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Realization of Target Yield in Bt Cotton (*Gossypium hirsutum*) with Different Methods of Establishment under Varied Dates of Planting

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A B S T R A C T

A field experiment was conducted at Agronomy Farm, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka with the objective to know how long target yields in *Bt* cotton could be achieved in the TBP irrigation command. Cotton seeds dibbled or seedlings transplanted during 1st and 2nd fortnights of June and July and 1st fortnight of August using a split plot design. Transplanting of seedlings (3457 kg ha^{-1}) out yielded seed dibbling (3280 kg ha^{-1}) and the difference widened with delay in planting (50 kg to 266 kg ha^{-1}). Among all, June 1st fortnight transplanted crop produced significantly higher seed cotton yield (4426 kg ha^{-1}) followed by dibbled crop during the same period (4376 kg ha^{-1}) owing to better growth. Yield decreased by 967 kg to 1042 kg ha^{-1} with July 1st fortnight over June 2nd fortnight planting with dibbling and transplanting, respectively. August 1st fortnight planted crop recorded the lowest yields (1640 and 1906 kg ha^{-1} with dibbling and transplanting, respectively) among all. Thus, time of planting appeared more critical than method of planting.

Introduction

Karnataka, in India ranks fifth in area, fourth in production and fifth in productivity among the cotton growing states. *Bt* cotton is intensively cultivated in the North Eastern Dry Zone and Northern Dry Zone of the state (Zone 2 and 3) covering partly the Tungabhadra and Upper Krishna (TBP and UKP) irrigation Commands on black soil. The area under this crop in these commands has been increasing distinctly over the past half a decade. The average yields which hovered around 4.0 to 5.0 t ha^{-1} initially with the advent of *Bt* cultivars of late are either remaining stagnant of declining which is a deterrent to the farmers due to squeezing returns and hence needs special attention. In the Northern Karnataka region, there are several reasons for the low yields in cotton such as imbalanced fertilizers application, late planting, and improper pest management etc. where the rainy season starts probably during second fortnight of June to as late as August.

Therefore, there is very large yield gap between the average productivity of the country and of the region under the study. In this context, there is need for efforts to achieve pre-set yield targets with balanced fertilization and appropriate method of planting.

Transplanting, which was found promising in cotton in UKP irrigation project (Salakinkop, 2011and Honnali and Chittapur, 2013) was hypothesized to make good the yield losses caused due to late planting as a month old seedlings are used for planting and these seedlings could pick up their growth from where they have stopped in the nursery. Hence, the present study on impact of method of establishment and time of planting was envisaged in the Tunga Bhadra irrigation command on vertisols.

Materials and Methods

On-station field study was conducted during *kharif* 2015 in Agronomy Farm, University of Agricultural Sciences, Raichur, Karnataka, India. The soils are alkaline (pH 8.2), non-saline (EC 0.24 dS/m), medium in organic Carbon (0.62 %), low in available N (220 kg ha^{-1}), medium in P_2O_5 (31 kg ha^{-1}) and high in K_2O (283 kg ha^{-1}).

Fertilizer N, P and K requirements were calculated by accounting the indigenous nutrient supply for a yield target of 5 t ha^{-1} (400:140:142.5 N:P_2O_5:K_2O kg ha^{-1}) and nutrient demand per ton of cotton lint yield as per set procedures of International Plant Nutrition Institute.

Ten treatments consisted of transplanting and dibbling of cv. Jaadhu at five dates of planting viz., 1st and 2nd fortnights of June and July and 1st fortnight of August were laid out using Split plot design with three replications with a gross plot of 9 m x 6 m and spacing of 90 cm X 60 cm. Entire phosphorus and 50 per cent N and K were applied basally. Remaining N and K were applied twice at 45 and 75 days after planting. Prophylactic plant protection measures were taken up as and when pest and disease crossed ETL. Growth and yield attributes were recorded, analysed and interpreted.

Results and Discussion

2015 being dry year and due to outbreak of American pink bollworm in spite of prophylactic measures neither with planting technique nor with time of planting target yield was achieved.

Of the two methods of establishment, transplanting recorded higher yields (3457 kg ha^{-1}) than seed dibbling (3280 kg ha^{-1}) (Table 2), however, it was hardly by about 5.3 %. Results are in line with Honnali and Chittapur (2013). Nevertheless, the differences were more conspicuous with time of planting, reductions ranged from 2.3 % with 2nd fortnight of June to 19 and 63 %, respectively with 1st and 2nd fortnight of July and to a maximum of 148 % with 1st fortnight of August planting over planting during 1st fortnight of June (4401 kg ha^{-1}). In all, transplanting during 1st fortnight of June followed by dibbling at the same time fared better and transplanting during 2nd fortnight of June was on par. The lowest yields were recorded with last planting particularly with dibbling (1906 and 1640 kg ha^{-1}, respectively) (Fig. 1).

