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The Effect of No-Tillage Method and the Amount of Consumed Seed on Wheat Yield

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ABSTRACT

This research aims to study and analyze the effect of the no-tillage method and seeding rate on wheat yield in Khorramabad Region, Iran. Moreover, data was evaluated, and the split-plot design in form of randomized complete blocks was used with three replicates. The main factor includes three levels of different tillage methods: 1) moldboard plow + disc (2 times) + drill-deep furrow planting (the region's conventional method); 2) disk (2 times) + deep furrow; and 3) no-tillage seeding (direct seeding). The secondary factor, however, was the seeding rate at three levels (150, 180, and 220 kg/ha). The results indicated that the highest germination rates belong to the minimum tillage and conventional tillage treatments. In terms of germination rate, Treatment 1 performed better than the minimum tillage treatments with 150, 180 and 220 kg/ha; however, this difference was not statistically significant. This could be due to loose soil allowing roots to penetrate further. Additionally, according to the results, it could be concluded that different tillage methods produce tangible and significant effects on wheat yield. The mean comparison showed that Treatment 2 had the best performance, in terms of yield, with 5540 kg/ha followed by Treatment 1 (conventional) and Treatment 3 with 4560 and 3780 kg/ha, respectively. Moreover, the maximum harvest index belonged to Treatment 2 and the best seeding rate to achieve the highest harvest index was 180 kg/ha.

Keywords: Tillage; Wheat; Yield; Seeding Rate.

INTRODUCTION

The main concept of *conservation tillage* is to keep the previous year's crop residues on the field. In addition, this facilitates the implementation of crop residue management since, although tillage provides proper air conditioning, this, in turn, leads to the fast degradation of organic substances [1]. In a study, the effect of three tillage systems on the crop residue coverage and wheat yield in rotation with rice was investigated. These three systems included: moldboard plowing in autumn with spring discing, no-tillage and spring discing, which brought about better residue cover, better growth, and finally better yield compared to the no-tillage method [10]. Another research investigated the effect of three field preparation methods including plowing with discing in autumn, chisel plowing with spring discing in autumn, and no-tillage treatment on four wheat cultivars. The results showed no significant difference between crop yield in different treatments; however, chisel plowing with discing had the highest yield compared to other treatments [5]. Chopping residues from the last year's crops and applying minimum tillage practices increases soil moisture preservation, make wheat yield sustainable, and also reduces tillage [3]. Seed germination decreases exponentially as the soil gradation increases.

A seedbed's soil gradation depends on several factors including the type and amount of imposed energy from tillage equipment. Breaking aggregates into fine grades by cracking them depends on factors such as soil moisture and tillage practices [6]. Reduced application of farm machineries can reduce costs and time required for field preparation before planting, therefore reduces costs per area unit. Accordingly, costs incurred by no-tillage seeding practices (direct seeding) are significantly lower than costs of other practices [12]. The primary tillage machinery type and seed density have no significant effect on the yield of rainfed wheat. Consequently, in order to achieve minimum tillage, soil erosion and moisture control, lower energy consumption, faster field preparation, lower production costs, and higher yield per area unit, it was suggested to use a chisel plow or asymmetric disc with the seed density of 140 kg/ha [4]. A farming practice containing no-tillage or reduced tillage practice, crop rotation and the large-scale returning of crop residues to soil can increase biomass and the diversity of soil microflora activities [8].

The conservation tillage increases soil porosity, loosens the soil and also brings about better soil aeration and increases root growth [11].

To secure proper seed germination, there should be a 4-cm soil layer with more than 50% of the aggregates smaller than 5mm [9]. Leaving crop residues on the surface as well as the presence of dense surface roots, at least, can reduce soil compactness by 65% comparing to fields stripped from such materials [13]. The apparent density and permeability of different soil depths during the germination stage are not influenced by crop residues, while the presence of residues during the flowering stage can increase soil permeability at 3-15-cm depths and reduce the apparent density at depths of 0-15cm [2]. Organic matter strengthens soil structure and gradation, and this, in turn, facilitates root growth and development by improving soil aeration. With the increased soil organic matter, the soil color is darkened and its heat absorption capacity is also increased, therefore the soil is warming faster [7].

