Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

American-Eurasian J. Agric. & Environ. Sci., 12 (9): 1205-1208, 2012
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2012.12.09.1886

The Effect of Different Tillage Methods on Yield and Yield Components of Bread Wheat Under Rainfed Conditions

[1]Moslem Abdipur, [2]Nosrat Allah Heidarpur, [2]Behroz Vaezi, [2]Vahid Bavei, [3]Amir Hossein Ghanbari and [4]Sajad Talaee

[1]Young Researchers Club, Gachsaran Branch, Islamic Azad University, Gachsaran, Iran
[2]Dryland Agriculture Research Station, Gachsaran, Iran
[3]Former MSC. Student of College of Aburaihan, University of Tehran, Iran
[4]MSC. Student of Tarbiat Modares University, Tehran, Iran

Abstract: In the southwestern Iran mainly use conventional tillage (Moldboard plowing followed by two disc harrowing) to wheat production. Such a tillage system requires a high energy input and may also causes water loss and long-term soil physical degradation. This field study was conducted under dry conditions to determine weather reduced tillage systems have significant effect on wheat grain yield in rainfed conditions. For this purpose five tillage treatments (T_1: Moldboard plow + disc harrow as conventional method, T_2: Chisel plow + disc harrow, T_3: Moldboard plow without inversion page + disk harrow, T_4: Power harrow, T_5: Sweep plow + disk harrow) were studied during three years (2004-2007) in Gachsaran Dryland Agricultural Research Station (GDARS), Iran. Significant differences were found among tillage treatments for thousand kernel weight, biological yield, grain yield and harvest index. T_2 treatment almost had the highest amounts for above traits. Overall, Chisel plow + disc harrow treatment with 266 kg ha^{-1} yield increase compared with conventional tillage was recognized as the best tillage treatment.

Key words: Grain yield · Rainfed condition · Tillage methods · Wheat

INTRODUCTION

Wheat crop is the most important food crop in third world countries and has a vital role in their national economies. In many parts of the world, the farms are prone to abiotic stresses especially drought and heat stress. Drought stress is an important limiting factor, especially in sensitive stage such as generative growth phase and grain filling stage which can cause major loss in wheat productivity in arid and semi arid regions [1, 2]. Therefore, keeping the soil moisture at critical stages such as grain filling stage under rainfed conditions is very important. But in the most of the undeveloped countries, the old conventional tillage methods and lake of efficient information about minimum or no tillage methods which have lower energy requirement, lower soil erosion and lower soil moisture losses, led to more abiotic stress impacts on the crops productivity. Under rainfed condition, among the approaches for maintaining soil moisture, using appropriate tillage methods according to climate and soil characteristics is very important, because the effect of different tillage methods on soil properties varies from region to region [3]. On the other hand, proper tillage practices to reduce surface runoff and increase infiltration rates can be lead to more stored soil moisture. However, many researches reported that the ability to hold water in low and no-tillage methods is higher than conventional methods [4-8]. The conventional tillage method in our experimental region is generally Moldboard plowing followed by two discs harrowing which this tillage system requires a high energy input and also causes water loss and long-term soil physical degradation [9]. Therefore, finding appropriate tillage method with minimum soil impacting and erosion, lower water losses and minimum energy requirements can cause to reducing abiotic stress impacts and reducing farming costs. However, the results of evaluation of different tillage methods on wheat yield somewhat different, as Roozbeh and Pooskani [10], Moldboard plow, Sadeghnezhad [11], shallow tillage with a disk, Hargrove [12], Shamsabadi and

Corresponding Author: Moslem Abdipur, Dryland Agriculture Research Institute, Gachsaran Agricultural Research Station, P.O. Box: 178, Kohgiloyeh va Boyerahmad Province, Gachsaran city, Iran.
Tel: (+98) 7422553401, Mob: +989171406619.

Rafiee [13] and Mohammadi *et al*. [14], Chisel plow, as the best tillage treatment have reported. While, Kreuz [15], Shamsabadi [16], have not observed difference among tillage treatments. According to the fact that the results of different tillage practices under rainfed conditions depend on soil characteristics, climate conditions, cultivation equipment and even plant material used may be different for different regions, this study was conducted to find the effects of different soil tillage methods on wheat yield under rainfed conditions.

