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Effect of tillage and crop establishment methods on yield and economics of cotton

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ABSTRACT

In Haryana (India) cotton is generally sown with conventional tillage practices witnesses poor germination and plant establishment. Poor plant stand is attributed by burning of emerging plants due to very high temperature at the time of planting, which is further worsen by crust formation due to pre-monsoon showers. Keeping these points in view, an experiment was conducted with farmers' participatory research mode in village Hajwana of Kaithal district. Cotton sown with zero tillage technique resulted in approximately five percent higher yield *i.e.* 136.3 kg ha^{-1} over conventional tillage. Mean returns over variable cost of all the three years were 10.8 percent *i.e.* Rs. 11794 ha^{-1} more in zero tillage over conventional tillage. Benefit: cost ratio were 3.86, 3.86 and 4.61 in conventional method of planting, bed planting and zero tillage technique, respectively. Zero tillage planting of cotton reduced fuel consumption by 93.4 % and 91.7 % compared to bed planting and conventional planting respectively.

Keywords: *Bt* cotton, zero tillage, bed planting and yield

INTRODUCTION

Cotton production and related businesses are among the most main sources of employment and income for different nations around the world. In India, cotton is cultivated in 7.8 million hectares in varied agro-ecological conditions across nine major states. Cotton cultivation offers employment of 200 man-days/ha annually. It employs directly and indirectly more than 60 million persons in its production, processing and marketing (Vittal *et al.*, 2004). This is an essential raw material in textile and oil press industries in many countries. Cotton requires a growing season of more than 150 days. It not only provides fiber for the textile industry, but is also an oilseed whose cake can be fed to cattle. There are few revolutions in agriculture that occur in any one lifetime. For thousands of years tillage and agriculture were synonymous, and it was difficult to think of growing plants without tillage or without controlling weeds. However, with the introduction of modern herbicides, cultivation without tillage became a reality. Repeated intensive tillage on soils in the tropics and subtropics leads to soil loss, reduction in soil nutrients and organic matter (including soil organisms), release of soil carbon to atmosphere, undesirable changes in soil structure, and reduced water infiltration and moisture-holding capacity. Conventional cotton production practices encompass several tillage operations, including land planing, leveling, harrowing, chisel ploughing, and cultivation for weed control and maintenance of irrigation furrows. Tillage operations may lead to degradation of soil structure, oxidation of organic matter and soil loss through wind and water erosion. Zero tillage is an alternative production system that may offer several economic and environmental profits. Over time, crop residue on the soil surface may increase the infiltration of water into the soil as compared to conventional tillage production, reduce crusting and decrease the effect of wind and temperature on soil water evaporation from the soil surface. Reducing tillage operations can also enhance cotton root growth by minimizing soil compaction. These beneficial effects of conservation tillage practices related to soil and water management can enhance environmental quality and improve the natural resource base on which a large portion of agricultural economy depends. In Haryana (India) cotton is generally sown with conventional tillage practices in the month of April/May. At this time temperature is very high which lead to burning of emerging plant. Also pre - monsoon showers after sowing result in crust formation hence hampering germination. Heavy rain at early growth stage may result in stagnation of water and cotton is very sensitive to moisture at this stage. So farmers have to sow the cotton again and again.

The increases in fuel prices have renewed the interest in reduced tillage systems previously considered for conservation reasons, but now considered for economic reasons as well. De Vita *et al.* (2007) reported that zero tillage decreased the evaporation from the top soil. Straw of wheat is either removed from the fields or is burnt due to shortage of time between harvesting of wheat crop (mid April) and sowing of cotton crop (end of April to mid of May) that causes loss of carbon and other nutrients and development of water repellency in soil (Singh *et al.*, 2005). As a result, productivity of cotton–wheat system has become static or started declining and is showing the sign of fatigue. The objective of this study was to sustain and improve cotton productivity, investigate

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the effects of different tillage systems on lint yield of Bt cotton and to increase the profitability by reducing the tillage operations.

MATERIALS AND METHODS

Site characteristics

Field experiments were conducted for three rotations of cotton–wheat system in years of 2011, 2012 and 2013 at farmer's field in village Hajwana of Kaithal district (Haryana, India) in participatory mode. The soil of the experimental field was loamy in texture having pH 8.0, medium in organic carbon (0.45%), medium in available phosphorus (13.0 kg ha^{-1}) and medium in available potassium (172 kg ha^{-1}).

Treatments

The experiment was conducted with three treatments and seven replications in randomised block design.

