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Interactive Effect Of Different Farmyard Manure Levels And Tillage Operations On Yield Attributes Of Cotton

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ABSTRACT

Cotton (*Gossypium hirsutum* L.) crop has global importance and is extensively growing in more than 80 countries of the world. Tillage is vital feature for crop production and farm management. The present study was carried out to determine the effect of conventional and conservation tillage system in combination with farmyard manure application on cotton yield attributes for three years (2012, 2013 and 2014). Three tillage system including Minimum Tillage (Rotavator), Conventional tillage (Rotavator + Cultivator) and Deep tillage (chisel Plough) were evaluated at three farmyard manure levels (0, 10 and 15 tons/ha). Each year at crop maturity, plants were harvested and boll weight, number of bolls and plant height was recorded. Maximum boll weight was recorded at 15 tons/ha where conventional tillage operations were performed in the final year of the experiment (2014). Maximum bolls were counted at 10 tons/ha where conventional and deep tillage was carried out. Maximum plant height was recorded where deep tillage operations were performed, however, no significant difference in height was observed irrespective to the farm yard manure added. Maximum cotton yield was recorded in 2014 where deep tillage was performed adding 15 tons/ha farm yard manure.

KEYWORDS: *Gossypium hirsutum* L; Farmyard manure; Minimum Tillage; Conventional tillage; Deep tillage; Boll weight; Plant height; No. of bolls

INTRODUCTION

Tillage is vital feature for crop production and farm management. To cope with mounting concern of food security, there is need to identify ecofriendly and sustainable tillage system. Tillage is defined as mechanical manipulation of soil for crop production which ultimately affects different soil properties like soil temperature, soil water conservation and infiltration rate [12]. Tillage may be of two types, conventional tillage and conservation tillage. Conventional tillage involves different operations like disking, chisel ploughing aims to integrate plant residues and manures in the soil [15]. According to [8] conservation tillage is the method of seedbed preparation that contains residue mulch and an increase in surface roughness as the basic feature.

In conventional tillage a large number of serial passes are required for the preparation of land for planting resulting in soil surface bare and uncovered till crop development, this situation exposed the land for wind and precipitation causes soil erosion and nutrient loss [16]. Conventional tillage system is one of the reason affecting soil productivity because of erosion and degradation of organic matter in soil [4]. This system is expensive,

complex, relatively slow and labor intensive on the other side it requires a lot of energy and it is not an ecofriendly technique. [13], reported ecological disadvantages of conventional tillage like soil compaction due to recurrent machinery use over the same land, decrease in soil organic matter due to continuous disturbance of soil by intensive tillage and erosion of soil. [2], reported decrease in cotton yield up to 4% due to loss of each centimeter in topsoil. Keeping in view all the particulars mentioned, it is vital for cotton growers to move on reduced tillage practices instead of conventional system for better growth and high yield of cotton [3,7,10]. Long term and sustainable soil management can only be possible by the adoption conservation tillage practices like no-till system, crop residue management and crop rotation.

Reduced or conservation tillage system is ecofriendly technique as it requires less passes over the field which saves time, cost and energy in addition to these benefits this system can minimize the risk of soil erosion and loss of nutrients into groundwater through leaching. Long term conservation tillage system comprising of chiseling and no tillage showed positive impacts on soil physical properties as compared to conventional tillage [8,9]. Reduced tillage system provides better environment to crop and can influence the nutrient availability and supplemental nitrogen required to attain better yield of cotton. Triplett *et al.* reported increase in cotton yield with the adoption of reduced tillage system.

Little research work is done on organic amendments of soil in combination with tillage practices in Pakistan. The farmers of Pakistan use chemical fertilizers as main source to maintain crop yield and soil fertility while ignoring the importance of organic amendments like farm yard manure to maintain yield and fertility status of soils. Mosaddeghi, Hemmat, *et al*. [9], reported reduced soil compaction and better stand establishment of crop with the application and mixing of farm yard manure to the depth of 20 cm in soil. Improvement in soil structure amended with farm yard manure helps to check soil degradation [14]. The objective of this study is to determine the effect of conventional and conservation tillage system in combination with farmyard manure application on cotton yield attributes.