MATERIALS AND METHODS

To evaluation of different tillage methods in wheat-fallow rotation under dry condition a field experiment was conducted based on completely randomized block design with four replications at Gachsaran Dry land Agricultural Research Station (GDARS), Iran [50°50'N, 30°17'W, altitude 710 m] with calcareous type soil and Silty Clay Loam texture, pH: 7.3 and organic matter less than 1% during 3 years (2004-2007). Tillage treatments were included:

T_1 : Moldboard plow+disc harrow as conventional method
T_2 : Chisel plow+disc harrow
T_3 : Moldboard plow without inversion page+disk harrow
T_4 : Power harrow
T_5 : Sweep plow+disk harrow

In this experiment, a bread wheat cultivar namely Kouhdasht (which was widely cultivated in South-West part of Iran) was planted. The experiment site had a hot climate with moderate winter and dry and warm summer. Plots were sown at a seeding rate of 300 seed per m^2 in December which weather is moderate and soil moisture is favorable for planting and were same for three years of study. Plot size was 13 rows, 20 m long, 9 m width and boarder of 17.5 cm in wide. Fertilizing was applied as 50 kg ha^{-1} N plus 50 kg ha^{-1} P_2O_5 before planting. No any disease symptoms were observed during growth season and weeds control was made by hand. Metrological data during growth season (December to May) was taken in Figure 1. At maturity time, each plot individually harvested and grain yield and biological yield was calculated. Harvest index was calculated by following equation.

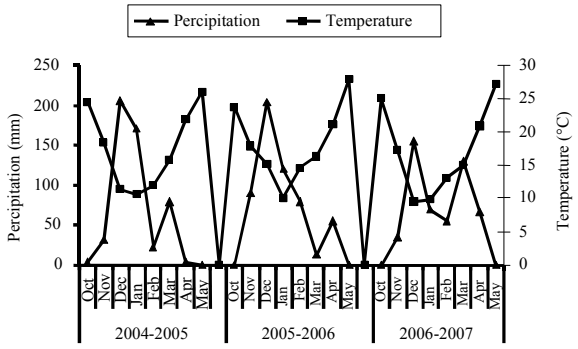

Fig. 1: Amount of temperature and precipitation during 3 years

$$HI = \frac{\text{Grain Yield}}{\text{Biological Yield}}$$

Statistical Analysis and means comparison of treatments values was performed by Duncan multiple-range test (DMRT) using statistical software SAS 9.1 [17], at 5% probability level.

RESULTS

The results of combined analysis of variance for yield and yield components were taken in Table 1. For all traits significant different among years was observed. However, tillage treatments didn't show significant difference for all traits and tillage treatments because of none significant difference for plant per square meter, tillers per square meter, spike length and grains per spike traits placed in a same class (Table 2). While tillage treatments showed significant difference for 1000-grain weight, biological yield, grain yield and harvest index traits and mean comparison of thousand kernel weight, biological yield, grain yield and harvest index traits placed tillage treatments in different classes. T_1 and T_4 treatments for 1000-grain weight, T_2, T_4 and T_5 treatments for biological yield and T_1 treatment for harvest index had the highest amounts. While, T_1 treatment (conventional tillage) had the lowest biological and grain yield.

DISCUSSION

According to difference in rainfall distribution and amount during three-year and especially amount of rainfall on December (planting time), March and April months (flowering and grain filling stages) (Fig. 1), significant difference for all traits between years could be expected (Table 1). However, there was not significant difference

Table 1: Combined analysis of variance of yield and yield components

Source of variation	d.f	Plants per square meter	Tillers per square meter	Spike length	Grains per Spike	1000-grain weight	Biological Yield	Grain yield	Harvest Index
Year (Y)	2	64480.650**	115976.450**	21.302**	102.304*	484.095*	12925249.067**	719674.850	230.091**
Year×Replication	9	1019.744	14360.556*	0.053	6.488	6.205	682600.356	172120.350	22.881*
Treatment (T)	4	474.942	10747.714	0.276	25.501	8.845*	753000.942 **	150510.55*	24.102*
Y×T	8	1099.567*	4257.246	0.154	14.520	1.940	275612.942	51860.288	12.431
Error	36	335.036	3901.652	0.230	11.039	3.020	182064.286	50103.517	6.439
C.V%	9.37	11.47	5.85	8.06	4.66	7.77	13.54	9.01	

