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Demonstration and Evaluation of Various Tillage Practices and Farm Yard Manure on the Yield of Wheat in Ecological Zone of Vehari Punjab Pakistan

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ABSTRACT

A field experiment was conducted to evaluate the effect of various tillage practices and farm yard manure on the yield of wheat in ecological zone of Vehari during two consecutive years 2011-12 and 2012-13. The tillage practices included T1 (one pass of chisel and disc harrow), T2 (one pass of chisel and rotavator), T3 (one pass of chisel and two passes of cultivator and T4 (four passes of cultivator and two passes of planker) were used in this experiment. While in case of Farm Yard Manure three doses were checked out i.e. control (no manuring), 5 ton ha^{-1} and 10 ton ha^{-1} FYM. Results revealed that all the yield and yield parameters were significantly affected by the various tillage practices and farm yard manure. Some parameters were significantly affected by treatments while some has non-significant affect. In case of tillage practices (four passes of cultivator and two passes of planker) and FYM doses (10 kg ha^{-1}) dose proved to be best one with a maximum yield of 4063.89 kg ha^{-1} (average of two years results). On the basis of results, it is suggested that the application of FYM is more appropriate with four passes of cultivator and two passes of planker for better grain yields of wheat.

Keywords: Wheat, farm yard manure, tillage practices, grain yield and thousand grain weight.

INTRODUCTION

Wheat (*Trticum aestivum* L.) is a chief source of food for a great deal of population in the world. In Pakistan it ranks first among the cereal crops and occupies about 66% of the annual food cropped area (Anon., 2006). It is the staple food for the people of Pakistan and meets the major dietary requirements, supplies about 60% of the calories and protein of the average diet (Khalil & Jan, 2002). In the recent years, 5-10% of the total wheat harvest has been utilized as feed because wheat is cheaper than all other alternate feed grain substitutes (Mustafa *et al*., 2004). Wheat per capita consumption (125 kg year -1) is the highest in the world (Mustafa *et al*., 2004). Its straw is used as animal feed and also for manufacturing papers (Iqtidar *et al*., 2006). Actual farm yield of the wheat in Pakistan is about 30-35 % of the total potential yield, whereas 50% mean yield is realized in wheat as compared to leading nations like China and Mexico (Anon., 1997). Many developing countries including Pakistan are striving to increase agriculture production to feed the ever increasing population. Focus is being given on cultivation of cereal crops to meet the food requirements. Tillage is an operation that distracts the soil through various operations to place seeds and grow crops. However, almost all tillage operations are carried out to prepare a fine seed-bed for growing crops. Appropriate tillage operations are desired for better crop yields and as a result production increases. Proper operations improve soil physical properties while inappropriate, excessive, and unnecessary tillage operations may not provide the desirable results hence yield can significantly decrease (Khan, *et al.*, 1999; Khan, *et al.*, 2001; Iqbal, *et al.*, 2005). Tillage also exerts adverse effects on soil when it is performed under inadequate moisture conditions, or when inadequate tillage implements are used. Several studies suggest that tillage is one of the most essential operations carried out to improve soil

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(Lio, 2006) that in turn increases crop growth and yield production consequently boosts. (Khurshid *et al*., 2006; Rashidi and Keshavarzpour, 2007; Keshavarzpour and Rashidi, 2008; Rashidi and Keshavarzpour, 2008; Rashidi, *et al.*, 2008; Rashidi and Khabbaz, 2009), reported that plowing inverts the soil that reduces soil compaction. Tillage practices affect mechanical characteristics of seedbed considerably and thus crop emergence (Mohanty and Painuli, 2004).In many countries in the world, balanced use of organic manure has been considered as one of the best and comprehensive soil fertility management strategies (Lombin *et al.*, 1991). Similarly, Mahajan (1996) concluded that FYM (@ 5 ton ha^{-1}) was useful in increasing the yield of wheat by 20%. The high yields are attributed to complementary application of organic fertilizers as they increase nutrient accessibility and reduce losses (Kramer *et al.*, 2002). Khan *et al.* (2008) reported that maximum tillers m^{-2} (291) and maximum plant height (103.7 cm) was recorded in plots subjected to cultivated and rotavated than chiseled plots when FYM was applied @ of 10 tons ha^{-1} and 20 tons ha^{-1} combined with 30 and 60 kg N ha^{-1}. The organic manures (FYM + poultry manure) @ of 10 Mg ha^{-1}, 20 Mg ha^{-1} and 30 Mg ha^{-1} application has increased the wheat yield by 11.13 (105 %) to 13.53 (128 %) g pot^{-1}, relative to the control. The wheat plant height (44.06 cm), number of tillers, spike length, straw yield, grain yield and 1000 grain weight (45.26 g) all were statistically different from that of control. The findings of the trial suggested that crop productivity may be improved significantly by the application of organic manures for longer time.