MATERIALS AND METHOD

Three-year study was carried out at the Adaptive Research Farm, Sargodha, Pakistan during the year 2013-15. The soil was loam in texture. The experiment was laid out in Split plot design comprising of three replications, having a net plot size of 30ft x 50ft and main plot size 90ft x 50ft. Experiment was comprised of three tillage system including Minimum Tillage (Rotavator), Conventional tillage (Rotavator + Cultivator) and Deep tillage (chisel Plough). After tillage operations, decayed farmyard manure at rates of 0, 10, and 15 tons ha^{-1} were uniformly applied on the surface and mixed to 15 cm depth by spade each year.

A soaking irrigation was applied before seedbed preparation. Seedbed was prepared by using cultivator 2-3 times for cultivating the soil followed by planking. Prior to sowing, seeds of Cotton cultivar CIM 496 were acid delinted and fungicide treated. Seeds were sown using no tillage pneumatic seed drill keeping 80 cm plant to plant distance at the end of June. Each year at crop maturity, plants were harvested and boll weight, number of bolls, plant height and cotton yield was recorded. Cotton yield was handpicked from two central rows in every plot.

The experimental data was analyzed using Analysis of Variance (ANOVA). The treatments means were compared by Least Significant Difference (LSD) test [11]. Data was statistically analyzed by computer simulated software "SAS 9.3" (Inc., 2011-2012) and expressed in tabular form by Microsoft excel 2016 [17].

RESULTS ANS DISCUSSION

The significant impact of farm yard manure levels on boll weight was seen with respect to different tillage technologies. In minimum tillage where no farm yard manure was added, the boll weight was significantly lower in the first year of the experiment as compared to the subsequent years. In 2012, minimum boll weight was recorded in those cotton plants where no farm yard manure was applied adopting the minimum tillage as compared to others tillage operations and farm yard manure levels. No significant in difference in boll weight of cotton plant in 2013 and 2014 where conventional tillage and deep tillage operations were performed without adding the farm yard manure. The plants grown in 10 tons/ha were higher in boll weight as compared to those who were grown in 0 tons/ha in all tillage operations. Boll weight gradually increased after the first year application of 10 tons/ha in subsequent years (2013 and 2014) where minimum tillage was done, however, the boll weight was lower as compared conventional tillage and deep tillage operations. In all three year experiments, small difference was noted where conventional tillage and deep tillage technologies were carried out in all three levels of farm yard manure levels. In 2012 and 2013 year experiments, close difference in boll weight was recorded where 10 tons/ha and 15 tons/ha farm yard manure added. Significant increase in boll weight was recorded in 2014-year experiment 10 tons/ha and 15 tons/ha applied plants as compared to first two years' experiments. Maximum boll weight was recorded at 15 tons/ha where conventional tillage operations were performed (Table 2).

Significant increase in number of bolls per plant was recorded with the increase in farm yard manure levels in soil using all types of tillage operations. The plants grown where minimum tillage was done and no farm yard manure was added, the recorded number of bolls per plants were least significant as compared to other tillage technologies which were aggrandized with 10 tons/ha and 15 tons/ha farm yard manure in soil. However, the increasing trend was observed in following years of the experiments (2013 and 2014). No significant difference in number of bolls was observed where conventional and deep tillage technologies were adopted in 0 tons/ha farm yard manure in soil in 2012. In first year of experiment (2012), the plants where conventional tillage and deep tillage was adopted, the number of bolls were same at 0 tons/ha. Similar results were seen at 10 and 15 tons/ha were no significant difference in number of bolls were seen adopting conventional tillage and deep tillage technologies. In the second year, minimum tillage yielded lower number of bolls at all three farm yard manure levels (0, 10 and 15 tons/ha) with respect to conventional and deep tillage operations, however, the number of bolls per plant were more as compared to the previous year. Significant increase in number of bolls per plant was observed in 2013 as compared to 2012. Deep tillage, both at 10 and 15 tons/ha expressed significant results due to increased number of bolls comparing to the conventional tillage and minimum tillage. Significant increase in number of bolls were observed in last year of experiment as compared to the succeeding years. No significant difference in number of bolls per plant was seen where conventional and deep tillage was done at 0 tons/ha. Similar results were seen in 10 tons/ha and 15 tons/ha farm yard manure applied plants. Maximum bolls were counted at 10 tons/ha where conventional and deep tillage was carried out (Table 2).