- Farmers' Practice (Conventional tillage) : (3 harrowing + 2 cultivator + 2 planking)
- Bed Planting : (3 harrowing + 2 cultivator + 2 planking)
- Zero tillage: (no harrowing and no cultivator)

Crop management

Field was prepared for sowing of cotton crop by applying a pre-sowing irrigation of 7cm. The recommended doses of fertilizers @ 175 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1} were applied as per recommendation. In conventional sowing and zero tillage, sowing of Bioseed 6488 BG II was done with the cotton planter on 2nd May, 28th May and 6th May during 2011, 2012 and 2013 respectively. The seed rate was 2.25 kg ha^{-1}. The spacing was 100 cm row to row x 45cm plant to plant. In bed planting method a slight modification was made so as to prepare bed of 80 cm width and sowing was done on the bed with bed planter maintaining row to row spacing of 100 cm. Weeds were controlled with pre-emergence application of Stomp 30 EC (pendimethalin) @ 2.5 L ha^{-1} and two manual hoeings at 40 and 65 days after sowing of the crop. Protected spray of 0.5% glyphosate was done to control weeds in zero tillage planting. Insects and sucking pests were controlled by adopting the recommended schedule as per Haryana Agricultural University, Hisar. Thinning/gap filling was done before first irrigation so as to maintain the recommended spacing and only single plant was left at one place.

Irrigations were applied to the crop depending on the requirements and rainfall during the crop season. The data on number of monopods, sympods and bolls/plant were recorded from randomly selected (tagged) five plants in each treatment when the boll formation was completed and seed cotton yield was recorded from the whole plot excluding boarder rows. The crop was picked three times in each treatment. The crop was harvested on 2nd week of December in both the years. Fuel consumption was obtained using full tank method for both seed bed preparation and planting operations. Total time required for seed bed preparation and planting operations in each treatment was measured by adding time spent in each operation.

Statistical analysis

The data was analyzed using OPSTAT. Online Statistical Analysis was available on CCSHAU, Hisar website.

RESULTS AND DISCUSSION

Seed cotton yield

The data presented in Table 1 clearly revels that there was no significant difference in seed cotton yield and yield contributing characters during all the three years, although maximum seed cotton yield was realized under zero tillage sowing of cotton. Mean data on seed cotton yield of all the three years presented in Fig. 1 reveal that cotton sown with zero tillage technique resulted in approximately five percent higher yield *ie* 136.3 kg ha^{-1} over conventional tillage. The higher yield achieved may be be due to reduction of some weather risks such as burning of young seedling due to higher temperature, crust formation due to rain, avoidance from heavy rain due to increase in infiltration rate, better moisture retention and reduced rainfall runoff. Kennedy and Hutchinson (2001) reported that no-tillage had a five and 16 percent higher yield than the conventional till and reduced till systems, respectively. Boquet *et al.* (2004) also showed a five and a nine percent higher lint yield in a no-tillage system than in a conventional tillage system, respectively.

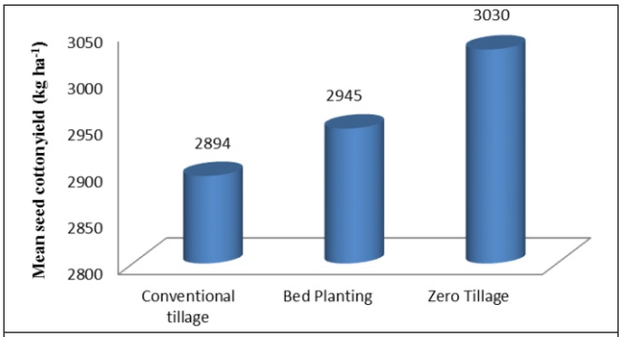

Fig 1: Mean Seed cotton yield (Kg ha^{-1}) in different methods of planting

Table1: Effect of different planting methods on yield and yield attributing characters of *Bt* Cotton

Treatments	Sympods / plant			Bolls/ plant			Seed cotton Yield (kg ha^{-1})		
Conventional	2011	2012	2013	2011	2012	2013	2011	2012	2013
Tillage	31.00	29.17	32.00	47.51	42.00	48.0	3125	2300	3256
Bed Planting	32.15	30.00	33.2	47.20	42.00	48.6	3175	2350	3310
Zero Tillage	32.00	30.20	33.6	48.00	44.16	48.6	3250	2500	3340
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Monitory benefit

Data presented in Table 2 reflect that highest returns over variable cost were achieved under zero tillage planting method of cotton. Returns were more in 2011 because the rate of seed cotton was Rs. 6500 qt^{-1}, whereas, in 2012 and 2013 rate was Rs. 4000 qt^{-1}. Seed cotton yield was also more in 2011and 2013 as compared to 2012.