The present study was undertaken to evaluate the effect of different tillage methods and manure application levels on the growth and yield of wheat.

MATERIALS AND METHODS

The experiment was conducted to evaluate the effect of various tillage practices and farm yard manure on the yield of wheat during the Rabi seasons of 2011-12 and 2012-13 at Adaptive Research Farm, Vehari. The farm is located at 30 ^{o} 01' 56" N latitude and 72 ^{o} 21' 22" E longitude, while the elevation is 455 ft. The weather of the study area is sub-tropical. The climate of the district is hot and dry in summer and cold in winter. The maximum and minimum temperature ranges between 49°C and 25°C in summer. During winter, the temperature fluctuates between 21°C and 5°C. The average annual rainfall is about 127 mm. The topography of the study area is plain land and moderately well drained. The climate data were taken for both the seasons (Table 1 & 2). The experiment was laid out in a split plot (RCBD) design with three replicates. The tilth methods were arranged on main-plots and farm yard manure was added in sub-plots. The experiment comprised of 36 plots, each measuring 16 x 61 ft for season 2011-12 and 15 x 56 ft for season 2012-13. The treatments included were: T_1 one pass of chisel and disc harrow, T_2 one pass of chisel and rotavator, T_3 one pass of chisel and two passes of cultivator and T_4 four passes of cultivator and two passes of planker. While three fertilizer treatments included were control (no manuring), 5 ton ha^{-1} FYM and 10 ton ha^{-1} FYM.Drill sowing was completed on 18th November, 2011 for Rabi 2011-12 and on 13th November, 2012 for Rabi 2012-13. Irrigation was applied according to the need of the crop.

Table1. *Temperature, rainfall and relative humidity at experimental site during 2011-12*

Month	Temperature (^{0}C)		Rainfall (mm)	Relative Humidity (%)	
	Maximum	Minimum		Maximum	Minimum
November	26.77	16.83	-	86.90	39.53
December	23.03	9.39	-	86.26	39.68
January	17.84	3.45	-	87.03	40.55
February	18.76	5.24	-	84.97	39.21
March	26.06	11.55	-	72.77	31.61

Table2. *Temperature, rainfall and relative humidity at experimental site during 2012-13*

Month	Temperature (^{0}C)		Rainfall (mm)	Relative Humidity (%)	
	Maximum	Minimum		Maximum	Minimum
November	26.33	15.37	-	85.13	40.93
December	19.16	6.00	2	87.39	45.35
January	18.68	4.65	-	87.52	46.10
February	19.46	9.15	6.57	87.50	48.61
March	26.58	11.94	1	82.26	37.94

A complete dose of PK and half dose of N were applied at the time of bed preparation and remaining dose of N was applied during 2nd, 3rd and 4th irrigation. The FYM was applied and well mixed with soil during land preparation process before seed bed preparation. Weed management practices were done by Buctril Super @ 1200 ml/acre and Clodinofop @ 120 g/ acre.Seeds of a Wheat variety (Sahar 2006) were drilled, keeping row to row spacing at 4.5 inches with seed rate of 50 kg $acre^{-1}$. In each plot, ten plants were randomly selected and tagged for measurement of plant height (cm) while germination, tillering, 1000-grain weight and grain yield data was recorded from one square meter.All the data were subjected to analysis of variance (ANOVA). The treatment means were separated using least significant difference (LSD) for comparisons at $p<0.05$.