Farm yard manure concentration significantly impacted on cotton plant height in case of all tillage operations. With the increase in farm yard manure, the increase in plant height was recorded. Among three tillage technologies, plant height was found maximum where deep tillage was performed. Increase in plant height was observed after the first year of experiment in all tillage operation at different farm yard manure levels. In 2012, the minimum tillaged plants which were grown in 0 tons/ha farm yard manure were least in height as compared to the other plants. Maximum plant height was recorded where deep tillage technology was adopted in 15 tons/ha farmyard manure soil. In 2013, no significant increase in plant height was observed at 0 tons/ha as compared to the previous year. Among three different technologies, at 0 tons/ha farm yard manure, deep tillage favored the plant height as compared to the others. No significant difference in plant height was observed between 10 tons/ha and 15 tons/ha farm yard manure levels where minimum tillage was performed. In deep tillage technology, no significant difference in plant height was observed at three levels of farmyard manure. In 2014, no difference in plant height was recorded at all levels of farm yard manure using different tillage technologies as compared to the previous year's experiment. Maximum plant height was recorded where deep tillage operations were performed, however, no significant difference in height was observed irrespective to the farm yard manure added (Table 3).

Significant impact of different tillage technologies using three levels of farmyard manure on cotton yield was recorded on three years of experiments. With the increase of farm yard manure in all three tillage technologies, the increase in cotton yield was seen. Gradual increase in cotton yield was recorded in in 2013 and 2014 after 2012 experiments regardless to the farm yard manure levels and tillage technologies. In first year of experiment, at 0 tons farm yard manure level, minimum yield was recorded where no farm yard manure was added adopting minimum tillage technology. The yield recorded in 10 tons/ha applied plants was more as compare those plants where no farm yard was added but was least in yield with respect to 15 tons/ha farmyard manure applied plants. Maximum yield was obtained at 15 tons/ha farm yard in 2012 where deep tillage was carried out. In 2013, the plants grown in 0 tons/ha with minimum tillage were more in yield in all tillage operations comparing to the last year experiments. The similar trend was seen in 10 tons/ha and 15 tons/ha farm yard manure added. Maximum yield was recorded in those plants where 15 tons/ha farm yard manure adopting deep tillage technology in 2013. In 2014, the cotton yield was found highest comparing to the last two years experiments. The cotton plants which were 15 tons/ha farm yard applied were more in yield as comparing to the 0 ton/ha and 10 tons/ha farm yard added cotton plants. Maximum cotton yield was recorded where 15 tons/ha farm yard manure applied and deep tillage was performed (Table 4).

Tillage is vital feature for crop production and farm management. Little research work is done on organic amendments of soil in combination with tillage practices in Pakistan. The farmers of Pakistan use chemical fertilizers as main source to maintain crop yield and soil fertility while ignoring the importance of organic amendments like farm yard manure to maintain yield and fertility status of soils. The farm yard manure is rich source of micro and macro nutrients, upon decomposition yields necessary elements which are required for optimum plant's growth and its functions. In 2012, the boll weight, no. of bolls and plant height was lower as compared to the subsequent years. Several micro-organisms vitally involve for its decomposition which greatly depends upon many physico-chemical factors like temperature, pH and the nature of the substance in the farm yard manure. Initially when farm yard manure was added in the soil, it requires the time for its decomposition. So, first year yielded the lower biological yield. In the second year, the farm yard manure of the previous year well decomposed, however, more farmyard manure was aggrandized but the last years decamped manure increased the yield as compared to the 1st year's results. In last year of the experiment (2014), the added

farmyard manure of two years (2012 and 2013) decomposed finely, reached to its maximum nationality yielded maximal position with respect to the previous years.

Ishaq, Ibrahim, *et al*. [6], studied effects of tillage and fertilizer on wheat and cotton yield for two years. The interaction of tillage and fertilizer treatments was significant. Tillage systems did not significantly affect the plant tissue elemental contents of wheat (at tillering) and cotton (at flowering). However, the increasing rates of N, P and K caused a corresponding increase in tissue contents of N, P and K of wheat and cotton. Tillage and fertilizer treatments had a positive effect on nutrient uptake by wheat. CT and DT increased N, P and K uptake compared to MT treatment.

