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Original Research

Determination of intraspecific and interspecific competition of different varieties of wheat (*Triticum aestivum*) and weeds in the area of Gilavand

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ABSTRACT:

This study aimed to investigate intraspecific and interspecific competition of different varieties of wheat (*Triticum aestivum*) and weeds and their effect on the growth of wheat in the area of Gilavand in the crop year 2014-2015. The bivariate factorial experiment was conducted in a randomized complete block design. Regression model 1/w (reciprocal of per plant) and natural logarithm of the reciprocal of individual-plant weight (ln1/w) and yield per plant (w) were used to determine the species and sub-species of weeds and wheat in the farm. The results showed that the ivy has greatest positive impact on wheat lines (c.81014) in the presence of other species. The interaction between these weeds revealed their positive effect on growth of wheat.

Keywords:

Components of performance, competition, wheat, performance, weeds

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INTRODUCTION

Some factors, such as increasing population growth, degradation of natural capital, destruction of wildlife, environmental pollution, soil erosion, increasing salinity of fields and lack of proper management of production, have created a dark future for the inhabitants of the earth planet. Suitable food production is not homogeneous and consistent with rapid population growth and it has some shortcomings related to the speed of population growth (Subba *et al.*, 1979).

The aim of organic farming is ecological balance and enhancing biological processes. In this system, non-chemical method is used to maintain soil fertility and boost its nutritional elements, as well as control insects, weeds and other pests. Organic farming is a form of ecological agriculture to reduce abnormal institutions (Siraj, 2008).

Cereal plays a special role in any country's consumption patterns in the world. The world's population will be 8112 billion in 2025 (Noormohammadi *et al.*, 1997. The relative nutritional value of wheat plays the role of the dietary patterns for more than 75 percent of the world's population (Noormohammadi *et al.*, 2000). The wheat plant is known commonly as an annual plant derived from a perennial and there is no precise distinction between species Sharifzadeh *et al*. (2006).

The plant is made up of a root and shoots system. There found two types of roots including seminal roots and nodal roots (adventitious or crown roots) (Aldrich and Kermer, 1997). These roots arise from the lower nodes of the shoot. The shoot is consist of a series of phytomers, each potentially composed of a node, a leaf, an elongated internode and a bud in the axil of the leaf (Behina, 1998).

Wheat is a plant cultivated in the northern and southern hemispheres and can grow in areas with a temperature of 17-50°C (Noormohammadi *et al*., 1997). Although wheat is a strong and tolerant plant, it is sensitive to competition with weeds Sharifzadeh *et al*., (2006). Weeds compete to absorb light, water and nutrients, and affect the growth and crop yield. Obviously, the pressure of weed interference is different depending on the density and weed species at different stages of crop growth (Alderich and Kermer, 1997). Weeds of the agricultural land include several species that do not operate independently. The positive qualities such as nutrient cycling, preventing erosion, and population growth should be considered for the competitive review and assessing the economic damage of weeds (Sosnoskie *et al*., 2006). Changes in weed communities cannot be calculated as a single variable because plant communities are affected by biotic and abiotic factors. Agronomic and environmental factors such as rotation, cover crops, soil type, moisture, etc. can affect weed communities.

Today, quantitative assessment of the behavior and effects of weeds in agricultural ecosystem is necessary instead of removing weeds in a field. This requires knowledge of the characteristics of crop plants and weeds during the growing season and their interactions in terms of competition and growth indicators of weed population dynamics. Hence, this study was conducted to assess the competitiveness of wheat genotypes in cold areas with natural flora of weeds, the power of competition, and reciprocal effects of adjacent species on each other.

Table 1. The name of the formulation, the recommended dose per hectare and toxicity of herbicides used in tests

Generic name (Brand)	Formulation	The recommended dose per hectare	Direction of control
2,4-D (U-46)	SL72%	1-1.5 liters per hectare	broadleaf
Topik	EC80%	0.8-1 liter per hectare	narrow-leaf

