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# Winter Wheat (*Triticumaestivum* L.) Yield and Weeds Height as influenced by Tillage Systems and Weed Control Methods

# Ali Farhadi<sup>1</sup>, Reza Hamidi<sup>2</sup>

<sup>1</sup>The former graduate student at the Shiraz University, College of Agriculture, <sup>2</sup>Associate Professor at Shiraz University, College of Agriculture,

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# ABSTRACT

Conventional tillage in agriculture is one of the high-energy consumption operations accounted for approximately 50% of total energy consumption. Field studies were conducted to evaluate the effects of the tillage systems and weed control methods on winter wheat (*Triticumaestivum* var. Shiraz) yield and weed whole flowered plant heights in agriculture faculty of Shiraz University on 2011-2012. The experimental design was a split-plot with three replications. The main factor was tillage systems including no tillage (NT), reduced tillage (RT)(tillage using compound), and conventional tillage (CT) (use of Suki plows, disking, and leveling up), and the sub-factor was various methods of weed control including hand weeding during the crop plant growth (HW), use of herbicides (H), and the case (without any weed control) (C).Results showed that the highest grain yield of wheat was belonged to the conventional tillage, reduced tillage, and no tillage treatments, respectively. There were no significant differences between weed control methods (p<0.05) in regard to the wheat grain yield. The highest whole flowered plant height sat crop heading and tillering stages were observed in no-tillage treatment. At crop tillering stage, there were no significant differences between weed whole flowered plant heights in all weed control treatments. According to the results of the study, using conventional tillage system together with herbicide application can be suggested for gaining of high winter wheat yield under Bajgah climatic condition.

**KEYWORDS:** Tillage systems, Weed control methods, Winter wheat, Whole flowered plants height, *Alopecurusmyosuroides, Lithospermumarvense, Lamiumamplexicaule.* 

# INTRODUCTION

Grains are the most important food plants on earth supplying the food for 70% of world population. Wheat and rice approximately supply 60% of energy needed by human. Generally, grains supply more than <sup>3</sup>/<sub>4</sub> of energy and <sup>1</sup>/<sub>2</sub> of protein needed by human [1]. According to the definition of Weed Science Society of America (WSSA), weeds are the plants that either distort or intervene with human activities and welfare [2]. Weeds compete with crop plants to get water, light, nutrient, growth space, and sometimes carbon dioxide and reduce their yields [3]. Weed control is one of the most important aspects of production in any agricultural system [4]. Tillage farming is as old as agriculture and it has been the symbol of production for centuries. Although the technology has gone through significant changes during the centuries, the reasons for tillage are still firm [5]. Weed control, seed bed preparation and subsoil natural cover, and manure and crop residues are cited as the main reasons for tillage before planting [6]. Weeds consume a significant amount of nutrients in the soil and their consumption rate is higher than economic corps. Due to competition that weeds make with the crops, they reduce the crop yield [7]. In the field and while there is a competition between 1-yaer old weeds and planted crops, controlling is common. Efficient controlling of weeds at the beginning of the season is the base for efficient farming. This control at the beginning of the season is usually more important than controlling at the end of it [8].

# METHODS AND MATERIALS

Field experiments were conducted on the Experimental Station of College of Agriculture, Shiraz University at Bajgah located 1810 meters above the sea level with a longitude of 52°32′E and latitude of 29° 36′ Nin 2011-2012. The previous crop planted in the field was wheat. The experimental design was a split-plot with three replications. The main factor was tillage systems including no tillage, reduced tillage (tillage using compound), and conventional tillage (including the use of Suki plows, disking, and leveling up); and the sub factor was various methods of weed control including hand weeding during the crop plant growth, use of herbicide, and the Case (without control). For