Blaise, Singh, *et al*. [1] sconducted two-year field experiments to evaluate the effect of fertilizer with or without farmyard manure (FYM) application on cotton productivity and fibre quality. He found that uniformity ratio and ginning outturn (GOT) was greater in the FYM amended plots than the plots without FYM. Nitrogen and P balance was positive in the fertilizer-N and P applied plots whereas K balance was negative in spite of the addition of fertilizer-K. Potassium balance was positive only when FYM was applied.

Table 1: Effect of different Farmyard manure levels on Boll weight with respect to different tillage technologies.

	2012			2013			2014		
TREATMENTS	*0 tons/ha*	*10 tons/ha*	*15 tons/ha*	*0 tons/ha*	*10 tons/ha*	*15 tons/ha*	*0 tons/ha*	*10 tons/ha*	*15 tons/ha*
Minimum Tillage (Rotavator)	1.14 K	1.28 I	1.32 GHI	1.17 JK	1.31 HI	1.34 FGH	1.20 J	1.37 F	1.42 E
Conventional tillage (Rotavator + Cultivator)	1.27 I	1.51 CD	1.53 BCD	1.28 I	1.52 BCD	1.55 BC	1.33 FGH	1.57 BC	1.58 A
Deep tillage (chisel Plough)	1.28 I	1.50 D	1.52 BCD	1.28 I	1.51 CD	1.52 BCD	1.36 FG	1.57 B	1.57 B
LSD= 0.053									

The values sharing similar letter do not differ significantly
$\alpha = 0.05$

Table 2: Effect of different Farmyard manure levels on no. of bolls per plant with respect to different tillage technologies

	2012			2013			2014		
	0 tons/ha	*10 tons/ha*	*15 tons/ha*	*0 tons/ha*	*10 tons/ha*	*15 tons/ha*	*0 tons/ha*	*10 tons/ha*	*15 tons/ha*
Minimum Tillage (Rotavator)	17.33 N	25.67 IJK	28.00 I	20.00 MN	23.33 KL	26.00 IJK	27.33 IJ	35.33 FG	38.33 CDE
Conventional tillage (Rotavator + Cultivator)	22.33 LM	35.66 EF	37.67 CDEF	24.00 KL	36.67 DEF	38.33 CDE	32.67 GH	39.67 BC	42.67 A
Deep tillage (chisel Plough)	22.33 LM	37.33 CDEF	39.67 BC	24.67 JKL	39.67 BC	42.33 AB	32.00 H	39.00 CD	42.33 A
LSD = 2.78									

The values sharing similar letter do not differ significantly
$\alpha = 0.05$

Table 3: Effect of different Farmyard manure levels on plant height with respect to different tillage technologies

	2012			2013			2014		
	0 tons/ha	10 tons/ha	15 tons/ha	0 tons/ha	10 tons/ha	15 tons/ha	0 tons/ha	10 tons/ha	15 tons/ha
Minimum Tillage (Rotavator)	124.33 N	131.33 LM	132.33 L	125.00 N	137.00 K	137.33 JK	129.00 M	140.00 J	139.33 JK
Conventional tillage (Rotavator + Cultivator)	146.33 I	149.33 FGH	152.00 EF	146.67 GHI	150.67 F	154.00 DE	147.67 HI	150.33 FG	154.00 CDE
Deep tillage (chisel Plough)	153.67 DE	155.67 BCD	154.33 CDE	156.00 ABCD	156.67 ABC	157.33 AB	157.67 AB	158.33 A	158.67 A
LSD = 2.77									

The values sharing similar letter do not differ significantly

Table 4: Effect of different Farmyard manure levels on yield with respect to different tillage technologies.

	2012			2013			2014		
	0 tons/ha	10 tons/ha	15 tons/ha	0 tons/ha	10 tons/ha	15 tons/ha	0 tons/ha	10 tons/ha	15 tons/ha
Minimum Tillage (Rotavator)	613.0 M	689.7 K	739.3 H	628.7 M	716.0 J	716.7 IJ	685.0 K	859.0 G	892.7 F
Conventional tillage (Rotavator + Cultivator)	659.3 L	869.3 G	896.3 EF	678.3 K	888.7 F	902.7 EF	869.0 G	1083.3 C	1109.7 AB
Deep tillage (chisel Plough)	690.7 K	889.7 F	914.0 DE	734.3 HI	905.0 EF	924.3 D	893.7 F	1092.0 BC	1112.0 A
LSD = 18.214									

The values sharing similar letter do not differ significantly

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