Mean returns over variable cost of all the years were 10.8 percent *i.e.* Rs. 11794 ha^{-1} more in zero tillage planting over conventional tillage practices. Benefit: cost ratio were 3.86, 3.86 and 4.61 in conventional method of sowing, bed planting and zero tillage technique, respectively. Increase in profit may be due to reduced energy needs, savings in labor and lower fuel use in field preparation and planting.

Sullivan *et al.* (2008) also reported that no-till management can reduce costs and improve performance compared to conventional tillage. Dangolani and Narob (2013) also reported the similar results. Atwell *et al.* (2001) reported that no tillage had a $104 (Rs. 6672) ha^{-1} and $180 (Rs.11548) ha^{-1} higher profit than a strip tillage and conventional tillage system, respectively, in the first three years of a study. Smart *et al.* (2001) found that conservation till had a $121 (Rs. 7763) ha^{-1} lower input cost and equal or greater economic returns than a conventional moldboard plow tillage system.

Table 2: Economics of different planting methods

Treatments	Returns over variable cost (Rs. ha^{-1})				B:C Ratio			
Conventional	2011	2012	2013	Mean	2011	2012	2013	Mean
Tillage	168236	63965	94650	108950	5.49	2.61	3.48	3.86
Bed Planting	170699	65928	96002	110876	5.47	2.65	3.47	3.86
Zero Tillage	180373	79619	102241	120744	6.40	3.42	4.02	4.61

Time requirement

In bed planting method, 425 minutes were required for seed bed preparation and planting operations in one hectare while, these times were 312.5 and 37.5 minutes for conventional and zero tillage methods, respectively (Fig. 2). Since there was no seed bed preparation operation in the zero tillage method, time saving in this method was 88% as compared to farmers' practice *i.e.* conventional tillage. Afzalinia *et al.* (2011) also reported that zero tillage planting saved 73.9 % time as compare to conventional tillage.

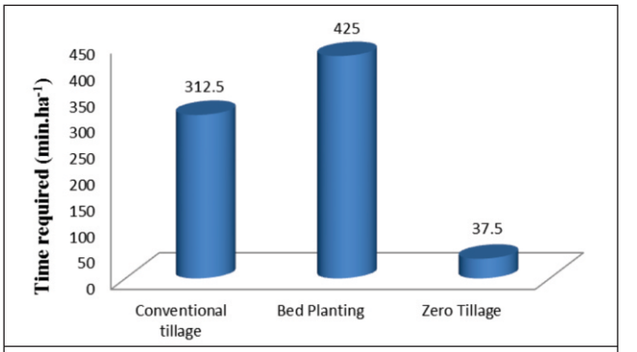

Fig 2: Time required for seedbed preparation and planting in different planting system

Fuel consumption

The effect of tillage methods on fuel consumption during seed bed preparation and planting process is shown in Fig 3. Bed planting consumed the highest amount of fuel (56.5 L ha^{-1}) *i.e.* 52.75 L ha^{-1} more than zero tillage planting as no operation was done for seed bed preparation in zero tillage planting. Results reveal that zero tillage planting of cotton reduced fuel consumption by 93.4 % and 91.7 % as compared to bed planting and conventional planting respectively. Rusu (2005) reported that minimum tillage reduced fuel consumption by 12.4 to 25.3 liter per hectare and power requirement by 23.6 to 42.8 % compared to conventional tillage. Afzalinia *et al.* (2011) also reported that fuel consumption saving was 77.3 % when using zero tillage method.

Table: 3: Cost comparisons in seedbed preparation and planting (Rs. ha^{-1}) among different treatments

Name of operation	Conventional sowing (Rs. ha^{-1})				Bed Planting (Rs. ha^{-1})				Zero Tillage (Rs. ha^{-1})			
	2011	2012	2013	Mean	2011	2012	2013	Mean	2011	2012	2013	Mean
Harrowing	3000	3375	3750	3375	3000	3375	3750	3375	-	-	-	-
Cultivator	2000	2500	2500	2333	2000	2500	2500	2333	-	-	-	-
Planking	500	750	750	667	500	750	750	667	-	-	-	-
Sowing	1000	1000	1250	1083	2000	2500	2500	2333	1000	1000	1250	1083
Total	6500	7625	8250	7458	7500	9125	9500	8708	1000	1000	1250	1083

Cost comparison

Net monitory saving in seed bed preparation and planting under zero tillage over conventional tillage and bed planting in cotton is Rs 6375 and Rs 7625 respectively (Table 3). Jalota *et al.* (2008) also reported that net monitory saving under optimum tillage over conventional tillage was 31.0 US$ in cotton.