** and * significant at 0.01 and 0.05 levels, respectively

Table 2: Mean yield and yield components for tillage treatments

Treatment	Plants per square meter	Tillers per square meter	Spike length (cm)	Grains per spike	1000-grain weight (g)	Biological Yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Harvest Index (%)
T_1	193.6 a	563.1 a	10.3 a	39.69 a	36.61 cd	5125 b	1582 b	30.87 ab
T_2	204.1 a	581 a	10.21 a	41.28 a	41.53 a	5668 a	1848 a	32.60 a
T_3	189.3 a	524.2 a	10.53 a	39.87 a	38.78 b	5381 ab	1700 ab	31.59 ab
T_4	190.2 a	506.2 a	10.13 a	42.58 a	35.42 d	5520 a	1674 ab	30.33 ab
T_5	199.3 a	549 a	10.27 a	42.80 a	37.38 bc	5761 a	1741 ab	30.22 b

Means with the same letter are not significantly different

among tillage treatments for plant per square meter, tillers per square meter, spike length and grains per spike traits. Considering the appropriate amount of rainfall from November to February and lack of moisture and heat stress and the formation of the above traits during these months, these results can be normal. Also, Lithourgidis *et al*. [18], Mohammadi *et al*. [14], had similar results. However, for 1000-grain weight, biological yield, grain yield and harvest index traits were observed significant difference and placed tillage treatments in different classes. T_2 treatment almost had better position for 1000-grain weight, biological yield, grain yield and harvest index compared with other tillage treatments (Table 2). These results are conform with those reported by Ciha *et al.* [19], Touchton [20], Hargrove [12], Shamsabadi and Rafiee [13], Lithourgidis *et al*. [17] and Mohammadi *et al*. [14], reports. While, conventional tillage had not suitable situation in this study. Specially, T_1 treatment in terms of biological yield and grain yield had the lowest amounts compared with other tillage treatments. Usually, these traits can be affected by moisture and heat stress in late-stage development and greatly reduce. Many researchers, [21, 22, 14] reported that the use of moldboard is increased soil moisture loss. On the other hand, Asghari- Meidani [23], Shamsabadi and Rafiee [13] and Mohammadi *et al*. [14] in study on different tillage treatments under dry conditions reported that the most soil moisture at tillage with chisel obtained. So, any tillage method that can save moisture at critical development stages, especially at the grain filling stage can be effective in the stability of these traits. Enough moisture in the grain filling stage prevents to shortening grain filling during and grain weight increases.

CONCLUSION

Chisel plow + disc harrow treatment compared with other tillage treatments, especially conventional tillage with save soil moisture and prevent to high impact of moisture and heat stress on wheat at the end of the season has led to yield stability. Seems, this treatment with 266 kg ha^{-1} yield increase compared with conventional tillage is suitable tillage treatment for wheat under rainfed condition.

ACKNOWLEDGMENTS

The authors are grateful for the support provided by the Dryland Agricultural Research Institute (DARI), Iran.

REFERENCES

1. Ahmadi, A., M. Joudi and M. Janmohammadi, 2009. Late defoliation and wheat yield: little evidence of post-anthesis source limitation. Field Crops Research, 113: 90-93.
2. Vaezi, B., V. Bavei and B. Shiran, 2010. Screening of barley genotypes for drought tolerance by agro-physiological traits in field condition. African Journal of Agricultural Research, 5(9): 881-892.

