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RESEARCH ARTICLE

Optimization of spacing and time and dose of Defoliant application for High-Density Planting system in cotton

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ABSTRACT

A field experiment was conducted at Cotton Research Station, Srivilliputtur from October 2017 to February 2018 to optimize spacing and time and dose of defoliant application to suit high-density planting system in cottonunder irrigated conditions. The experiment was conducted in a split-plot design with three replications. The treatments consisted of three levels of plant spacings (100 x 10 cm, 60 x 15 cm and 75 x 30 cm) in main plot and four treatments with time and doses of defoliant application of Dropp Ultra (Tembotrione 34.4 % SL) at 200 ml/ha at 120 DAS, 200 ml/ha at 130 DAS, 2000 ppm (500 ml/ha) at 120 DAS and 2000 ppm (500 ml/ha) at 130 DAS were accommodated in subplot. The results revealed that though the normal spacing of 75 x 30 cm produced higher number of sympodial branches and bolls per plant, it was comparable with that of HDPS with 100 x 10 cm spacing. Among the three spacings, 100 x 10 cm with a plant population of 1,00,000 plants/ha (HDPS) registered the highest seed cotton yield of 2063 kg/ha which was comparable with closer spacing of 60 x 15 cm with 1,11,111 plants/ha (1947 kg/ha) and significantly superior than the existing recommended spacing of 75 x 30 cm with 44,444 plants/ha (1779 kg/ha). Higher gross income, net income and higher benefit-cost ratio were also recorded with HDPS followed by 60 x 15 cm. Dropp ultra application at the rate of 200 ml/ha on 130 DAS was found to be effective for higher seed cotton yield and economic benefits.

Keywords*: Cotton, spacing, defoliant, seed cotton yield, economics*

Cotton is known as “white gold” is an important fibre cum cash crop in India and Tamil Nadu as well. In Tamil Nadu, cotton is cultivated in an area of 1.48 lakh ha during 2016-17 with the production of 2.80 lakh bales and productivity of 599 kg/ ha which is below the world average yield of 788 kg/ ha (Anonymous, 2017). Among the various production factors, spacing plays a significant role in efficient utilization of available sources. Determination of optimum plant spacing for realizing optimum yield is necessary for maximum utilization of various resources like light, soil moisture and CO_2 to augment crop yield. High-Density Planting System (HDPS) is recently considered as an alternative production system having a potential for improving the productivity and profitability, increasing input use efficiency, reducing input costs and minimizing the risks associated with the current production system in India (Venugopalan *et al.*, 2013). Having an indeterminate growth habit, cotton is very responsive to alter the growth pattern through management practices. Many attempts have been made to alter the growth habit of the crop through mechanical and chemical means so as improve the productivity and bring about some amenability for cultural manipulations. One of them is application of defoliant which is having potential to enhance phonological reactions and series of growth processes leading to greater main stem node and sympodial branches and bolls and finally seed cotton yield. Keeping these facts in mind, the present study was carried out to investigate the effect of time and dose of defoliant application on growth and yield of cotton.

MATERIALS AND METHODS

A field experiment was conducted at Cotton Research Station, Srivilliputtur from October 2017 to February 2018 to optimize spacing and time and dose of defoliant application to suit high-density planting system in cotton under irrigated conditions. The experiment was conducted in a split-plot design with three replications. The treatments consisted of three levels of plant spacings (100 x 10 cm, 60 x 15

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cm and 75 x 30 cm) in main plot and four treatments with time and doses of defoliant application of Dropp Ultra (Tembotrione 34.4 % SL) at 200 ml/ha at 120 DAS, 200 ml/ha at 130 DAS, 2000 ppm (500 ml/ha) at 120 DAS and 2000 ppm (500 ml/ha) at 130 DAS were accommodated in subplot. The soil of the experimental field was sandy clay loam with a pH of 8.3. The available nutrient N, P and K status of the soil was low, medium and high, respectively. The pre-release cotton culture TCH 1819 was used in the experiment and a standard fertilizer dose of 100: 50: 50 kg NPK /ha was applied for all the treatments. Mepiquat chloride was sprayed at 200 ml/ ha as common for all the treatments during square formation and boll development stages. Observations on yield attributes and seed cotton yield were recorded and economics worked out.

RESULTS AND DISCUSSION

Yield attributes

Different spacings exhibited significant influence on all the yield attributes of cotton (Table 1). Adoption of normal spacing of 75 x 30 cm produced a higher number of sympodial branches (15.15) and bolls per plant (20.50) which was comparable with that of HDPS with 100 x 10 cm and significantly higher than closer spacing of 60 x 15 cm. However, the highest boll weight of 4.47 g was recorded by HDPS and this was on par with 75 x 30 cm (4.33 g) and significantly superior to 60 x 15 cm (4.01 g). Higher yield attributes with higher plant population as observed in the present investigation were in conformity with the findings of Sarkar and Malik (2004) and Farrukh Saleem *et al. (*2009).