MATERIALS AND METHODS

The research was conducted in Iran, Khorram-abad located at latitude of 48˚18’, longitude of 33˚30’ and altitude of 1171m, approximately at the center of Lorestan Province. The soil of the study location had a non-saline, alkaline and heavy texture (clay-loam). Due to proper soil moisture, no pre-irrigation was needed.

The strip-split plot design in form of randomized complete blocks was used with three replicates. The main factor included tillage methods at three levels: a_1) moldboard plow + disc (2 times) + drill-deep furrow planting (the region’s conventional method); a_2) disk (2 times) + deep furrow planting; and a_3) no-tillage seeding (direct seeding). Moreover, the secondary factor included the seeding rate at three levels: b_1) 150 kg/ha; b_2) 180 kg/ha; and b_3) 220 kg/ha. The seeding rates were selected according to the rates common in the region which were suggested by experts of agricultural service centers. The area of the used piece of land was 540 m^2 (30m*18m). The spacing of the blocks was 8m with 2m between two neighboring treatments. It should be noted that all above-mentioned practices were performed in autumn simultaneously with planting (early December). The operation depth for moldboard plowing was also considered to be 25cm.

Data related to the effect of the tillage treatments on different properties such as apparent soil density, mean weight diameter (MWD) of aggregates, soil turning level, the number of seedlings, germination percent, harvest index, seed yield, and ANOVA were calculated. In statistical analysis, treatment means were analyzed using MSTAT-C. Diagrams were drawn in Excel and the means were compared using the *F-test*.

RESULTS AND DISCUSSION

The statistical analysis was studied separately for each property based on the effects of the no-tillage method and seeding rate on wheat yield.

Germination percent: as shown in the mean comparison table, the no-tillage method had lower germination percent than the other two methods. On the other hand, the maximum germination percent belonged to minimum-tillage treatments (two-times discing + deep furrow drilling). However, these treatments were in a same group as conventional tillage treatments and there was no significant difference between them. The seeding rate of 180 kg/ha had a relatively higher, but non-significant, germination percent.

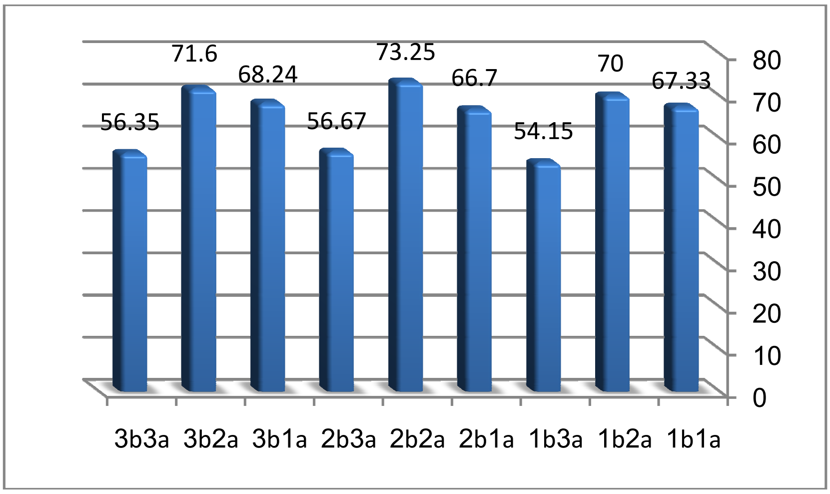

Figure 1: Germination percent of different treatments

Seedling emergence per square meter: the maximum seedling emergence belonged to the minimum-tillage and conventional tillage treatments, among which the a_1b_3, a_1b_2 and a_1b_1 treatments had more seedling emergence than the minimum-tillage treatments; this difference was, however, non-significant. This might be due to deeper loose soil allowing further penetration of roots into soil.