\* Corresponding Author: Ali Farhadi, The former graduate student at the Shiraz University, College of Agriculture, alia.f66@gmail.com

application of the trial treatments, firstly the treatments of different tillage systems were applied and then the field was split into 27 plots of 10m length and 5m width. Every main plot was divided into three parts and each part was randomly allocated to the three sub-factor treatments. "Total", dual-purpose herbicide, was applied in related treatments at rate of 40 g ha<sup>-1</sup>together with 1250 ml special surfactant. The direct seeding machine was used for seeding in no-tillage treatment, and the composed tillage was used for reduced tillage treatment. Winter wheat seeds (230 kg ha<sup>-1</sup>)were planted in lines at 11 cm apart by cereal planting machine. At two stages of wheat life cycle (tillering and flowering) whole flowered plant height was measured for three weed species, *Alopecurusmyosuroides, Lithospermumarvense* and *Lamiumamplexicaule*.

# **RESULTS AND DISCUSSION**

### Wheat grain yield

The results of variance analysis indicated that the effects of different systems of tillage are significant at 5% level, however the effects of different methods of weed controlling and interaction between different systems of tillage and different methods of weed control are not significant (Table 1).

For different tillage system treatments, the highest yield of the grain was obtained from conventional tillage system (3625.77 kg per hectare) and the lowest grain tillage was obtained form no-tillage system (652.88 kg ha<sup>-1</sup>). Wheat grain yield in reduced tillage system (2017.77 kg ha<sup>-1</sup>) was significantly reduced compared to that of conventional tillage. In terms of comparison between reduced tillage and no-tillage, wheat grain yield in no-tillage system was significantly lower than that of reduced tillage one (Figure 1).

Different studies on effects of different tillage systems on wheat grain yield have given different results. In a study, Bloyns & Fry (1993) stated that in most soils, the yield for no-tillage system is equal to or less than conventional or reduced tillage [8]. Coachran *et al.*[9] indicated that the lowest wheat grain yield was belonged to the no-tillage system which derives from weed growth patterns, soil compactness increase, reduction in root growth, and nitrogen absorption [9]. Humel[10] in a study concluded that the lowest yields of the wheat was belonged to no-tillage, conventional, and reduced tillage systems, respectively. He indicated that consecutive use of no-tillage system can be related to soil physical loss in 30cm depth from the soil surface.

It seems that the factors such as higher weeds growth in no-tillage system compared to the two other ones and also shortage of soilnitrogen due to microorganisms activity and lower soil temperature, reduced crop yield.

There were no significant differences in regard to wheat grain yield between the weed control methods, however, the highest yields was belonged to the case treatment (2251.77kg ha<sup>-1</sup>), hand weeding (2058.88 kg ha<sup>-1</sup>), and herbicide use (1985.77 kg ha<sup>-1</sup>), respectively (Figure 2).

# The whole flowered plant height of *Alopecurusmyosuroides* at wheat tillering stage

The results of variance analysis indicated that the effects of different tillage systems are significant at 5% level, however, the effects of different weed control methods and the interactions between different tillage systems and various weed control methods is not significant (Table 1).

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Sources of change	Degree of freedom	Alopecurusmyosuroides (Tillering)	Lithospermumarvense (Tillering)	<i>Lamiumamplexicaule</i> (Tillering)	
Tillage	2	192.89*	155.17*	228.50 <sup>*</sup>	
Replication	2	14.39 <sup>ns</sup>	9.50 <sup>ns</sup>	170.17 <sup>ns</sup>	
Trial error	4	8.89	9.67	41.42	
Weed control	1	16.05 <sup>ns</sup>	0.22 <sup>ns</sup>	2592*	
Tillage * control	2	9.55 <sup>ns</sup>	0.72 <sup>ns</sup>	228.50 <sup>ns</sup>	
Trial error	6	6.05	1.39	84.33	
Coefficient of variation		17.93	10.71	76.53	

#### Table 1. Mean squares of whole weed flowered plant height at wheat tillering stage.

NS and \*are non-significant and significant at 0.05, respectively.



Figure 1: Effects of different tillage systems on wheat grain yield.



Figure 2: Effects of different weed control methods on wheat grain yield.