Higher kapas yields with early planting (June planting) irrespective of method of planting could be attributed to seed cotton yield per plant (272.67 and 238.33 g/ plant), boll weight per plant (5.71 and 5.19 g/boll), seed index (11.67 and 10.63), harvest index (0.46 and 0.45), and good opened bolls per plant at harvest (44.93 and 43.80 respectively with transplanting and dibbling during 1st fort night of June) (Table 2).

The results are in line with Iqbal *et al.*, (2012), Zaheer *et al.*, (2014) and Rajesh Kumar *et al.*, (2014). Elayan *et al.*, (2015) reported a yield increase of 29 per cent with early planting (3rd week of May) over delayed planting (2nd week of June).

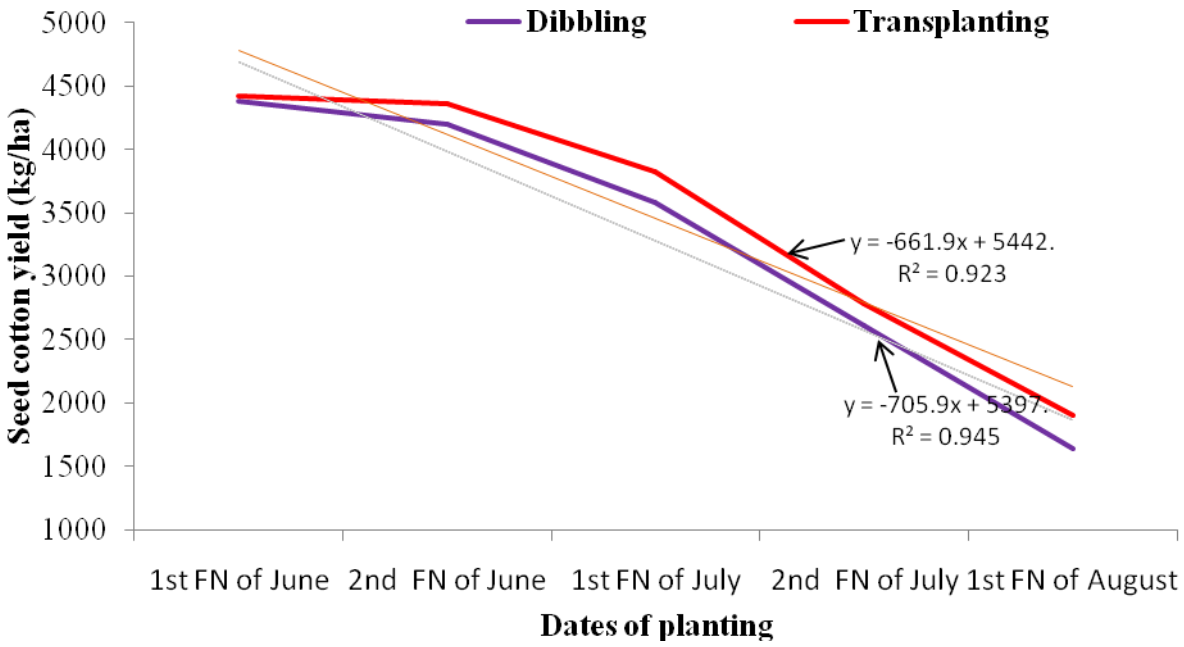
Table.1 Growth parameters of *Bt*-Cotton as influenced by methods and dates of planting

Treatments	Plant height (cm)	Mono./ plant	Sym. / plant	Leaf area / plant (dm^2)	Leaf area index	SPAD reading at 90 DAS/DAT	NDVI values at 90 DAS/DAT
Method of planting							
Dibbling	138	2.01	37.03	122.05	2.28	44.03	0.72
Transplanting	149	2.23	39.81	124.64	2.33	46.36	0.80
S. Em. ±	1.06	0.03	0.12	0.26	0.01	0.18	0.01
C. D. @ 5%	6.95	0.16	0.80	1.69	0.03	1.15	0.05
Dates of planting							
1st FN of June	179	2.57	42.54	135.49	2.52	49.89	0.81
2nd FN of June	163	2.33	39.65	132.74	2.46	47.86	0.80
1st FN of July	145	2.07	39.02	121.18	2.33	45.08	0.77
2nd FN of July	127	1.87	35.98	116.13	2.16	42.35	0.73
1st FN of August	103	1.77	34.90	111.18	2.06	40.80	0.68
S. Em. ±	1.28	0.08	0.29	0.73	0.02	0.43	0.01
C. D. @ 5%	3.86	0.24	0.88	2.21	0.07	1.31	0.03
Interaction between method and dates of planting							
Dibbling – 1st FN of June	171	2.47	40.46	133.50	2.47	48.24	0.78
Dibbling – 2nd FN of June	162	2.07	38.75	130.82	2.42	46.76	0.77
Dibbling – 1st FN of July	140	2.00	37.81	121.17	2.31	43.50	0.72
Dibbling – 2nd FN of July	120	1.80	34.47	114.33	2.14	41.55	0.69
Dibbling – 1st FN of August	95	1.73	33.65	110.43	2.05	40.12	0.62
Transplanting - 1st FN of June	186	2.67	44.61	137.48	2.56	51.55	0.84
Transplanting – 2nd FN of June	164	2.60	40.56	134.65	2.49	48.97	0.82
Transplanting – 1st FN of July	150	2.13	40.23	121.19	2.35	46.66	0.81
Transplanting – 2nd FN of July	134	1.93	38.31	117.94	2.18	43.15	0.76
Transplanting – 1st FN of August	110	1.80	35.33	111.94	2.07	41.48	0.74
S. Em. ±	1.93	0.10	0.39	0.96	0.03	0.57	0.57
C. D. @ 5%	8	NS	1.31	NS	NS	NS	NS

