



## RESEARCH PAPER

# Germination and crop yield in cotton - maize cropping system influenced by tillage and land configuration

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**Abstract :** A field experiment with different tillage practices and planting management in cotton - maize cropping systems was conducted under irrigated conditions in a sandy clay loam soil at the Tamil Nadu Agricultural University, Coimbatore during 2011-12 and 2012-13. Totally there were 8 treatments which were replicated thrice in a Randomized Block Design. The treatments consisted of three tillage practices viz., conventional tillage, reduced tillage and zero tillage and three types of land configurations viz., flat bed and furrow irrigated raised bed (FIRB) which were compared with the existing practice of ridges and furrows. The two years average of the germination and yields of cotton - maize cropping systems as a whole under different tillage and planting management revealed that the zero tillage with flat surface planting system gave lesser number germination percentage and yield compared with other types of tillage and planting management which was followed by reduced tillage once to cotton alone and planting on FIRB and conventional tillage once to cotton alone and planting on FIRB. Tilled plot got more germination percentage compared to no-tilled plots and more yield was registered with tillage once to cotton alone and planting on FIRB and conventional tillage once to cotton alone and planting on FIRB.

**Key Words :** FIRB, Conventional tillage (CT), Reduced tillage (RT), Zero tillage (ZT), Germination

**View Point Article :** Puvila, P., Siddeswaran, K. and Shanmugam, P.M. (2016). Germination and crop yield in cotton - maize cropping system influenced by tillage and land configuration. *Internat. J. agric. Sci.*, **12** (2) : 252-256, DOI:10.15740/HAS/IJAS/12.2/252-256.

**Article History :** Received : 01.02.2016; Revised : 04.03.2016; Accepted : 25.04.2016

## INTRODUCTION

In this context an experiment was conducted from 2011 to 2013 to study the germination and yield of the cotton - maize cropping systems under different tillage and planting management techniques. Tilled plots with more seed of cotton and maize in both the year getting higher germination percentage compared to no-till plots. Conventional tillage registered more population compared to other tillage method (zero tillage's). Due to the highly pulverize, friable soil condition and favorable for seed germination, reduced tillage and conventional tillage plot

were registering more population due to higher seed germination. The higher germination percentage registers for tilled polts directly equal to the yields. Furrow irrigated raised bed method of sowing significantly reduced the plant mortality percentage as compared to flat beds (Ram *et al.*, 2012). Further, improved aeration and conducive air-water relationship under FIRB method of sowing might have contributed to healthy growth and development of plants thereby reducing mortality percentage. The present study was conducted on germination and yield influenced by tillage and land

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configuration in cotton and maize cropping system.

## MATERIAL AND METHODS

Field experiment was conducted under irrigated conditions during winter and summer seasons of 2011-12 and 2012-13 at Tamil Nadu Agricultural University, Coimbatore to study the influence of tillage and land configuration on the growth, productivity and energy of cotton - maize cropping systems in sandy clay loam soil. The experiment with cotton (Bt Bunny) - maize (NK 6240) cropping system was laid out in a randomized block design with eight treatments replicated thrice. The treatment combinations were T<sub>1</sub>: Conventional tillage to both cotton and maize and planting on flat bed, T<sub>2</sub>: Conventional tillage to both cotton and maize and planting on furrow irrigated raised bed (FIRB), T<sub>3</sub>: Conventional tillage once to cotton alone and planting on FIRB, T<sub>4</sub>: Reduced tillage to both cotton and maize and planting on flat bed, T<sub>5</sub>: Reduced tillage to both cotton and maize and planting on FIRB, T<sub>6</sub>: Reduced tillage once to cotton alone and planting on FIRB, T<sub>7</sub>: Zero tillage and planting on flat bed and T<sub>8</sub>: Conventional tillage to both cotton and maize and planting on ridges and furrows (existing practice as check). Under the conventional tillage, initial ploughing was carried out with five tyne cultivator once followed by two ploughing with cultivator. Finally one rotavator ploughing was done. Under minimum tillage, initial ploughing was carried out with

five tyne cultivator once followed by one rotavator ploughing. The raised bed was formed with 90 cm width and 15 cm height and furrow width of 30cm. All the recommended packages of practices were adopted to both cotton and maize as per the crop production guide of Tamil Nadu.

## RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

### Germination (%) :

The germination percentage of cotton and maize crops were unaffected due to the tillage operations and land configurations during 2011-12. However, during 2012-13, there was significant difference among the treatments. Whenever, cotton and maize crops were sown under flat bed system either with conventional tillage or reduced tillage or without any tillage operation (zero tillage), the germination percentage was significantly affected compared to cotton and maize crops were raised in FIRB or ridges and furrows. The lowest germination percentage of crop cotton 89.7 was recorded in the zero-tillage plots (T<sub>7</sub>). In maize crop lowest germination percentage was recorded with CT to both cotton and maize and planting on flat bed (78 %) (T<sub>1</sub>) and it was statistically at par with zero tillage and planting on flat

**Table 1 : Effect of tillage and land configuration on germination of cotton and maize crops**

Treatments	Cotton germination (%)		Maize germination (%)	
	2011-12	2012-13	2011-12	2012-13
T <sub>1</sub>	87.3	92.3	88.3	78.0
T <sub>2</sub>	91.7	93.6	92.7	91.7
T <sub>3</sub>	93.7	93.2	89.0	87.0
T <sub>4</sub>	85.3	91.2	88.3	87.0
T <sub>5</sub>	93.7	92.8	89.7	92.7
T <sub>6</sub>	92.0	93.8	89.3	85.7
T <sub>7</sub>	85.3	89.7	87.3	79.3
T <sub>8</sub>	95.0	93.4	91.0	91.7
S.E. ±	4.4	1.0	2.1	2.6
C.D. (P=0.05)	NS	2.1	NS	5.4

NS=Non-significant

T <sub>1</sub> :	Conventional tillage to both cotton and maize planting on flat bed	T <sub>5</sub> :	Reduced tillage to both cotton and maize planting on FIRB
T <sub>2</sub> :	Conventional tillage to both cotton and maize planting on furrow irrigated raised bed (FIRB)	T <sub>6</sub> :	Reduced tillage once to cotton alone planting on FIRB
T <sub>3</sub> :	Conventional tillage to once cotton alone planting on furrow irrigated raised bed (FIRB)	T <sub>7</sub> :	Zero tillage and planting on flat bed
T <sub>4</sub> :	Reduced tillage to both cotton and maize planting on flat bed	T <sub>8</sub> :	Conventional tillage to both cotton and maize planting on ridges and furrows (existing practice as check)

bed (T<sub>7</sub>) (Table 1).

Conventional tillage has registered higher germination percentage compared to RT and ZT. Higher plant population was recorded in CT which was at par with RT. Whenever, cotton and maize crops were sown either, under flat bed system with conventional tillage or reduced tillage and zero tillage, there was a no significant difference in the germination per centage. Furrow irrigated raised bed method of sowing significantly reduced the plant mortality percentage as compared to flat beds. Similar results were found by Ram *et al.* (2012). Further, improved aeration and conducive air-water relationship under FIRB method of sowing might have contributed to healthy growth and development of plants thereby reducing mortality percentage. As against this, plants on flat bed were subjected to temporary water logging and surface crusting which might have accentuated the detrimental effects of salts from saline irrigation water. The EC of the irrigated water less than 4(ds/m), it was mixed with good quality water irrigated to the field. Lesser salt encrustation was observed on the raised beds compared to flat beds and reduced water logging effects on crops grown on FIRB. Similar result has been reported by Singh *et al.* (2010).

#### Seed cotton yield (kg ha<sup>-1</sup>) :

Remarkable increase in the seed cotton yield (kg

ha<sup>-1</sup>) was achieved due to different tillage and land configuration treatments during both the years of study. In general, the productivity level of seed cotton yield during 2011-12 was better than 2012-13 (Table 2).

Higher seed cotton yield and stalk yield were registered under RT and planting on FIRB (T<sub>5</sub>) compared with other CT and ZT cotton planting systems. Conventional tillage and RT with FIRB planting system produced statistically at par yield, but ZT and planting on flat bed produced lesser yield. It might be due to higher population recorded in the tilled plots compared to ZT. However, CT increased seed cotton yield and lint yield over the ZT which might be due to higher plant density in CT (Abaye *et al.*, 1995). Zero tillage was found to be significantly inferior to CT and RT which might be due to the poor root growth and considerable reduction in biomass production was noted due to reduction in initial plant population (Venkatesawarlu *et al.*, 2009). It is important to mention that, the number of plants per unit area is maintained by changing the plant to plant and row to row spacing. It has been observed that usually the plant population is greater in bed and furrow system than in the traditional flat and ridges and furrow planting practices (Ahmad *et al.*, 2011).

Furrow irrigated raised bed and ridges and furrow methods produced significantly higher yield compared to flat bed sowing. The difference in seed cotton yield

**Table 2 : Effect of tillage and land configuration on cropping system crop yields (kg ha<sup>-1</sup>)**

Treatments	Crop yield (kg ha <sup>-1</sup> )			
	Cotton seed yield		Maize grain yield	
	2011-12	2012-13	2011-12	2012-13
T <sub>1</sub>	2307	2192	7419	4966
T <sub>2</sub>	2698	2248	7687	6094
T <sub>3</sub>	2746	2432	8084	6558
T <sub>4</sub>	2424	2205	6968	5615
T <sub>5</sub>	2887	2560	7610	6360
T <sub>6</sub>	2546	2326	7464	5736
T <sub>7</sub>	2039	1886	6631	4928
T <sub>8</sub>	2802	2451	7794	6638
S.E. ±	107	95	362	265
C.D. (P=0.05)	224	202	757	554