In terms of different tillage systems, the highest flowering height of *Alopecurusmyosuroides* was belonged to no-tillage system (19.5cm) which was significantly higher than flowering height of *Alopecurusmyosuroides* in reduced tillage system (13.5cm) and conventional tillage system (8.17cm). The whole flowered plant height of *Alopecurusmyosuroides* in reduced tillage system was significantly higher than that of conventional tillage system (Figure 3). It seems that due to lack of sufficient contact between seed and soil in no tillage system and consequently reduction in wheat seed germination percentage[12], the conditions for weeds growth are better in this treatment compared to conventional and reduced tillage systems. The quantity and height of the weeds per square meters was increased in no tillage system due to higher access of weeds to light, water, nutrients (reduction of environmental resources and higher competitive ability of weeds over crop plants)[13].

There were no significant differences between weed control methods in whole flowered plant height of *Alopecurusmyosuroides*, however, whole flowered plant height of *Alopecurusmyosuroides* for case treatment (14.67) was higher than herbicide use treatment (12.78) (Figure 4).



Figure 3: Effects of different tillage systems on whole flowered plant height of *Alopecurusmyosuroides* at wheat tillering stage.



Figure 4: Effects of different weed control methods on whole flowered plant height of *Alopecurusmyosuroides* at wheat tillering stage.

### The whole flowered plant height of Lithospermumarvense at wheat tillering stage

The results of variance analysis indicated that the effects of different systems of tillage are significant at 5% level, however the effects of different weed control methods and the interactions between different tillage systems and various weed control methods is not significant (Table 2).

In terms of different tillage systems, the highest whole flowered plant height of *Lithospermumarvense* was belonged to no-tillage system (16cm) which was significantly higher than that of *Lithospermumarvense* in conventional tillage (5.83cm). The whole flowered plant height of *Lithospermumarvense* in no-tillage treatment was not significantly different with that of reduced tillage (11.17cm). The whole flowered plant height of *Lithospermumarvense* in reduced tillage system was significantly higher than that of conventional tillage (Figure 5).

It seems that due to lack of sufficient contact between seed and soil in no tillage system and consequently reduction in wheat seed germination percentage [12], the conditions for weeds growth are better in this treatment compared to conventional and reduced tillage systems. The quantity and height of the weeds per square meters was increased in no tillage system due to higher access of weeds to light, water, nutrients (reduction of environmental resources and higher competitive ability of weeds over crop plants) [13].

There were no significant differences between weed control methods in whole flowered plant height of *Lithospermumarvense*, however whole flowered plant height of *Lithospermumarvense* for the case treatment (11.11cm) was higher than herbicide use treatment (10.89 cm) (Figure 6).



Figure 5: Effects of different tillage systems on whole flowered plant heights of *Lithospermumarvense* at wheat tillering stage.



Figure 6: Effects of different weed control methods on whole flowered plant height of *Lithospermumarvense* at wheat tillering stage.

# The whole flowered plant height of Lamiumamplexicaule at wheat tillering stage

The results of variance analysis indicated that the effects of different tillage systems are significant at 5% level, however, the effects of different weed control methods and the interactions between different tillage systems and various weed control methods is not significant (Table 1).

In terms of different tillage systems treatment, the highest whole flowered plant heights of *Lamiumamplexicaule* was belonged to no-tillage system (8.33cm) which was significantly higher than that of *Lamiumamplexicaule* in conventional tillage (5cm). The whole flowered plant height of *Lamiumamplexicaule* in no-tillage treatment was not significantly different with that of reduced tillage (7.5cm). The whole flowered plant height of *Lamiumamplexicaule* in reduced tillage treatment was significantly higher than that of conventional tillage (Figure 7).

It seems that due to lack of sufficient contact between seed and soil particles in no tillage system and consequently reduction in wheat seed germination percentage [12], the conditions for weeds growth are better in this treatment compared to conventional and reduced tillage system. The quantity and height of the weeds per square meters was increased in no tillage system due to higher access of weeds to light, water, nutrients (reduction of environmental resources and higher competitive power of weeds over crop plant)[13].