RESULTS AND DISCUSSION

Germination counts (m^{-2})

Germination counts the growth of wheat plant. The results on germination under tillage treatments are shown in Table 3 and 4 for two Rabi seasons. The results showed non-significant difference in wheat germination between the different tillage treatments applied for the year 2011-2012 and 2012-13. The maximum number of germination (205) was observed in the plot where cultivator was ploughed (T_1) while the lowest germination counts (193.67) were observed in the plot where chisel + disc harrow was ploughed (T_1 & T_2) for the year 2011-12. The comparison of various farmyard manure treatments revealed that germination counts increased significantly as compared to control. The application of highest dose of FYM produced the maximum number of germination counts (205) while poor results were recorded under zero application of FYM. Similarly, for the growing season 2012-13, the result showed non-significant difference in wheat germination between the different tillage treatments applied. The maximum number of plants (206.33) was observed in the plot where cultivator was ploughed (T_4) while the lowest number of plants (188.33) was observed in the plot where chisel + disc harrow were ploughed (T_1). The comparison of various farmyard manure treatments revealed that germination increased significantly as compared to control. The application of highest dose of FYM produced the maximum number of plants (206.33) while poor results were recorded under zero application of FYM. Increased germination rate with application of FYM is attributed to more availability of nutrients and nitrogen and more pulverized soil throughout the growing season.

Number of Tiller (M^{-2})

Tillering is also very sensitive to water stress, being almost halved if conditions are dry enough (Peterson *et al*., 2003). Data regarding number of tillers m^{-2} are presented in table 3 and table 4.The results showed significant difference in wheat tillering between the different tillage treatments applied for the year 2011-2012 and 2012-13. The maximum number of tillers (360) was observed in the plot where cultivator was ploughed (T_4) while the lowest value (325) was observed were observed in the plot where chisel + rotavator was ploughed (T_2) for the year 2011-12. The comparison of various farmyard manure treatments revealed that tiller counts increased significantly as compared to control. The application of highest dose of FYM produced the maximum number of tillering counts (360) while poor results were recorded under zero application of FYM. Similarly, for the growing season 2012-13, the result showed significant difference in wheat tillers for various tillage treatments applied. The maximum number of tillers (370) was observed in the plot where cultivator was ploughed (T_4) while the lowest number of tillers (329.33) was observed in the plot where chisel + rotavator were ploughed (T_2). The comparison of various farmyard manure treatments revealed that tillering increased significantly as compared to control. The application of highest dose of FYM produced the maximum number of plants (370) while poor results were recorded under zero application of FYM. Increased tillering rate with application of FYM is attributed to more availability of nutrients and nitrogen and more pulverized soil throughout the growing season.

Plant Height (cm)

Plant height is an important parameter that determines the growth of wheat plant. The results on plant height under different tillage treatments are shown in Table 3 and 4 for the two Rabi seasons. The results showed non-significant difference in wheat plant height between the different tillage treatments applied for the year 2011-2012. The tallest plants (113 cm) were observed in the plot where cultivator was ploughed (T_4) while the shortest plants (106 cm) were observed in the same plot. The comparison of various farmyard manure treatments revealed that plant height increased

significantly as compared to control. The application of highest dose of FYM produced the tallest (113 cm) plants under cultivator while poor results were recorded under zero application of FYM. Similarly, for the growing season 2012-13 the result showed non-significant difference in wheat plant height between the different tillage treatments. The tallest plants (115 cm) were observed in the plot where cultivator was ploughed (T_4) while the shortest plants (107 cm) were observed in the plot where chisel + rotavator were ploughed (T_2). The comparison of various farmyard manure treatments revealed that plant height increased significantly as compared to control. The application of highest dose of FYM produced the tallest (115 cm) plants under cultivator while poor results were recorded under zero application of FYM. Increased plant height with application of FYM is attributed to more availability of nutrients and nitrogen throughout the growing season. These results are in agreement with the findings by Mitchell and Tu (2005) for Maize crop. Almost similar results were reported in previous studies by Akbar *et al*., (2002) and Rasheed *et al*., (2004), they observed increased plant heights in response to higher levels of nitrogen.

1000-Grain Weight (g)

Statistical analyses of the data reveal that the tillage and farmyard manure treatments significantly affected 1000-grain weight of wheat. The interactions among tillage and FYM treatments were also significant for grain weight. The results showed significant differences in 1000-grain weight between the different tillage treatments. Treatment T_4 (with 4 cultivators and 2 planking) produced heavier grains than other tillage implements at all FYM treatments. Similarly application of FYM had significant influence on grain weight and maximum dose of FYM proved to be superior in terms of 1000-grain weight than plots where no FYM was applied. The maximum (46.74 g) 1000-grain weight was observed under T_4 while the lowest (41.57 g) 1000-grain weight was observed in T_2 for the growing season of 2011-12. Similarly, maximum (44.78 g) 1000-grain weight was observed under T_3 while the lowest (42.23 g) 1000-grain weight was observed in T_1 for the growing season of 2012-13. The comparison of various fertilizer treatments showed that the 1000-grain weight increased significantly with application of organic fertilizers as compared to control. Significant interaction among tillage and fertilizer was obvious in 1000-grain weight. Higher 1000-grain weight has been attributed to increased application rate of nitrogen in studies from past (Maqsood *et al*. 2001). Alkain *et al.* (1993) also reported that increased levels of N increased 1000-grain weights.