T <sub>1</sub> :	Conventional tillage to both cotton and maize planting on flat bed	T <sub>5</sub> :	Reduced tillage to both cotton and maize planting on FIRB
T <sub>2</sub> :	Conventional tillage to both cotton and maize planting on furrow irrigated raised bed (FIRB)	T <sub>6</sub> :	Reduced tillage once to cotton alone planting on FIRB
T <sub>3</sub> :	Conventional tillage to once cotton alone planting on furrow irrigated raised bed (FIRB)	T <sub>7</sub> :	Zero tillage and planting on flat bed
T <sub>4</sub> :	Reduced tillage to both cotton and maize planting on flat bed	T <sub>8</sub> :	Conventional tillage to both cotton and maize planting on ridges and furrows (existing practice as check)

could be mainly attributed to different in DMP and crop growth functions. The LAI and NAR were higher in normal sown crops in treatments ridges and furrows and FIRB (Halepyati and Hosamani, 1991). This is in contrast to the finding of Ali and Ehsanullah (2007) who reported that flat planting gave higher seed cotton yield than bed planting and ridges and furrows planting. The maximum seed cotton yield was recorded in the treatment ridges and furrows, which was significantly superior to rest of the treatments. The ridges and furrows was found most effective and feasible for soil moisture conservation and producing the highest seed cotton yield on black cotton soil under assured rainfall condition (Jadhav *et al.*, 2008).

### Maize yield :

*Grain yield (kg ha<sup>-1</sup>) :*

Maize grain yield was significantly influenced by the different tillage practices with different land configuration during 2011-12 and 2012-13 (Table 2). Conventional tillage once to cotton alone and maize planting on permanent FIRB (T<sub>3</sub>) recorded higher grain yield of 8084 kg ha<sup>-1</sup> which was statistically at par with CT to both cotton and maize and planting on ridges and furrows (T<sub>8</sub>) (7794 kg ha<sup>-1</sup>), CT to both cotton and maize and planting on flat bed (T<sub>2</sub>) (7687 kg ha<sup>-1</sup>), and RT to both cotton and maize and planting on FIRB (7610 kg ha<sup>-1</sup>) during 2011-12 year. During both the years of study the plots under ZT recorded lower maize grain yield. Between the two years of study, higher maize grain yield was realized during 2011-12 as compared to 2012-13.

Tillage and land configuration treatments significantly influenced the grain of maize. Conventional tillage once to cotton alone and planting maize on permanent FIRB (T<sub>3</sub>) recorded higher of maize compared to other treatments. Grain yield of CT plot was statistically at par with RT but was significantly higher than ZT plots. Similar results were observed by Khan *et al.* (2009). However, in contrast, it is interesting to note that ZT gave statistically similar yield to RT and CT (Singh and Brar, 1994). However, higher maize yield was recorded in RT as compared to the CT in cotton - maize crop rotation (Sharma *et al.*, 2011).

Higher yield was recorded in mechanically tilled and bed / ridges planted plots compared to zero-tilled plots which might improve the soil macro porosity and aeration due to tillage. Further enhanced root growth and uptake of nutrients in tilled plots than zero-tilled plots could be

possible in tilled and bed or ridges planted system. The implication of this is that some form of soil preparation is required for optimum maize grain yield. Higher yield attributes in maize leads to higher grain yield and due to the improved soil macro porosity and aeration of tilled plots. Higher degree of reduction in the soil nutrient status and grain yield of maize in mechanically tilled plots in the second planting season compared to zero-tilled plots implies a faster rate of soil degradation in mechanically tilled plots. Hence, ZT could better soil conserving tillage practice especially for the present situation of continuous cropping of the limited land resources. Similar results were observed by Ojeniyi and Adekayoda (1999) and Johnson-Maynard *et al.* (2007).

Planting system brought a marked variation in grain yield of maize (Bhahma *et al.*, 2007; Thind *et al.*, 2010 and Kumer *et al.*, 2012). The superiority of yield in case of bed and furrow seems to be due to better plant population and a better combination of number of rows per grains, cob weight, grains per cob and other yield attributes (Mehmood, 2000; Tehreema Iftikhar *et al.*, 2010). The increase in grain yield of maize under FIRB could be attributed to higher yield attributes whereas, the increase in biological yields under in FIRB due to better soil environment in raised beds since prolonged ponding reduces yield. Similar results were reported by Idnani and Kumar (2012).

### Conclusion :

Among the different tillage practices, cotton and maize crops were sown under flat bed system either with conventional tillage or reduced tillage or without any tillage operation (zero tillage), the germination percentage was significantly affected compared to cotton and maize crops were raised in FIRB or ridges and furrows. Higher seed cotton yield was registered under RT and planting on FIRB (T<sub>3</sub>) compared with other CT and ZT cotton and maize planting systems. The lowest germination percentage and cotton and maize grain yield were recorded in all the season in the zero-tillage plots.

### Acknowledgement :

The authors are thankful to the Project Directorate for Farming Systems Research (ICAR), Modipuram, Meerut (UP) for providing the technical and financial support.

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