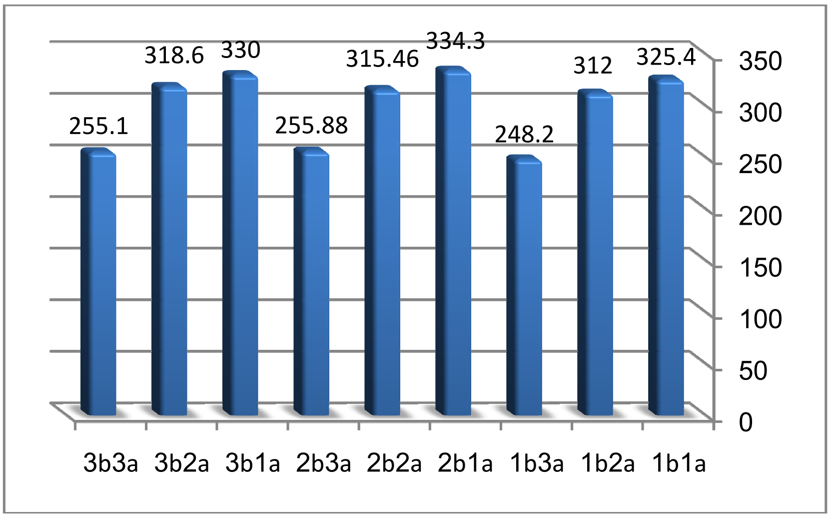

Figure 2: Seedling emergence per square meter of each treatment

Uniform seed distribution: as shown, there was a small and statistically non-significant difference between different tillage treatments in terms of uniform seed distribution. Since all three tillage methods were followed by sufficiently precise seed drilling, this result was expected.

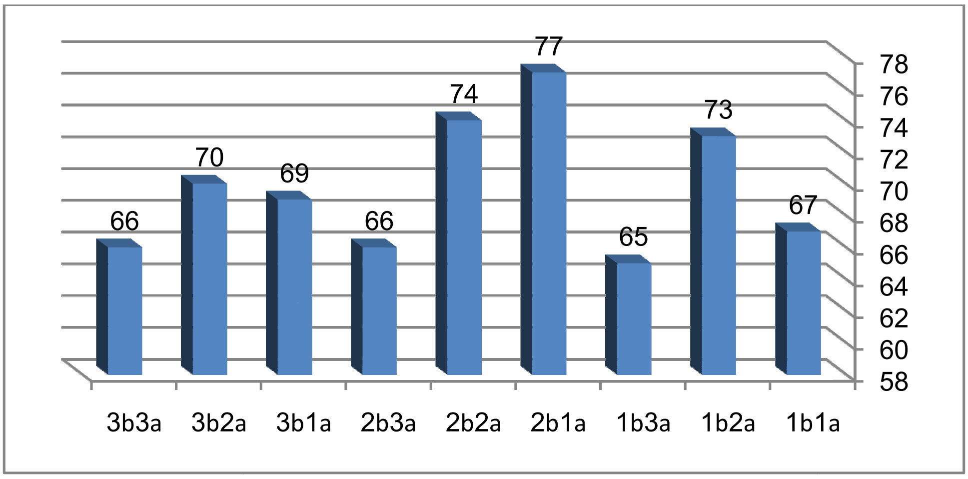

Figure 3: Uniformity of seed distribution for different treatments of wheat at the study field

Harvest index: the maximum harvest index belonged to the a_2b_2 treatment (two-time discing + deep furrow drilling, a_2, and 180 kg/ha seeding rate, b_2). The study results indicated that the harvest index performance in reduced tillage is relatively better the conventional tillage, where the optimum seeding rate to achieve the maximum harvest index belonged to the 180 kg/ha treatment.