3. Mujdeci, M., B. Kara and A.A. ISiIdar, 2010. The effects of different soil tillage methods on soil water dynamic. Scientific Research and Essays, 5(21): 3345-3350.
4. Chaudhary, A.D., M. Javed, M.A. Rana, A. Sarwar and Q. Zaman, 1992. Comparative performance of direct drilling and conventional t illage practices under rice-wheat rotation system. Pakistan Journal of Agricultural Sciences, 29: 5-8.
5. Rasmussen, K.J., 1999. Impact of ploughless soil tillage on yield and soil quality: a Scandinavian review. Soil and Tillage Research, 53(1): 3-14.
6. Mrabet, R., 2000. Differential response of wheat to tillage management systems in a semiarid area of Morocco. Field Crops Research, 66: 165-174.
7. Martinez, E., J. Fuentes, P. Silva, S. Valle and E. Acevedo, 2008. Soil physical properties and wheat root growth as affected by no-tillage and conventional tillage systems in a Mediterranean environment of Chile. Soil and Tillage Research, 99: 232-244.
8. Erenstein, O., U. Farooq, R.K. Malik and M. Sharif, 2008. On-farm impacts of zero tillage wheat in south Asia's rice-wheat systems. Field Crops Research, 105: 240-252.
9. Barzegar, A.R., M.A. Asoodar, A.R. Eftekhar and S.J. Herbert, 2004. Tillage effects on soil physical properties and performance of irrigated wheat and clover in semi arid region. Asian Journal of Agronomy, 3(4): 237-242.
10. Roozbeh, M. and M.A. Pooskani, 2003. The effect of different tillage methods on wheat yield when in rotation with corn. Iranian Journal of Agricultural Sciences, 34(1): 29-38.
11. Sadeghnezhad, H.R., 2006. The comparison of wheat yield under different tillage methods. Iranian Journal of Agricultural Sciences, 12(1): 103-112.
12. Hargrove, W.L., 1985. Influence of tillage on nutrient uptake and yield of corn. Agronomy Journal, 77: 763-767.
13. Shams Abadi, H.A. and S. Rafiee, 2007. Study on the effect of tillage practices and different seed densities on yield of rainfed wheat. Journal of Agricultural Sciences and Natural Resources, 13: 95-102.
14. Mohammadi, K.H., K. Nabi Allahi, M. Aghaalikhani and F. Khormali, 2009. Study on the effect of different tillage methods on the soil physical properties, yield and yield components of rainfed wheat. Iranian Journal of Plant Production, 16(4): 77-91.
15. Kreuz, E., 1990. The influence of no-plough tillage for winter wheat in a three-course rotation on yield and yield structure. Archives of Agronomy and Soil Science, 34(9): 635-641(Abst.)
16. Shamsabadi, H.A., 2008. Study on the effect of primary tillage practices, planting machines and different seed densities on the yield of rainfed wheat. Asian Journal of Plant Sciences, 7(1): 79-84.
17. SAS Institute, 2003. The SAS system for windows. Release 9.1. SAS Inst., Cary, NC.
18. Lithourgidis, A.S., K.V. Dhima, C.A. Damalas, I.B. Vasilakoglou and I.G. Eleftherohorinos, 2006. Tillage effects on wheat emergence and yield at varying seeding rates and on labor and fuel consumption. Crop Science, 46: 1187-1192.
19. Ciha, A.G., 1982. Yield and yield components of four spring wheat cultivar selection. Agron. J., 78: 795-799.
20. Touchton, J.T., 1982. Soybean tillage and planting methods effects on yield of double -cropped wheat and soybean. Agronomy Journal, 74(1): 57-59.
21. Azim Zadeh, S., A. Kuchaki and M. Pala, 2002. Study on the effect of plow different methods on bulk density, porosity, soil moisture and wheat yield. Iranian Journal of Crop Sciences, 4: 218-233.
22. Halvorson, A.D., A.L. Black, J.M. Krupinsky, S.D. Merrill, B.G. Wienhold and D.L. Tanaka, 2000. Spring wheat response to tillage and nitrogen fertilization in rotation with sunflower and winter wheat. Agronomy Journal, 92: 136-144.
23. Asghari-Meidani, J., 2006. Study on the effects of soil tillage methods and crop residue management on wheat grain yield in dryland. 4th National Congress on Agriculture Machinery Engineering and Mechanization 29-30 August 2006. Tabriz University, Iran, pp: 14-15.