Number of Grains Spike^{-1}

Data regarding number of grains spike^{-1} is shown in Table-3 and 4. The data showed that application of different tillage practices had significantly ($P \leq 0.05$) affected grains spike^{-1}. Mean value of the data for the year 2011-12 indicated that maximum grains spike^{-1} (47.33) was produced from the plots treated with T_4, while minimum grains spike^{-1} (41) were produced from plot treated with T_3. Mean value of the data for the year 2012-13 indicated that maximum grains spike^{-1} (47) was produced from the plots treated with T_4, while minimum grains spike^{-1} (40) were produced from plot treated with T2. Similarly, FYM has also significant results. Maximum number of grain per spike is produced where high dose of FYM was applied while minimum results have been shown in control plots where no FYM was applied.

Grain Yield Kg ha^{-1}

The results on grain yield under various tillage and FYM treatments are shown in Table 3 and 4. Analysis of the data revealed that tillage and FYM treatments have a non-significant affect on grain yield of wheat. The maximum average yield is observed in T_4 (4090 kg/ha) while minimum average yield value is observed in T_2 (4012.33 kg/ha) for the year 2011-12. Similarly, maximum average yield is observed in T_4 (4062 kg/ha) while minimum average yield value is observed in T_1 (4025 kg/ha) for the year 2012-13. Grain yields were affected by different FYM treatments and they had a positive linear relationship with FYM application i.e., plot with high FYM dose have high yield. FYM produced the maximum (4090 Kg ha-1) grain yield under the treatment where 10 ton/ha FYM was applied while the minimum (4012.33 Kg ha-1) grain yield was recorded under the plot where no FYM was applied. The lower grain yields under no FYM treatment are attributed to slow early crop growth as compared to FYM treatments for the year 2011-12. Similarly, maximum (4062 Kg ha-1) grain yield under the treatment where 10 ton/ha FYM was applied while the minimum (4025 Kg ha-1) grain yield was recorded under the plot where no FYM was applied. The lower grain yields under no FYM treatment are attributed to slow early crop growth as compared to FYM treatments for the year 2012-

13. The present results are in agreement with those of Polthanee and Wannapat (2000) who reported that tilled plots produced higher number of seeds plant-1 than that of untilled plots. According to them tillage operation which improve soil aeration provide better results. In a study, Rashidi and Keshavrzpour (2007) evaluated seven tillage methods under clay-loam soil and observed higher maize grain yield and yield components under tillage treatments as compared to no till treatment. Beyaert *et al.* (2002) did not find any significant effects of early corn growth on maize yields under different tillage systems. Higher grain yields under conventional tillage methods have also been reported by many researchers (Halvorson *et al.*, 2001).

Table3. *The effect of farmyard manure on grain yield and yield components for the year 2011-12*

Treatments	Average germination counts (m^{-2})	Average Tiller counts (m^{-2})	Average plant height(cm)	Average 1000 grain weight (g)	Average no. of grain per spike	Average grain yield (kg/ ha)
T1M1	193.67	340 A	108	42.61 B	42 A	4037.67
T1M2	195.67	343 A	107	43.87 A	42 A	4047.67
T1M3	198.67	347 A	110	46.24 A	45.67 A	4060
Average	196	343.33	108	44.24	43.22	4048.44
T2M1	193.67	325 B	110	41.57 B	41.67 B	4012.33
T2M2	197.67	332 B	107	43.60 A	40.67 B	4017.67
T2M3	200	335 B	108	44.58 A	39.33 B	4018.33
Average	197.11	330.67	108	43.25	40.56	4016.11
T3M1	194	336 B	107	42.14 B	41 B	4015
T3M2	198	340 A	108	43.68 A	43.33 A	4022.33
T3M3	202.33	341 A	113	45.68 A	43.67 A	4034.67
Average	198.11	339	109	43.83	42.67	4024
T4M1	195.67	353 A	106	42.54 B	47 A	4074.33
T4M2	204.33	357 A	108	46.11 A	47 A	4084
T4M3	205	360 A	113	46.74 A	47.33 A	4090
Average	201.67	356.67	109	45.13	47.11	4082.78
LSD	Ns	22.04	Ns	3.51	5.62	Ns