MATERIALS AND METHODS

The experiment was carried out in Gilavand in the crop year 2014-2015. Gilavand is located at 45 km East of Tehran, at an altitude of 1850 meters above sea level and latitude 25° 43′ and longitude 55°, with average rainfall of 340 mm, the minimum average temperature - 6.2°C and the average maximum temperature 20°C. Loam soil (22% clay, 46%silt, and 32% sand) included potassium 238 ppm, phosphor 4.54 ppm and pH 7.16. Preparing the ground operation consists of two stages: harrowing for crushing clods, grading, terracing. The bivariate factorial experiment was conducted in a randomized complete block design. Regression model 1/w (reciprocal of per plant) and natural logarithm of the reciprocal of individual-plant weight (ln1/w) and yield per plant (w) were used to determine the species and sub-species of weeds and wheat in the farm. Experimental plots consisted of seven stacks which were 60 centimeters with the length 3 km, an area of 2.7 square meters. This scheme was factorial with 2 treatments, including lack of weed control (normal flora) and weed control using Topik poison and hormone poison 2, 4-D. sampling was done by a Quadrat 50 × 50 in two stages of 20 and 45 days after treatment. Herbicide 2,4- D was used to control broadleaf weeds at a rate of 1-1.5 liters per hectare in tillering (Zadoks 30-32). Topik poison was used to control narrow-leaf weed at the time of tillering (Zadoks 30-32). Spraying was done with a pressure of 200 kPa and the amount of water consumption of 200 liters per hectare (Zand *et al*., 2008).

After identifying weeds and counting the number of species, wheat was transported to the laboratory. After putting in the oven for 72 hours at 70°C, dry weight of weeds and wheat were measured using digital scale. Leaf area was measured by machine Leaf Area Meter (Model Licor). Data were analyzed by SAS software and mean comparisons were performed (Zand *et al*., 2004).

Calculating intraspecific and interspecific competition of wheat and the weeds

The reciprocal of individual-plant weight was used to calculate intraspecific and interspecific competition of wheat and the weeds. Regression model 1/w (reciprocal of yield per plant) and natural logarithm of the reciprocal of individual-plant weight (ln1/w) and yield per plant (w) were used to determine the species

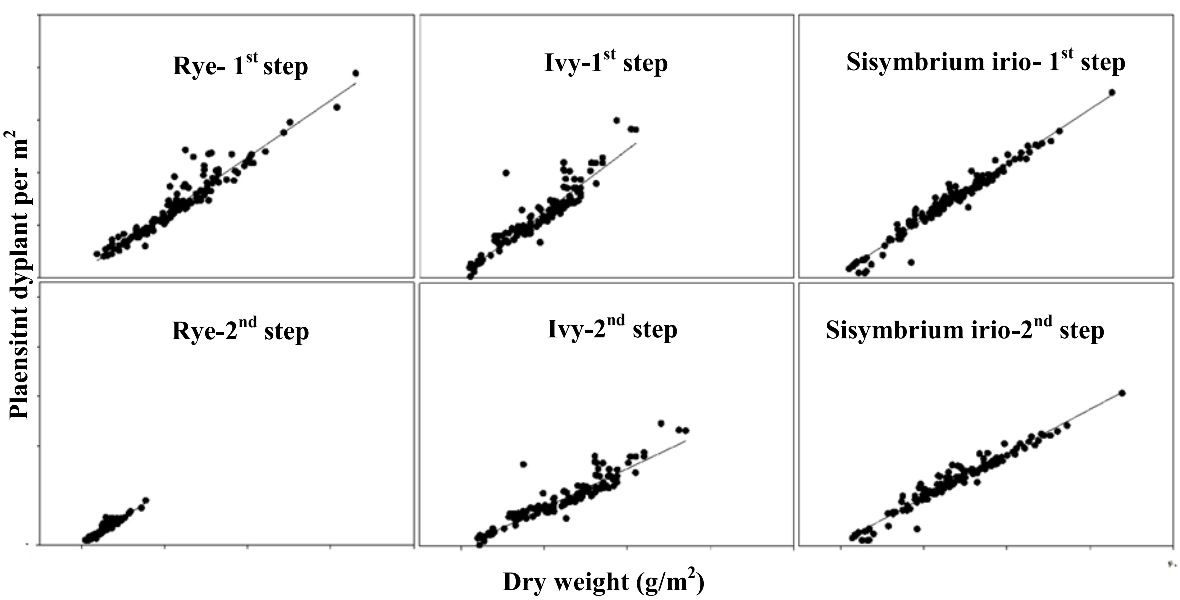

Figure 1. The relationship between dry weight and plant density of weeds (stage one: 20 days after spraying; stage two: 45 days after spraying) in Gilavand area

Table 2. Linear regression coefficients and significance level of linear relationships between weeds parameters (independent variables) and the dry weight and density of weeds