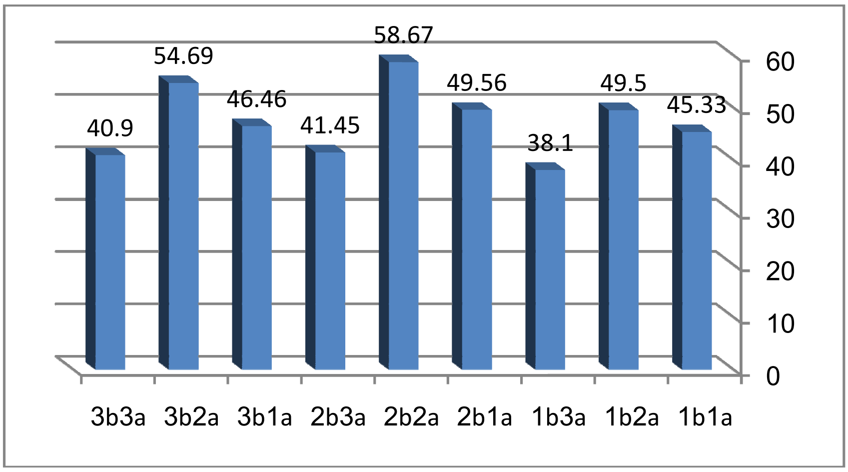

Figure 4: Comparison of mean harvest index for different tillage and seeding rate (percent) treatments

Seed yield: the mean comparison revealed that the highest seed yield belonged to the minimum-tillage treatment (two-time discing + deep furrow drilling) with 5540 kg/ha followed by the conventional method (moldboarding + two-time discing + deep furrow drilling) and direct-seeding treatments with 4560 and 3780 kg/ha, respectively. Gangwar studied the effect of three tillage methods along with three crop residue management in a wheat-rice rotation and found that the minimum-tillage method can significantly increase wheat yield when compared to the conventional method. This confirms the results of the present study [9].

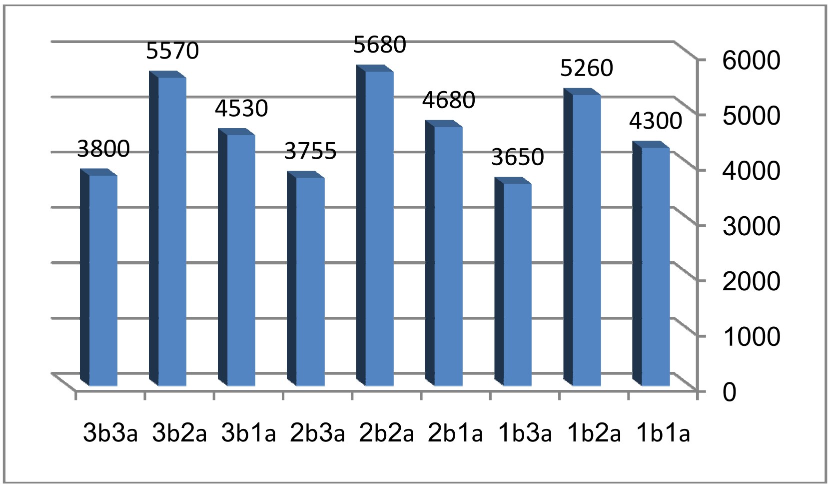

Figure 5: Crop yield of different treatments (kg/ha)