Table4. *The effect of farm yard manure on grain yield and yield components for the year 2012-13*

Treatments	Average germination counts (m^{-2})	Average Tiller counts (m^{-2})	Average plant height (cm)	Average 1000 grain weight (g)	Average no. of grain per spike	Average grain yield (kg/ ha)
T1M1	198.67	356 A	108	42.3 B	46 A	4048
T1M2	188.33	362.67 A	110	43.53 A	42 B	4025
T1M3	193	365.33 A	112	42.23 A	41.33 B	4060
Average	193.33	361.33	110	42.69	43.11	4044
T2M1	193.67	329.33 B	107	42.7 B	40 B	4026
T2M2	199	336.33 B	108	43.15 B	41 B	4033
T2M3	202.67	345.33 A	109	44.23 A	42.33 B	4030
Average	198.44	337	108	43.36	41.11	4030
T3M1	195.67	349.67 A	109	43.43 A	49 A	4039
T3M2	198.67	354.33 A	111	42.97 B	44.67 A	4027
T3M3	204	360.33 A	112	44.78 A	41 B	4033
Average	199.44	354.78	111	43.73	44.89	4033
T4M1	194.33	361.67 A	110	43.72 A	45 A	4038
T4M2	205.33	367 A	112	44.10 A	47 A	4062
T4M3	206.33	370 A	115	43.53 A	44 B	4036
Average	202	366.22	112	43.78	45.33	4045
LSD	Ns	29.08	Ns	1.55	4.67	Ns

Table5. *% increase in wheat yield (kg/ha) for the year 2011-12 and 2012-13*

Treatment	Av.yield (2011-12) (kg/ha)	% increase in wheat yield	Av. yield (2012)-13 (kg/ha)	% increase in wheat yield
T_2	4016.11	-	4030	-
T_3	4024	0.19	4033	0.07
T_1	4060	0.89	4044	0.27
T_4	4082.78	0.56	4045	0.024

Table 5 shows that the highets yield was produced in T_4 with 0.56 % and 0.024 % yield increase in comparison of other tillage practices which has produced the least yield/ ha for Rabi 2011-12 and 2012-13 respectively.

CONCLUSION

Different tillage treatments were evaluated on the basis of plant height and yield components of wheat. Some parameters are significantly ($p<0.05$) affected by treatments while some has non-significant affect. Treatment T_4 has higher results in almost every parameter that has been observed. The study further revealed that wheat yield from control was significantly lower as compared FYM treatments. The affect of FYM (10 kg/ha) has provided the highest results under different tillage practices followed by discrete application of FYM (i.e., 5 ton/ha). Based on the results of this study, it is suggested that the application of FYM is more appropriate for better grain yields of wheat.

REFERENCES

[1] Akbar, H., Miftahullah Jan., M. T. Jan and Ihsanullah. 2002. Yield potential of sweet corn as influenced by different level of nitrogen and plant population. Asian J. Plant Sci., 6: 631- 633.

[2] Alkain, A., B. Sade, A. Tamkoe and A. Topat. 1993. Effect of different plant densities and nitrogen fertilizer rates on grain yield and some morphological characters of maize. Doga turk Tarim Ve Ormoncilik Dergisi, 17: 281-294.

[3] Anonymous. 1997. *FAO production yearbook*-1997.

[4] Anonymous. 2006. Govt. Pakistan, ministry of food, agriculture and livestock. *Econ. Wing, Islamabad*, 18-19.

[5] Beyaert, R. P., J. W. Schott and P. H. White. 2002. Tillage effects on corn production in a coarse-textured soil in suthern Ontario. Agron. J., 94: 767-774.

[6] Halvorson, A. D., B. J. Weinhold and A. L. Black. 2001. Tillage and nitrogen fertilization influences on grain and soil nitrogen in a spring wheat-fallow system. Agron. J., 93: 1130-1135.

[7] Iqbal, M., A. U. Hassan, A. Ali and M. Rizwanullah. 2005. Residual effect of tillage and farm manure on some soil physical properties and growth of wheat (*Triticum aestivum* L.). Int. J. Agri. Biol., 7: 54-57.