Weeds density (N)		Weeds dry weights (DM)				
P-value	**r**	***P-value***	**R**	**Dependent variable**	**Cultivar**	**Sampling time**
0.60	0.16	0.93	-0.02	W	C.81.14	20 days after spraying
0.61	0.16	0.94	-0.02	LnW		
0.31	0.31	0.40	0.26	W	C.82.12	
0.37	-0.28	0.46	-0.23	1/W		
0.34	0.29	0.43	0.25	LnW		
0.26	-0.35	0.15	-0.44	W	C.84.18	
0.41	0.25	0.23	0.37	1/W		
0.32	-0.30	0.18	-0.41	LnW		
0.20	0.39	0.18	0.41	W	C.84.4	
0.21	-0.38	0.19	-0.40	1/W		
0.21	0.38	0.18	0.40	LnW		
0.83	-0.06	0.47	-0.22	W	Alvand	
0.81	0.07	0.43	0.24	1/W		
0.82	-0.07	0.45	-0.23	LnW		
0.88	0.04	0.73	0.11	W	Toos	
0.87	-0.05	0.70	-0.12	1/W		
0.87	0.05	0.71	0.11	LnW		
0.23	-0.37	0.09	-0.50	W	Zarrin	
0.20	0.39	0.08	0.52	1/W		
0.21	-0.38	0.08	-0.51	LnW		
0.21	-0.38	0.08	-0.51	LnW		
0.96	-0.01	0.76	-0.09	W	Syson	
0.79	0.08	0.63	0.15	1/W		
0.88	-0.04	0.70	-0.12	LnW		
0.23	-0.37	0.10	-0.49	W	Shahriyar	
0.19	0.40	0.09	0.50	1/W		
0.20	-0.39	0.09	-0.50	LnW		
0.51	-0.20	0.84	-0.06	W	Gascogene	
0.41	0.26	0.73	0.11	1/W		
0.46	-0.23	0.78	-0.08	LnW		
0.83	-0.06	0.77	0.09	W	Marton	
0.64	0.14	0.58	0.17	1/W		
0.73	-0.10	0.67	-0.13	LnW		
0.004	-0.75	0.01	-0.67	W	Mahdavi	
0.003	0.77	0.01	0.70	1/W		
0.003	-0.76	0.01	-0.68	LnW		
0.42	0.25	0.81	0.07	W	C.81.14	45 days after spraying
0.30	0.32	0.39	0.27	W	C.82.12	
0.36	-0.28	0.45	-0.24	1/W		
0.33	0.30	0.42	0.25	LnW		
0.10	-0.49	0.06	-0.54	W	C.84.18	
0.24	0.36	0.16	0.43	1/W		
0.15	-0.43	0.10	-0.49	LnW		

Continue…….

Continue…..

0.20	0.39	0.22	0.37	W	
0.21	-0.38	0.22	-0.38	1/W	C.84.4
0.20	-0.39	0.22	0.38	LnW	
0.59	-0.17	0.30	-0.32	W	
0.57	0.18	0.27	0.43	1/W	
0.58	-0.17	0.28	-0.33	LnW	Alvand
0.58	-0.17	0.28	-0.33	LnW	
0.58	-0.17	0.28	-0.33	LnW	
0.58	-0.17	0.28	-0.33	LnW	
0.63	0.15	0.56	0.18	W	
0.66	-0.13	0.58	-0.17	1/W	Toos
0.65	0.14	0.57	0.18	LnW	
0.24	-0.36	0.10	-0.48	W	
0.22	0.37	0.09	0.50	1/W	Zarrin
0.23	-0.37	0.09	-0.49	LnW	
0.72	0.11	0.91	0.03	W	
0.87	-0.05	0.94	0.02	1/W	Syson
0.79	0.08	0.98	0.006	LnW	
0.32	-0.31	0.20	-0.39	W	
0.26	0.35	0.17	0.42	1/W	Shahriyar
0.28	-0.33	0.18	-0.41	LnW	
0.12	-0.47	0.48	-0.22	W	
0.08	0.51	0.39	0.26	1/W	Gascogne
0.10	-0.49	0.43	-0.24	LnW	
0.80	-0.07	0.75	-0.10	W	
0.62	0.15	0.57	0.18	1/W	Marton
0.71	-0.11	0.65	-0.14	LnW	
0.01	-0.66	0.03	-0.61	W	
0.01	0.69	0.02	0.64	1/W	Mahdavi
0.01	-0.68	0.02	-0.62	LnW	

Parameters related to identified values were used as data for competitive coefficients evaluation model.

and sub-species of weeds and wheat in the farm. The reciprocal of individual-plant weight was considered as the dependent variable and density of weeds after spraying was considered as the independent variable. Equation (1) was used as the study of this relationship (Rahimian and Shariati, 1999).

$$W = a_0 + bN_1 + cN_2 + dN_3 + \cdots + nN_n \qquad (1)$$

where "w" is the reciprocal of individual-plant weight for wheat, "a_0" is the maximum individual-plant weight in the absence of competition, "N_1" is density of wheat per area, "b" is the coefficient of intraspecific competition for wheat, "N_2" and "N_n" are weed species density in the neighborhood, and "c" is interspecific competition coefficient (Rahimian and Shariati, 1999).

