (N_2). Similar to the plant height, LAI was also higher for the plants sown on September 21st (D_1) followed by October 6thsowing. LAI was significantly higher at September 21st (D_1) with 100 kg Nha^{-1} (N_3) at all times compared with other treatments ($D3N_3$) (Table 2).

Table.1 Effect of nitrogen levels and dates of sowing on cotton plant height (cm)

Treatment	30 DAS				60 DAS				90 DAS				120 DAS			
	N_1	**N_2**	**N_3**	**Mean**	**N_1**	**N_2**	**N_3**	**Mean**	**N_1**	**N_2**	**N_3**	**Mean**	**N_1**	**N_2**	**N_3**	**Mean**
D_1	38.10	30.60	42.10	36.93	96.30	89.00	111.40	98.90	145.9	133.7	158.2	145.9	168.2	148.6	175.2	164.0
D_2	31.80	27.60	34.10	31.17	91.80	85.10	99.70	92.20	139.9	127.2	143.5	136.8	152.6	145.4	162.9	153.6
Mean	34.95	29.10	38.10		94.05	87.05	105.55		142.9	130.4	150.9		160.4	147.0	169.0	
	D	**N**	**D*N**		**D**	**N**	**D*N**		**D**	**N**	**D*N**		**D**	**N**	**D*N**	
SEd	0.70	0.86	1.22		1.24	1.52	2.16		1.44	1.77	2.51		1.63	1.99	2.83	
CD	1.51	1.85	2.61		2.67	3.26	4.62		3.10	3.79	5.37		3.49	4.28	6.05	

Table.2 Effect of nitrogen levels and dates of sowing on cotton LAI

Treatment	30 DAS				60 DAS				90 DAS				120 DAS			
	N_1	**N_2**	**N_3**	**Mean**	**N_1**	**N_2**	**N_3**	**Mean**	**N_1**	**N_2**	**N_3**	**Mean**	**N_1**	**N_2**	**N_3**	**Mean**
D_1	0.74	0.67	0.85	0.75	1.87	1.80	1.90	1.87	2.75	2.58	2.79	2.71	2.91	2.78	3.02	2.90
D_2	0.69	0.65	0.76	0.70	1.76	1.62	1.83	1.80	2.60	2.24	2.68	2.51	2.89	2.35	2.99	2.74
Mean	0.71	0.66	0.81		1.82	1.71	1.87		2.67	2.41	2.73		2.90	2.56	3.00	
	D	**N**	**D*N**		**D**	**N**	**D*N**		**D**	**N**	**D*N**		**D**	**N**	**D*N**	
SEd	0.009	0.012	0.02		0.017	0.020	0.03		0.032	0.039	0.06		0.054	0.066	0.09	
CD	0.020	0.025	0.035		0.035	0.043	0.061		0.068	0.084	0.119		0.11	0.14	0.20	

Table.3 Effect of nitrogen levels and dates of sowing on no. of monopodia plant^{-1}, no. of sympodia plant^{-1}, no. of fruiting points plant^{-1} and no. of bolls plant^{-1} of cotton

Treat Ment	No. of Monopodia plant^{-1}				No. of Sympodia plant^{-1}				No. of fruiting points plant^{-1}				No of bolls plant^{-1}			
	N_1	**N_2**	**N_3**	**Mean**	**N_1**	**N_2**	**N_3**	**Mean**	**N_1**	**N_2**	**N_3**	**Mean**	**N_1**	**N_2**	**N_3**	**Mean**
D_1	1.50	1.25	2.01	1.63	23.75	18.00	21.50	21.08	56.05	48.90	50.85	51.93	62.00	46.25	53.75	54.00
D_2	1.43	1.23	1.75	1.49	22.00	15.00	17.25	18.08	51.45	40.50	46.80	46.25	51.50	42.75	49.00	47.75
Mean	1.47	1.24	1.88		22.88	16.50	19.38		53.75	44.70	48.83		56.75	44.50	51.38	
	D	**N**	**D*N**		**D**	**N**	**D*N**		**D**	**N**	**D*N**		**D**	**N**	**D*N**	
SEd	0.02	0.03	0.05		0.35	0.44	0.62		0.68	0.83	1.18		1.05	1.28	1.82	
CD	0.06	0.07	0.10		0.77	0.94	1.33		1.46	1.79	2.54		2.25	2.76	3.90	

Oosterhuis *et al.,* (1983) found a distinct differences in plant dry weight and leaf area at 120 kg N ha^{-1} treatment, in which maximum dry matter production was 114 g $plant^{-1}$ and leaf area index had attained a maximum of 3.7 after 115 days from sowing.

Yield attributes (Table 3)

Yield is directly related with number of monopodia and sympodia branches, fruiting points and number of bolls $plant^{-1}$. The higher monopodia branches of 1.88 recorded in the application of 100 kg N ha^{-1} (N_3). This might be due to application of higher than recommended dose of nitrogen, which promotes excess vegetative growth. Different dates of sowing and nitrogen levels had significant influence on the yield attributes of cotton. The higher yield attributes of sympodia branches (22.88), fruiting points (53.75), number of bolls $plant^{-1}$ (62.0) showed that favorable increase with the application of 80 kg N ha^{-1} followed by 100 kg N ha^{-1}, whereas significantly lower (16.50, 44.70, 44.50) was recorded in 60 kg Nha^{-1}.

Among the dates of sowing higher yield attributes of sympodia branches (21.08), fruiting points (51.93) and number of bolls $plant^{-1}$ (54.0) recorded in September 21^{st} followed by October 6^{th}. Results obtained from the combination effect, the various Nitrogen levels and dates of sowing the yield attributes sympodia branches (23.75), fruiting points (56.05) number of bolls $plant^{-1}$ (62.0) showed an impressive improvement under the application of 80 kg N ha^{-1}(N_1) with D_1 September 21^{st} (D_1N_1). Galloway *et al.,* (2003) who reported that the primary detriment is when surplus N encourages excessive vegetative growth resulting in poor boll set caused by vegetative shading and insect attractiveness and lodging, late maturity and difficulty in defoliation. Nitrogen application significantly increased the yield attributes. The increase in yield may be attributed to favorable effect of nitrogen application on yield attributing characters *i.e.* plant height, monopodia branches, sympodia branches and bolls $plant^{-1}$. Similar positive response was observed by Meena *et al.,* (2007).

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