[8] Iqtidar, H., K.M. Ayyaz and K.E. Ahmad. 2006. Bread wheat varieties as influenced by different nitrogen levels. *J. Zhejiang Univer. Sci.*, 7: 70-78.

[9] Keshavarzpour, F. and M. Rashidi. 2008. Effect of different tillage methods on soil physical properties and crop yield of watermelon (*Citrullus vulgaris*). World Appl. Sci. J., 3: 359-364.

[10] Khalil, I.A. and A. Jan. 2002. *Cereal crops.* In: Cropping technology. A text book of Agriculture New Million Edition. *National Book Foundation*. pp. 169.

[11] Khan A., M. T. Jan, M. Arif, K. B. Marwat and A. Jan. 2008. Phenology and crop stand of wheat as affected by nitrogen sources and tillage systems. Pak. J. Bot., 40(3): 1103-1112.

[12] Khan, F. U. H., A. R. Tahir and I. J. Yule, 2001. Intrinsic implication of different tillage practices on soil penetration resistance and crop growth. Int. J. Agri. Biol., 3: 23-26.

[13] Khan, K., M. Iqbal, Z. Shah, B. Ahmad, A. Azim and H. Sher. 1990. Grain and stover yield of corn with varying times of plant density reduction. Pak. J. Biol. Sci., 6 (19): 1614-1743.

[14] Khurshid, K., M. Iqbal, M. S. Arif and A. Nawaz. 2006. Effect of tillage and mulch on soil physical properties and growth of maize. Int. J. Agri. Biol., 8: 593-596.

[15] Kramer, A. W., T. A. Doane, W. R. Horwath and C. V. Kessel. 2002. Combining fertilizer and organic inputs to synchronize N supply in alternative cropping systems in California. Agric. Eco. Envir., 91: 233- 243.

[16] Lio, F. S. 2006. The influence of tillage practices on the performance of cereals and root and tuber crops. Journal of Sustainable Agriculture and Environmental Studies, 3 (3): 101-105.

[17] Lombin, L. G., J. A. Adepetu and K. A. Ayotade. 1991. Organic fertilizer in the Nigerian agriculture: present and future F.P.D.D. Abuja, pp. 146-162.

[18] Mahajan, K.K. 1996. Management of phosphorus and farmyard manure in maize-wheat system in sub-humid zone of Hiamachel Pradesh J. Hills Res. 9 (1): 43-45.

[19] Maqsood, M., A. A. Amanat, I. Iqbal and M. I. Hussain. 2001. Effect of variable rates of nitrogen and phosphorus on growth and yield of maize (Golden). Biol. Sci. 1 (1): 19-20.

[20] Mohanty, M. and D.K. Painuli. 2004. Modeling rice seedling emergence and growth under tillage and residue management in rice-wheat system on a Vertisol in Central India. Soil and Tillage Res. 76: 167-174.

[21] Mustafa, Z.S., S. Yasmin, N.S. Kisana and M.Y. Mujahid. 2004. Results of the national uniform yield trials. PARC, Islamabad, 1-2.

[22] Pederson, P. and J. G. Lauer. 2003. Corn and soybean response to rotation sequence, row spacing, and tillage system. Agron. J., 95:965-971.

[23] Polthanee, A., and S. Wannapat. 2000. Tillage and mulching affect on growth and yield of cowpea grown following rice in the post-monsoon season of northeastern Thailand. Kasetsart J. (nat. Sci.), 34: 197-204.

[24] Rasheed, M., T. Mahmood, M. S. Nazir, W. A. Bhutta and A. Ghaffar. 2004. Nutrient efficiency and economics of hybrid maize under different planting methods and nutrient levels. International Journal of Agriculture and Biology, 6 (5): 922-925.

[25] Rashidi, M. and F. Keshavarzpour. 2008. Effect of different tillage methods on soil physical properties and crop yield of melon (*Cucumis melo*). American-Eurasian J. Agric. and Environ. Sci., 3: 31-36.

[26] Rashidi, M., and F. Keshavrzpour. 2007. Effect of different tillage methods on grain yield and yield components of maize (*Zea mays* L.). Intl. J. Agric. Biol., 9 (2): 274-277.

[27] Rashidi, M., F. Keshavarzpour and M. Gholami. 2008. Effect of different tillage methods on yield and yield components of forage corn. American-Eurasian J. Agric. and Environ. Sci., 3: 347-351.