Table.2 Yield and yield attributes of *Bt*-cotton as influenced by methods and dates of planting

Treatments	Bolls/ plant	Boll weight (g)	Seed cotton yield (g/plant)	Seed cotton yield (kg/ha)	Seed index	Harvest index
Method of planting						
Dibbling	36.85	4.62	178.40	3280	9.24	0.36
Transplanting	39.88	5.09	205.11	3457	9.76	0.37
S. Em. ±	0.19	0.07	2.54	19.60	0.07	0.00
C. D. @ 5%	1.27	0.42	16.63	128.41	0.44	0.01
Dates of planting						
1st FN of June	44.37	5.45	255.50	4401	11.15	0.46
2nd FN of June	43.10	5.14	232.28	4277	10.08	0.44
1st FN of July	38.87	4.80	210.50	3698	9.60	0.41
2nd FN of July	35.70	4.50	158.33	2693	8.38	0.32
1st FN of August	29.80	4.38	102.17	1773	8.28	0.21
S. Em. ±	0.35	0.08	3.99	41	0.07	0.01
C. D. @ 5%	1.04	0.24	12.07	124	0.21	0.02
Interaction between method and dates of planting						
Dibbling – 1st FN of June	43.80	5.19	238.33	4376	10.63	0.45
Dibbling – 2nd FN of June	42.27	5.00	220.67	4198	9.89	0.44
Dibbling – 1st FN of July	36.07	4.59	199.33	3576	9.35	0.40
Dibbling – 2nd FN of July	33.27	4.24	146.00	2609	8.20	0.31
Dibbling – 1st FN of August	28.87	4.07	87.67	1640	8.07	0.19
Transplanting - 1st FN of June	44.93	5.71	272.67	4426	11.67	0.46
Transplanting – 2nd FN of June	43.93	5.28	243.90	4356	10.27	0.44
Transplanting – 1st FN of July	41.67	5.01	221.67	3819	9.85	0.41
Transplanting – 2nd FN of July	38.13	4.76	170.67	2777	8.56	0.32
Transplanting – 1st FN of August	30.73	4.70	116.67	1906	8.49	0.23
S. Em. ±	0.48	0.12	5.05	55	0.11	0.01
C. D. @ 5%	1.72	NS	NS	197	0.47	NS

Fig.1 Yield response curve of *Bt* Cotton under different methods and dates of planting



These variations in yield components could be further traced back to improved plant growth and architecture viz., plant height (186.2, 171.3 cm, respectively with transplanting and dibbling during 1st fortnight of June), number of monopodials per plant (2.67 and 2.47, respectively with transplanting and dibbling during 1st fortnight of June) and number of sympodials per plant (44.61 and 40.46, respectively with transplanting and dibbling during 1st fortnight of June) which enabled better net radiation assimilation as evidenced by leaf area (137.48 dm^2/plant with transplanting and 133.5 dm^2/plant with dibbling during 1st fortnight of June as against 111.94 dm^2/plant with transplanting and 110.43 dm^2/plant with dibbling, respectively during 1st fortnight of August), leaf area index (2.56 with transplanting and 2.47 with dibbling, during 1st fortnight of June as against 2.07 with transplanting and 2.05 with dibbling with during 1st fortnight of August), SPAD (51.82, 51.55, 47.54 and 44.61 with transplanting and 47.51, 48.24, 45.47 and 40.46 with dibbling, respectively at 45, 90 and 135 DAS/DAT, and at harvest during 1st fortnight of June as against 42.08, 41.48, 37.31 and 35.33 with transplanting and 38.74, 40.12, 36.84 and 33.65 with dibbling, respectively at 45, 90 and 135 DAS/DAT and at harvest during 1st fortnight of August), and NDVI (0.82, 0.84, 0.81 and 0.80 with transplanting and 0.79, 0.78, 0.77 and 0.76 with dibbling, respectively at 45, 90 and 135 DAS/DAT, and at harvest during 1st fortnight of June as against 0.71, 0.74, 0.73 and 0.67 with transplanting and 0.74, 0.62, 0.61 and 0.61 with dibbling, respectively at 45, 90 and 135 DAS/DAT, and at harvest during 1st fortnight of August) values which were higher with June planted crop whether dibbled or transplanted while last planted crop had the lowest values for all these attributes.

It was clear from the study that delayed planting would lead to yield reduction in spite of applying major nutrients in required quantities for targeted yields and planting methods would not help in recovering the yield losses though transplanting marginally fared better than dibbling.

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