

BEHAVIOUR OF VARIOUS WHEAT (*TRITICUM AESTIVUM* L.) CULTIVARES AT CONVENTIONAL AND ZERO TILLAGE UNDER SUBTROPICAL CONDITIONS OF FAISALABAD, PAKISTAN

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ABSTRACT - A field experiment to study the effect of tillage practices on the productivity of different wheat (*Triticum aestivum* L.) varieties was conducted at Government Seed Farm Kalodevi, Gojra, Toba Tak Singh, Pakistan, during 2005 - 2006. The experiment was laid out under Randomized Complete Block Design (RCBD) with split plot arrangement and having a four replication in which tillage systems were kept in main plot and wheat varieties were in sub plots. The net plot size was 2.5m x 7m. Experiment was comprised of a following treatment combination i.e; T₁ =Zero Tillage with four varieties such as V₁ (Bakkhar-2002), V₂ (SH-2002), V₃(AS-2002) and V₄ (Uqab 2000) and T₂ = Conventional Tillage with four varieties such as V₁ (Bakkhar-2002), V₂ (SH-2002), V₃ (AS- 2002) and V₄ (Uqab-2000). The data on various crop growth and yield attributes were recorded using standard procedures. The yield components like biological yield, grain yield and straw yield were higher in the zero tillage than the conventional tillage. Among the growth parameters such as plant height (cm),

number of grains per spike although increased under zero tillage but the difference remained statistically non-significant between the conventional and zero tillage. It is concluded from the results that tillage has no significant effect on the varieties to produce the yield greater than each other. So zero tillage can be preferred over the conventional tillage in a cotton-wheat cropping system as it will not only allow the planting at proper time but also it will reduce the cost of cultivation. These two factors will add a lot to the final yield which will ultimately result in more profit.

Key words: Tillage; Wheat varieties; Cropping system.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop in the world and is a staple food of about one third of the world's population. It is the principal source of carbohydrates for humans. Its straw

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constitute an essential part of livestock feed and provides raw material for paper industry.

Tillage is the mechanical manipulation of soil, and a tillage system is the sequence of operations that manipulates the soil to produce a crop. Conservation tillage is any tillage system that is not conventional, which is the sequence of operations most commonly used in a given geographic area to prepare a seedbed and produce a given crop. In zero tillage, the soil is left undisturbed from harvest to seeding and seeding to harvest. The only tillage is the soil disturbance in a narrow slot created by coulters, disk seed- furrow openers or hoe openers attached to the planter or drill. No drills must be able to cut residue and penetrate undisturbed soil. Weed control relies on herbicides applied pre-plant, pre-emerge, or post emerge. Strictly speaking, a no-till system does not allow operations that disturb the soil other than the planting operation (Jasa *et al.*, 2000). Yield potential usually increases on low organic matter soils after several years of no-till planting, due to improved soil physical properties.

Tillage systems could affect crop yield due to their effects on water conservation and soil chemical and physical properties (Bonfil *et al.*, 1999). Conservation tillage has been proposed as a promising strategy to improve soil and water conservation. Traditionally, 10 years ago, tillage practice for wheat comprised minimum ploughings with the country plough and two plankings to level the

soil (Meisnei, 2001). Intensive conventional tillage is known to degrade soil structure, however, the sustained use of no tillage with fine textured soils can result in adverse physical conditions (e.g. soil compaction) and poor drainage (Blevins and Frye, 1993).

Resource conservation techniques for wheat crop establishment ensure timely planting and increase the yield and saves expenditures (Hobbs & Gupta, 2002). Zero till wheat is being introduced to avoid late planting and poor land preparation. It ensures timely planting, better stand establishment and higher grain yield than conventional method. It also saves 30% on irrigation and land preparation costs (Aslam *et al.*, 1999).

Wheat area equals approximately 4 million hectares of wheat or 50 % of wheat area sown in Pakistan. The sowing of wheat is delayed due to the late harvesting of both cotton and rice in Pakistan, still proper time of wheat sowing is influenced by the cotton variety and maturity. The decision to have an extra picking of cotton and an additional collection of cotton sticks for fuel can be a valuable bonus for the farmer. Land preparation for wheat is often delayed for 15-20 days wheat can be planted in December or January. The optimal date for planting wheat is 20 November. On average 40 kg ha⁻¹ (160,000 tons per 4m ha) of grain is lost for every day planting is delayed after this date. Earlier plantings have lower yields because of frost damage during flowering.

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Delayed planting after cotton and rice substantially reduces yield potential. (Cheema *et al.*, 2001) This situation can be improved by using resource conservation technologies such as zero tillage, which allows the sowing of wheat at the proper time.

Importance of weed control to the success of conservation tillage systems has been well documented (Young *et al.*, 1994). Grass weed populations have been observed to build up rapidly under zero tillage (Arshad *et al.*, 1991) necessitating the use of increasingly sophisticated post-emergence weed management practices.