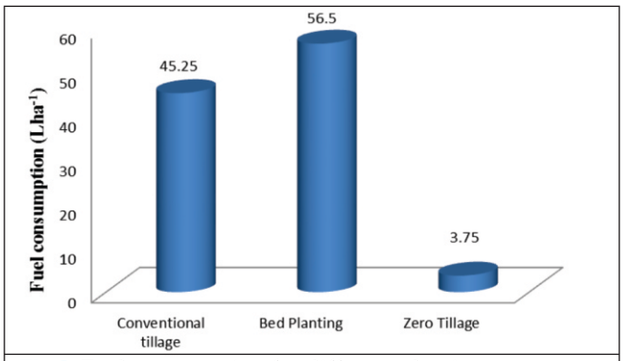

Fig 3: Fuel consumption for different planting systems

CONCLUSIONS

The studies suggested that cotton sowing under no-till systems not only help to avoid injury to cotton plant due to higher temperature and crust formation, but also avoided residue burning and environmental pollution.

Sowing of the crop was also advanced by a week in zero tillage technique which in turn helps in timely maturity of the crops. No – till technique planting of cotton also resulted in increase in cotton yield, higher returns over variable cost, more B: C ratio and less fuel consumption.

REFERENCES

Afzalinia S, Behaeen MA, Karami A, Dezfuli A and Ghaisari A. 2011. Effect of conservation tillage on soil properties and cotton yield. *Journal of Agricultural Machinery Science* **7**(1): 73-76.

Atwell K, Bradley J and Buman R. 2001. Cost comparisons of tillage systems in Southern Alabama. *Proceedings of the Beltwide Cotton Conference* **1**:196-198.

Boquet D, Hutchinson RL and Breitenbeck GA. 2004. Long-term tillage, cover crop, and nitrogen rate effects on cotton: Plant growth and yield components. Proceedings of the Conservation Tillage Cotton and Rice Conference. *Agronomy Journal* **96**(5):1443-1452.

Dangolani SK and Narob MC. 2013. The effect of four types of tillage operations on soil moisture and morphology and performance of three varieties of cotton. *European Journal of Experimental Biology* **3**(1):694-698.

De Vita P, DiPaolo E, Fecondo G, Difonzo N and Pisante M. 2007. No tillage and conventional tillage effects on durum wheat yield, grain quality and soil moisture content in southern Italy. *Soil and Tillage Research* **92**(1-2): 69-78.

Jalota SK, Buttar GS, Sood Anil, Chahal GBS, Ray SS and Panigrahy S. 2008. Effects of sowing date, tillage and residue management on productivity of cotton (*Gossypium hirsutum* L.) –wheat (*Triticum aestivum* L.) system in northwest India. *Soil and Tillage Research* **99**: 76–83.

Kennedy CW and Hutchinson RL. 2001. Cotton growth and development under different tillage systems. *Crop Science* 41:1162-1168.

Rusu T. 2005. The influence of minimum tillage systems upon the soil properties, yield and energy efficiency in some arable crops. *Journal of Central European Agriculture* **6**(3): 287-294.

Singh G, Jalota SK and Sidhu BS. 2005. Soil physical and hydraulic properties in a rice–wheat cropping system in India: effects of rice straw management. *Soil Use Manage.* **21**:17–21.

Smart JR, Greenberg SM and Bradford JM. 2001. Conservation tillage can affect cotton plant structure and yield. *Proceedings of the Beltwide Cotton Conference* 1:609-611.

Sullivan DG, Lee D, Beasley J and Brown S. 2008. Evaluating a crop residue cover index for determining tillage regime in a cotton-corn-peanut rotation. *Journal of soil and water conservation* **63**(1): 28-36.

Vittal KPR, Rajendran TP, Ravindra CG, Maruthi Sankar, GR Srijaya, Ramakrishna YS, Samra JS and Singh Gurbachan. 2004. District wise Promising Technologies for Rainfed Cotton based Production System in India. A compendium of AICRPDA, CRIDA, AICCIP, SAUs, State Department(s) of Agriculture and Agro-Industries. Central Research Institute for Dry land Agriculture Hyderabad India.

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