RESULTS AND DISCUSSION

Based on the relationship between the cultivars of the wheat and the predominant weeds in the field (Figure 1), density and dry weight of the weed after 45 days of spraying were considered as the independent variables and the reciprocal of individual-plant weight for the wheat was considered as the dependent variable. According to the regression analysis and comparison of

Table 3. Coefficients of intraspecific and interspecific competition for different varieties of wheat and weeds after 45 days of spraying in Gilavand

P-value	R^2	*A*	*Sisymbrium irio*	Ivy	Rye	Wheat	Cultivar
0.726	0.22	17.34	0.084	0.252	-0.087	0.04	C.81.14
0.287	0.46	14.10	0.119	0.497	0.954	0.02	C.82.12
0.382	0.41	29.11	-0.58	-0.36	1.41	-0.0005	C.84.18
0.613	0.28	30.87	0.152	0.509	-2.41	-0.09	C.84.4
0.015	0.79	24.93	-0.507	0.346	-0.077	-0.014	Alvand
0.890	0.13	21.39	-0.012	0.386	-0.276	-0.036	Toos
0.007	0.83	26.04	-0.999	0.647	0.671	-0.042	Zarrin
0.729	0.22	19.48	0.182	-0.073	-0.449	0.057	Syson
0.381	0.41	25.89	-0.505	0.504	-0.953	-0.023	Shahriyar
0.086	0.64	20.86	-0.228	-0.367	1.423	0.062	Gascogene
0.910	0.11	21.38	-0.210	0.135	1.852	0.058	Marton
0.086	0.64	25.84	-0.248	-0.045	-1.206	0.047	Mahdavi

*In each row, values are related to intraspecific and interspecific competitive coefficients of wheat and weeds

regression lines for the data related to Rye after 45 days of spraying, species density and dry weight were considered as independent variables (Gharakhlou, 2006; Abdollahi and Mohammadi, 2007). Atri and Zand (2005) stated that the relative leaf area can also be an expression of dry weight. Meyjani (2012) considered the relative leaf area and its similarities with the dry weight of early season and late season of weeds.

Linear relationship between weeds parameters (independent variables) and the reciprocal of individual-plant weight for the wheat (dependent variable) were used for explaining the interaction of weeds in terms of proximity to wheat.

Coefficients of intraspecific and interspecific competition for different varieties of wheat and weeds after 45 days of spraying in the area of Gilavand are shown in the Table (3). The coefficients indicated that the effects of the species on each other can be negative or positive. When a plant increases or decreases a food source, the response of neighboring plants may be positive, negative or neutral (Clay, 2006).

Due to the allelopathic conditions of plants and their interaction on the rhizosphere, they sometimes facilitate growth and occasionally cause growth cessation. Therefore, one of the competition condition for weeds is the presence of allelopathic substances (Radosevich *et al*., 1997).

Many types of neighboring effects of crops-weeds can be divided as neutralized (neutral life), positive effects (compulsory coexistence, optional co-operation, unilateral profitability, facilitation) and negative effects (parasitism, unilateral loss (allelopathy) and competition) (Ardakani, 2011).

Among the weeds, including rye (0.087), ivy (0.252) and *Sisymbrium irio* (0.084), Ivy had the most positive impact on Line c08014 in the presence of other species (Table 2). In fact, rye had a negative impact on line c08014 with a positive impact on ivy and *Sisymbrium irio*. In line C.82012, all three weeds had a positive impact. In line C.84018, the negative effect of rye and *Sisymbrium irio* on ivy caused the negative impact on wheat. For Alvand cultivar, the negative effect of rye and *Sisymbrium irio* on ivy caused the negative impact on wheat. For Rum, the negative effect of rye and *Sisymbrium irio* on ivy caused the negative impact on wheat. For Zarin, the negative effect of *Sisymbrium irio* on rye and ivy caused the negative impact on wheat. For Sayson, the negative effect of rye and ivy caused the positive impact on *Sisymbrium irio* and weed interactions had a positive effect on wheat. For Shahriar, the negative effect of *Sisymbrium irio* and rye caused the positive impact on ivy and finally the negative impact on Shahriar. For Gascogen, the negative effect of *Sisymbrium irio* and ivy caused the positive impact on rye and weed interactions had a positive effect on wheat. For Marathon, the negative effect of ivy and rye caused the negative impact on *Sisymbrium irio* and weed interactions had a positive effect on wheat.

CONCLUSION

Intraspecific and interspecific competition and competition with adjacent weeds always cause serious yield reduction. The effect of adjacent weeds causes the growth and enhances the performance of the species. Finally, it prevents the use of herbicides and their entry into the ecological niche.

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