There were no significant differences between weed control methods in whole flowered plant height of *Lamiumamplexicaule*, however whole flowered plant height of *Lamiumamplexicaule* for the case treatment (24cm) was higher than herbicide use treatment (0 cm) (Figure 10). In fact, after herbicide application, none of the *Lamiumamplexicaule* flowered.



Figure 7: Effects of different tillage systems on whole flowered plant height of *Lamiumamplexicaule* at tillering stage.



Figure 8: Effects of different weed control methods on whole flowered plant height of *Lamiumamplexicaule* at wheat tillering stage.

### The whole flowered plant height of *Alopecurusmyosuroides* at wheat heading stage

The results of variance analysis indicated that the effects of different systems of tillage are significant at 5% level, however, the effects of different weed control methods and the interactions between different tillage systems and various weed control methods is not significant (Table 2).

In terms of different tillage systems treatment, the highest flowering height of *Alopecurusmyosuroides* belonged to no-tillage system (18.83cm) which was significantly higher than flowering height of *Alopecurusmyosuroides* in conventional tillage (6.83cm). The flowering height of *Alopecurusmyosuroides* in no-tillage treatment was not significantly different with that of reduced tillage (10.33cm). The flowering height of *Alopecurusmyosuroides* in reduced tillage treatment was not significantly different with that of conventional tillage (Figure 9).

It seems due to lack of sufficient contact between seed and soil in no tillage system and consequently reduction in percentage of wheat germination [12], the conditions for weeds growth are better in this treatment compared to conventional and reduced tillage. The quantity and height of the weeds per square meters was increased in no tillage treatment due to higher access of weeds to light, water, nutrition (reduction of environmental resources limitation and higher competitive power of weeds over planted crop [13].

There were no significant differences between weed control methods in flowering height of *Alopecurusmyosuroides*, however flowering height of *Alopecurusmyosuroides* for case treatment (24cm) was higher than herbicide use treatment (0cm) (Figure 10).



Figure 9: the effects of different tillage systems on flowering height of *Alopecurusmyosuroides* at wheat heading stage



Figure 10: the effects of different weed control methods on flowering height of *Alopecurusmyosuroides* at wheat heading stage.

# The whole flowered plant height of *Lithospermumarvense* at wheat heading stage

The results of variance analysis indicated that the effects of different tillage systems, different weed control methods, and interactions between different tillage systems and weed control methods were all significant at 5% level (Table 2).

Sources of changes	Degree of freedom	Alopecurusmyosuroides (Heading)	Lithospermumarvense (Heading)
Tillage	2	3543.59*	93.17*
Replication	2	18.81 <sup>ns</sup>	1.71 <sup>ns</sup>
Trial error	4	10.43	1.83
Weed control	1	1.81*	4418.00*
Tillage *	2	18.26 <sup>ns</sup>	93.17*
Trial annon	6	110.33	1.61
Coefficient of conviction (0/)	0	7.0	0.10
Coefficient of variation (%)		1.02	8.10

Table 2.Mean squares of whole flowered weed height at wheat heading stage.

N and \*are the non-significance and significance levels at 0.05 level, respectively.





The flowering height of *Lithospermumarvense* in case treatment for all the three conventional tillage(24cm), reduced tillage (3.33), and no-tillage (39.6cm) was significantly higher than that of herbicide use treatment (Table 1). Generally, in all of the tillage systems, the weeds prevalence is reduced by the use of herbicide [14].

# Conclusion

The whole flowered plant height of weeds at wheat heading stage was higher than that of tillering stage. In such a condition, the weeds have to flower at a higher height to absorb the light. The highest whole flowered plant height of weeds at heading and tillering stages were observed for no-tillage system. There were no significant differences between the weeds whole flowered plant height in weed control methods at the heading stage. According to the obtained results, use of conventional tillage alongside with herbicide can be suggested for gaining of higher winter wheat yield under Bajgah climatic conditions.

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