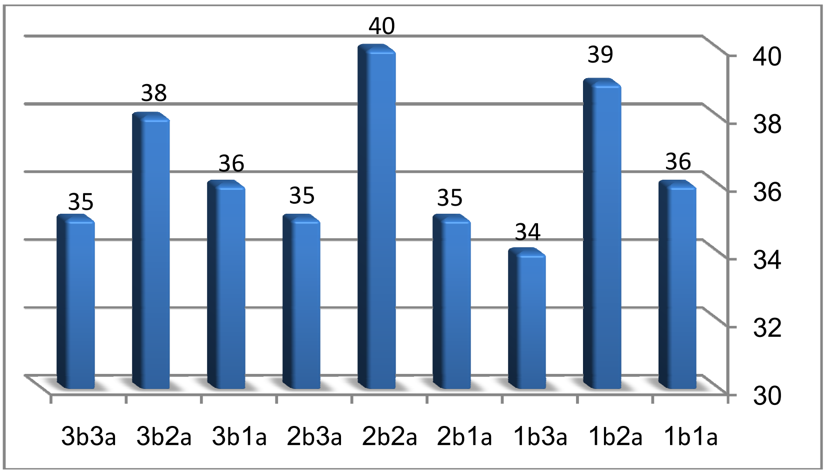

Figure 6: The 1000-grain weight for different treatments (gr)

Biological yield: as shown in Figure (7), the minimum yield belonged to the no-tillage treatment. This is inevitable since the study was carried out during one growing season. Due to the failure in providing proper soil moisture and the late germination and emergence of seeds, the no-tillage methods deliver improper biological yield during their first years of implementation.

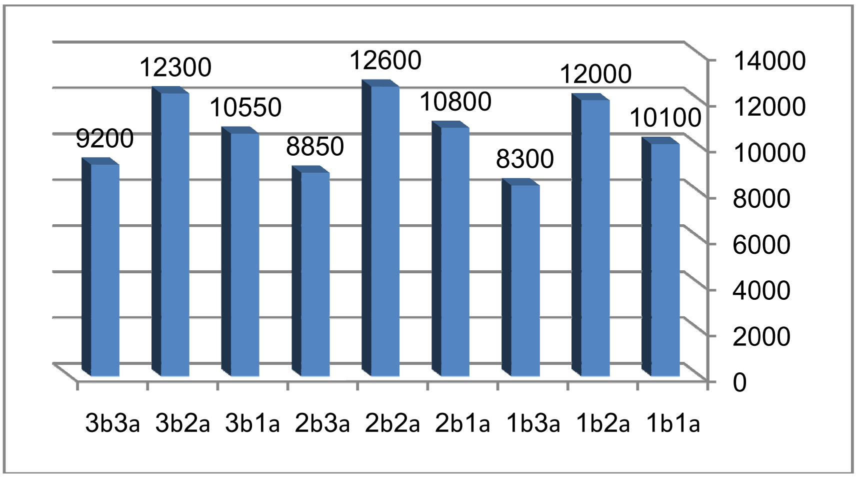

Figure 7: Crop biological yield for different treatments (kg/ha)

Table 1: The ANOVA results for yield and yield components of wheat exposed to different tillage methods and seeding rates

		The F-value was calculated						
Source of variations	**DOF**	**Germination percent**	**Seedling emergence**	**Seed distribution uniformity**	**Harvest index**	**Seed yield**	**Biological yield**	**1000-grain weight (gr)**
Block	2	$0.1489^{n.s.}$	$0.122^{n.s.}$	$0.325^{n.s.}$	$0.138^{n.s.}$	$0.780^{n.s.}$	$0.522^{n.s.}$	$0.235^{n.s.}$
Tillage practice (A)	2	2.35^{*}	1.466^{*}	$1.596^{n.s.}$	4.322^{**}	6.568^{*}	4.324^{*}	1.76^{*}
Error a	4							
Seeding rate (B)	2	$0.566^{n.s.}$	$0.378^{n.s.}$	$1.362^{n.s.}$	1.246^{*}	2.763^{*}	1.650^{*}	$0.632^{n.s.}$
A×B interaction	4	$2.234^{n.s.}$	$0.980^{n.s.}$	$0.777^{n.s.}$	$0.870^{n.s.}$	$0.980^{n.s.}$	$0.466^{n.s.}$	$0.986^{n.s.}$
Error b	12							
CV%		13.6	19.4	11.34	14.5	10.35	14.67	9.87