The objectives of the study was to compare the productivity of different wheat varieties under zero tillage and conventional tillage, in cotton-wheat cropping system, and also to investigate the variety that best performed under particular set of tillage practice.

MATERIALS AND METHODS

An experiment was conducted the study the growth and yield response of wheat to different tillage practices at Government Seed Farm Kalodevi, Gojra (T.T Singh), Pakistan, during 2005-2006. The experiment was laid out under Randomized Complete Block Design (RCBD) with split plot arrangement, having four replications in which tillage types were kept in main plot and wheat varieties were in sub plot.

Experiment comprised a following treatment combination i.e; T₁=Zero Tillage with four varieties such as V₁ (Bakkhar -2002), V₂ (SII-2002), V₃(AS-2002) and V₄ (Uqab-2000) and T₂ =

Conventional Tillage with four varieties such as V₁ (Bakkhar-2002), V₂ (SII-2002), V₃ (AS- 2002) and V₄ (Uqab - 2000). The crop was sown on 12 Nov, 2005, in zero tillage the four varieties were sown with a single row hand drill without any land preparation in a cotton plot, while in conventional tillage the wheat varieties were sown after land preparation by a method being followed conventionally i.e; three plowings followed by three plankings with a wooden planker. The seed rate used was 125 kg ha⁻¹ and the recommended doses of nitrogen (105 kg ha⁻¹) and phosphorous (63 kg ha⁻¹) were used by using urea and diammonium phosphate (DAP) as a nutrient source. Half of the nitrogen and full whole of phosphorous was applied at first irrigation, while remaining half of the nitrogen dose was applied at first irrigation. Weeds were controlled by using Buctril-M for both tillage practices. All other agronomic practices except those under study were kept uniform and normal.

Data on the germination count per unit area (m⁻²), plant height (cm), number of grains per spike, 1000- grain weight (g), biological yield (t ha⁻²), grain yield (t ha⁻²), straw yield (t ha⁻²), harvest index (%) and economic analysis were collected by using the standard procedures, during the conduct of experiment.

The data collected was analyzed statistically by using Fisher's analysis of variance technique and least significantly difference test at 5% probability level was applied to compare the treatments means (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Better germination ensures good crop stand which ultimately account much for high grain yield, due to the

optimum plant population. A good yield is expected only when the germination of seed is uniform and optimum. The germination count data revealed that there was no significant difference in both the tillage treatments. The reason for non-significant difference in different treatments was the availability of proper and uniform moisture condition in both the treatments and the seed rate was also used at an equal amount in both the treatments except the difference of land preparation in conventional tillage and sowing in a slot only in zero tillage. Also in both the cases the hand drill was used to sow the seed. The varieties in both the treatments were statistically at par with each other, the reason for the non-significant difference among the varieties was that the seed used was pure and of the same germination percentage. It is further supported by the hypotheses that germination process depends entirely only reserved food material in the seed, seed viability, optimum seed rate and favorable environment.

Plant growth is reflected in terms of plant height which is greatly influenced by crop nutrition and the environmental conditions. Plant height is the important component of straw yield and may also affect the grain yield. The data pertaining to final plant height is given in *table 1* indicated difference in the plant height between the two tillage treatments, wheat plant gaining the more plant height in the zero tillage treatment as compared to that of

conventional tillage treatment, but both the tillage treatments were statistically non-significant with each other. However significant difference in plant height was found among the varieties. Among the varieties V₄ i.e. Uqab- 2000 gained the maximum plant height (105.3 cm) as compared to AS- 2002 gained the minimum plant height 91 cm as in *Table 1*.

The same trend for the plant height of the varieties was also observed in the conventional tillage. The interaction between the four varieties and the tillage system was non-significant because the plant height is a genetic character and fertilizer application to both the zero tillage and conventional system and varieties was uniform according to the recommendations. So the varieties under both the tillage practices gained height according to their genetic traits under similar set of environmental conditions

Number of grains per spike is one of the most important yield components and has direct bearing on the grain yield of wheat. Number of grains per spike is greatly influenced by crop nutrition and ecological condition. The data presented in the table-I depict a non-significant difference between both the tillage practices and also between the varieties in both the tillage practices. As it is apparent from the previous data for spike length and spikelets per spike that four wheat varieties i.e. Bakkhar-2002, SH- 2002 and Uqab-2000 were at par with each other and very small difference was observed

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when compared with AS- 2002 both for spike length, which was small for AS- 2002 by genetic character and thus small spikes had yielded small number of grains but when several spikes of AS- 2002 were averaged for the number of grains per spike, it eventuated non-significant differences among the varieties.