Table 1. Effect of spacing and defoliant application on growth and yield of cotton

Treatment	No.of Sympodia/ plant	No. of Bolls / plant	Boll weight (g)	Seed cotton yield (kg/ha)
Spacing (M)				
M_1 - 100 x 10 cm	13.66	17.72	4.47	2063
M_2 – 60 x 15 cm	12.96	15.31	4.01	1947
M_3 – 75 x 30 cm	15.15	20.50	4.33	1779
SEd.	0.54	1.35	0.15	70
CD(P=0.05)	1.51	3.79	0.40	195
Time of Defoliant application (D)				
D_1 Dropp Ultra 200 ml/ha at 120 DAS	13.58	18.44	4.28	1903
D_2 -Dropp Ultra 200 ml/ha at 130 DAS	13.67	18.51	4.33	1948
D_3 Dropp Ultra 500 ml/ha at 120 DAS	13.60	18.45	4.29	1911
D_4 -Dropp Ultra 500 ml/ ha at 130 DAS	13.71	18.56	4.34	1952
SEd	0.36	1.06	0.12	53
CD(P=0.05)	NS	NS	NS	NS
Interaction	NS	NS	NS	NS

The dose and time of defoliant application did not cause any significant influence on all the yield attributes. However, a higher dose of dropp ultra application at the rate of 500 ml/ ha on 130 DAS registered slightly higher yield attributes followed by the same dose at 120 DAS. The higher number of sympodia with defoliant application might be due to increased nodes on main stem and inhibition of vertical growth and subsequently promoting lateral growth including branching. The beneficial effect of defoliant application on yield attributes of Bt cotton was observed by Kataria *et al. (*2012).

Seed cotton yield

The effect of spacing on seed cotton yield was significant while the effect of time and dose of defoliant application was not significant (Table 1). Among the three spacings, wider inter-row spacing of 100 x 10 cm with a plant population of 1,00,000 plants/ha (HDPS) registered the highest seed cotton yield of 2063 kg/ha but was comparable with closer spacing of 60 x 15 cm with 1,11,111 plants/ha (1947 kg/ha) and significantly superior than the existing recommended spacing of 75 x 30 cm with 44,444 plants/ha (1779 kg/ha). The higher seed cotton yield with closer spacing was due to higher yield attributes and also higher plant population accommodated per unit area. Manjunatha *et al.* (2010) reported that increasing the plant density/ unit land area increased the interplant competition within the plot for natural resources and because of higher competition between plants, contribution of yield components/plant with closer spacing was lower when compared to wider spacing but the loss in yield attributes/plant was compensated through higher plant population/ha. Venugopalan *et al.* (2011) recorded 29.5 per cent higher seed cotton yield under HDPS than normal spacing. Kerby *et al.* (1990) also realized increased yield under HDPS than normal spacing in cotton.

Though the dose and time of defoliant application did not show any significant influence on yield, a higher dose of dropp ultra application at the rate of 500 ml/ ha on 130 DAS produced slightly higher seed cotton yield and was followed by the same

dose at 120 DAS. The higher yield with the growth retardant application might be due to the inhibition of vertical plant growth and subsequently promoting lateral growth and branches and finally yield as reported by Kataria *et al*. (2012). Similar results of higher seed cotton yield with defoliant application as reported by Kumari and George (2012) and Chase samples *et al.* (2015) are in favour of this study. Significant increase of yield and quality of upland cotton by the application of growth retardant dropp ultra noticed by Fatullateshaev and Botir Khaitov (2015) is in support of the present finding.

Table 2. Effect of spacing and defoliant application on the economics of cotton

Treatment	Gross Income (Rs/ ha)	Cost of cultivation (Rs/ ha)	Net Income (Rs/ ha)	Benefit Cost Ratio
Spacing (M)				
M1 - 100 x 10 cm	94898	55422	39476	1.71
M2 – 60 x 15 cm	89562	55912	33650	1.60
M3 – 75 x 30 cm	81834	52762	29072	1.55
Time of Defoliant application (D)				
D1 -Dropp Ultra 200 ml/ha at 120 DAS	87538	54072	33466	1.62
D2 -Dropp Ultra 200 ml/ha at 130 DAS	89608	54072	35536	1.66
D3-Dropp Ultra 500 ml/ha at 120 DAS	87906	55325	32581	1.59
D4-Dropp Ultra 500 ml/ ha at 130 DAS	89792	55325	34467	1.62

Economics

The economic analysis revealed that higher gross income (Rs. 94898 / ha), net income (Rs.39476 /ha) and higher benefit-cost ratio of 1.71 were associated with HDPS with 100 x 10 cm spacing followed by 60 x 15 cm (Table 2). Higher economic returns from HDPS were due to higher number of bolls per unit area and corresponding increase in kapas yield. Higher net income realized under HDPS than farmers' method of cotton cultivation at Vidarbha region as reported by Venugopalan *et al*. (2013) is in favour of this result. Regarding defoliant, dropp ultra application at the rate of 200 ml/ha on 130 DAS recorded higher gross income (Rs.89792 /ha), net income (Rs. 35536/ha) and higher benefit cost ratio of 1.66.

Thus, it is concluded from the study that a spacing of 100 x 10 cm and application of defoliant dropp ultra at the rate of 200 ml/ha on 130 DAS could be optimum for higher seed cotton yield and economic benefits for high density planting system in cotton.

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