*, ** and $^{n.s.}$ denote significant at the level of 1%, significant at the level of 5% and no significant, respectively

Table 2: Mean comparisons* of yield and yield components of wheat exposed to different tillage methods and seeding rates

	Means						
Tillage×Seeding rate**	**Germination percent**	**Seedling emergence**	**Seed distribution uniformity**	**Harvest index**	**Seed yield**	**Biological yield**	**1000-grain weight (gr)**
a1b1	67.33a	325.4a	67b	45.33b	4300b	10100b	36b
a2b1	70.00a	312.00a	73a	49.5ab	5260a	12000a	39a
a3b1	54.15b	248.20b	65b	38.1c	3650c	8300c	34c
a1b2	66.70a	334.3a	77a	49.56ab	4680ab	10800ab	35b
a2b2	73.25a	315.46a	74a	58.67a	5680a	12600a	40a
a3b2	56.67b	255.88b	66b	41.44c	3755c	8850c	35b
a1b3	68.24a	330.0a	69b	46.46b	4530b	10550b	36b
a2b3	71.6a	318.6a	70b	54.69a	5570a	12300a	38a
a3b3	56.35b	255.1b	66b	40.90c	3800c	9200c	35b

** means with similar letters within a similar column has no significant difference at the 5% level*

*** the conventional practice, a_1; two-time discing + deep furrow drilling, a_2; and direct seeding, a_3. The seeding rates of 150, 180 and 220 kg/ha are denoted by b_1, b_2 and b_3, respectively.*

REFERENCES

[1]Asadi A. and Hemmat A. **2003**. *Journal of Research into Agricultural Sciences*. Vol 3(1). (In Persian).
[2]Jamishidian R. and Khajeh-pour M. R. **1998**. *Journal of Agricultural Sciences and Techniques. Isfahan University of Technology*. Vol. 2(3). Pp 35-49. (In Persian).
[3]Javadi A. and Shahidzadeh M. **2006**. *The effect of the combined machinery on the secondary tillage*. The 4th Conference on Agricultural Machinery Engineering and Mechanization. University of Tabriz, Tabriz. P10. (In Persian).
[4]Shamsabadi H. and Rafi'e Sh. **2006**. *Journal of Agricultural and Natural Resources Sciences*. 13th volume. (In Persian).
[5]Ciha,A., (**2006**). *Agron*, No.74,PP.317-320.
[6]Durr,C. and Aubertot,J., (**2002**). *Plant and Soil*, No.219,PP.211-220.
[7]Gangwar,K.S., Singh,K.K., Sharma,S.K. and Tomar,O.K, (**2006**). Alternative tillage and crop residue management in wheat after rice in sandy loam soils of Indo-Gangeticplains,Soil and Tillage Research. No. 88.
[8]Govaerts,B.Mezzalama,M.,Unno,K.,Ken,K.S.,Luna-Guido,M.,Vanherch,K., Dendooven,L. and Dechers,J., (**2007**). *Plant and Soil*, No.219,PP.2-252.
[9]Hakansson,I.,Myrbeck,A. and Etana,A.,(**2002**). *Soil and Tillage Research*. No.64, pp.23-40.
[10] Kaspar, T.C., (**2003**).Response to tillage-induced soil conditions. Trans, Of the ASAE, 29(3), PP.690-693.
[11] Lapen, D.R., Topp,G.C., Edwards, M.E., Gregorich, E.G.andCurnoe, W.E., (**2004**). *Soil and Tillage Research*. No.79, PP.51-62.
[12] Larson,E.andWilms, J., (**2007**).Effective machine concepts for use in conservation tillage farming, CT- Line in Farming Systems, PP. 1-40.
[13] Mckyes, E., (**1985**).Soil cutting and tillage, Elsevier Science Publishers, USA.