The weight of grain is an important yield component and makes major contribution towards grain yield of wheat. The 1000-grain weight is greatly influenced by ecological conditions. A perusal of the *Table 1* indicated that 1000-grain weight was not influenced by the tillage practices. But the significant difference does occur between the varieties. The highest grain weight was recorded in AS- 2002 (38.98 g) due to the big size of the grain AS- 2002 outlined a significant difference among other varieties. Although difference was observed between the 1000- grain weight of other three varieties but these varieties i.e. Bhakkar- 2002, SI I-2002 and Uqab- 2000 were statistically at par with each other. These results are in line with that of Carr *et al.*, 2003, who found that test weight or 1000- grain weight was unaffected by the tillage system.

Total biological yield shows overall growth performance of the plant. The data in *Table 1* revealed that biological yield per hectare was significantly higher in zero tillage than that of the conventional tillage. The reason was the efficient utilization of the nutrients by the plants under the zero tillage practice

than that of the conventional tillage. Significant difference was also noted between the varieties under both the tillage system. The greatest biological yield was achieved by AS- 2002 (11.79 t ha⁻¹), which was statistically at par with other, while the lowest biological yield was reflected by Bakkhar-2002 (9.34 t ha⁻¹). The reason for the lowest biological yield exhibited by the Bakkhar-2000 is that the variety was unable to show the full potential because of the environment, which has slightly low temperature and more rainfall than the environment and temperatures at which its genes are developed for.

Straw yield expresses the potential of a crop to accumulate dry matter in its vegetative parts and it is the function of an accumulated effect of all growth parameters like tillers and the final plant height. Analysis of variance for data on straw yield per hectare is presented in *Table 1*. The data shows that significant difference occur between the two zero tillage and the conventional tillage. This was due to the fact that although the small differences occur between the two tillage practices for both the plant height and number of productive tillers which were statistically non-significant with each other but they contributed to the final straw yield and caused the difference to become significantly high for the zero tillage. Straw yield was also found to be significant between the varieties.

The highest grain yield was recorded in Uqab-2000 (7.48 t ha⁻¹) which was statistically at par with

other treatment. The lowest yield was found in Bakkhar-2000 (6.4 t ha⁻¹).

The productive efficiency of a crop at variable agronomic practices is also measured in terms of harvest index. The data regarding harvest index is given in *Table 1*. The table shows that a significant difference existed between the zero tillage and the conventional tillage for the harvest index. Higher harvest index was recorded in conventional tillage than that of the zero tillage. Non significant difference was also found to occur among the varieties in both the tillage systems.

The data in *Table 1* shows a higher benefit cost ratio under the zero tillage. This is due to the sowing of crop at proper time by reducing the cultivations. Sowing at proper time prevented per day reduction in yield

and reduction of cultivation cost in zero tillage further supported zero tillage to be recommended in cotton-wheat cropping system for higher benefit cost ratio. *Table 1* showed that the highest cost benefit ratio was obtained in Uqab-2000 in both the tillage systems. While the lowest benefit cost ratio is recorded in Bakkhar- 2002, in both the tillage systems. The results in agreement with those of Chhokar *et al.*, 2007, who found that the reduced expenditure on tillage and higher yield provided additional profit of about Rs, 95167ha⁻¹ for zero tillage over farmer practice. Thus considering the benefits of in zero tillage reducing the cost and time of cultivation zero tillage is a successful option in cotton- wheat cropping system.

Table 1 - Influence of different tillage practices on the performance of various wheat varieties

Treatment	Germin per unit area(m ⁻²)	Plant Height (cm)	No. of grains spike ⁻¹	1000-grain wt.(g)	Biological yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	Grain yield (t ha ⁻¹)	H.I (%)	Economical analysis
T ₁ V ₁	194.62	98.77	47.60	32.88	10.36	3.43	6.93	30.09	500.6
T ₁ V ₂	194.22	99.15	44.55	31.82	11.79	4.29	7.48	36.04	626.3
T ₁ V ₃	198.87	92.70	49.60	38.98	11.05	4.29	6.91	32.89	626.3
T ₁ V ₄	194.60	105.35	49.40	32.97	11.47	4.55	6.75	39.78	664.6
T ₂ V ₁	193.92	96.90	35.45	34.09	9.34	3.54	6.04	30.61	385.9
T ₂ V ₂	195.55	97.95	49.10	32.82	10.55	4.05	6.95	36.25	453.2
T ₂ V ₃	196.55	91.00	48.20	38.71	9.93	3.98	6.35	40.14	440.7
T ₂ V ₄	192.47	101.2	51.80	32.67	10.14	4.28	6.39	42.29	478.6
LSD_{≥ 0.05}	NS	NS	NS	NS	NS	NS	NS	NS	NS

CONCLUSION

It is concluded from the results that tillage has no significant effect on the varieties to produce the yield greater than each other. So zero tillage can be preferred over the conventional tillage in a cotton-wheat cropping system as it will not only allow the planting at proper time but also it will reduce the cost of cultivation. These two factors will add a lot to the final yield which will ultimately result in more profit.

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