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Integration Effects of Split Nitrogen Fertilization and Herbicide Application on Weed Management and Wheat Yield

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ABSTRACT

A field study was conducted to determine the integration of split N fertilization and herbicide application on weed management and wheat (*Triticum aestivum* L.) yield in Shiraz, Iran, in 2005/2006 and 2006/2007 growing seasons. The experimental design was split plot with four replications. Main factors consisted of N timing and splitting, and sub plots included iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium, solfosulfuron and two weedy and weed free controls. Compared with the weedy check, iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium and solfosulfuron reduced weed biomass by 66% in 2005/06 and 55% in 2006/07, 37% in 2005/06 and 45% in 2006/07, respectively. In all herbicide treatments applied in both years, the highest (353.6 kg h^{-1} in 2005/06 and 224.1 kg h^{-1} in 2006/07) and the lowest (65.6 kg h^{-1} in 2005/06, and 24.0 kg h^{-1} in 2006/07) weed biomass were obtained from the full N (304 kg urea ha^{-1}) application at tillering stage and zero N application at sowing and stem elongation stages T_1N_0, T_2N_1, T_3N_0 and no N fertilization at sowing, tillering and stem elongation stages T_1N_0, T_2N_0 and T_3N_0. Nitrogen use efficiency of the crop increased when N was split. Consequently, wheat LAI and grain yield increased. However, in the presence of weeds, both LAI and grain yield increases were lower. The results of the present study showed that integration of N and herbicide treatments caused even a higher increase in wheat LAI and grain yield, but resulted in a higher reduction in weed biomass when compared with either treatment alone. N splitting of $T_1N_{1/2}$, $T_2N_{1/2}$ and T_3N_0 increased wheat grain yield (61% in 2005/06 and 75% in 2006/07), biological yield (76% in 2005/06, 94% in 2006/07), and LAI (62% in 2005/06 and 2006/07). In conclusion, weed control was essential for efficient use of N fertilizer by the crop. Therefore, in order to increase wheat grain yield, integration of split N and herbicide is recommended for the region. The results of this study showed that N splitting treatments of $T_1N_{1/2}$, $T_2N_{1/2}$, T_3N_0 and iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium had the best efficiency in terms of weed control in wheat.

Keywords: Herbicide, Nitrogen splitting, Nitrogen timing, Weed control, Wheat yield.

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INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important crop among food cereals. There are a good number of factors responsible for low yield among which one major cause is weed infestation. Weeds are the most serious pests reducing the growth and yield of wheat. Control of weeds is a basic requirement and major component of management in most crop production systems (Norris 1982). Traditionally, farmers in Iran used high N rate and herbicides to increase crop yield. As a result, evidence of increasing nitrate leaching under various land-use systems and weed resistance has elevated the interest and need to find better mitigating strategies.

Integrated weed management (IWM) systems essentially mean the integration of several practices, including herbicides, to

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reduce the negative impact of weeds on crops and the amount of seed produced by the weeds (O'Donovan *et al*., 2007). Information on the impact of several management techniques, e.g., herbicide rates and fertilizer application is needed for developing a reliable IWM (Jørnsgård *et al*., 1996). Malik *et al*. (1993) and Jarwar *et al*. (1999) observed that chemical weed control method was more effective when integrated with cultural methods of weed control.

In wheat, N supply directly correlates with weed competition and competitive ability (Iqbal and Wright, 1997). Managing for increased competitive ability of crops with weeds is an important component of integrated weed management systems (Gill *et al*., 1997). Effective fertilization management may be able to reduce weed interference with crops (Di Tomas, 1995; Liebman and Janke, 1990).

Conflicting results have been reported on the effect of N fertilizer on crop-weed interaction. Valenti and Wicks (1992) found that increasing N rates applied to winter wheat decreased annual grass weed populations and yields. Conversely, in other studies, application of N favored *Setaria viridis* (Peterson and Nalewaja, 1992) and *Avena fatua* (Carlson and Hill, 1986) over wheat. Jørnsgård *et al*. (1996) found differences in the biomass of individual weed species in both wheat and barley crops with N fertilizer application.

Integrated weed management systems have a potential to reduce herbicide use (and associated costs) and to provide more robust and long-term management of weeds. Numerous agronomic factors such as crop rotation, crop variety, seeding date, seeding rate, row spacing, and fertilization management have been evaluated for their potential to manage weeds (Gill *et al*., 1997).

Splitting of N fertilization has been suggested as a strategy to improve wheat N use efficiency (Alcoz *et al*., 1993). Limaux *et al*. (1999) reported that the timing of N applications had a significant effect on the uptake of fertilizer N by the crop and the resulting partitioning of added N between soil and plant.

Proper N splitting and timing will reduce the potential for environmental pollution and improve weed management. This study was conducted to determine the effect of N timing and splitting application in combination with two herbicides, solfosulfuron, and iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium on weed management and wheat yield.

MATERIALS AND METHODS

Field study was conducted in 2005/2006 and 2006/2007 growing seasons at the research station of the College of Agriculture of Shiraz University in Kooshkak (1650 asl, longitude 52˚, 36´, and latitude 30˚, 7´). The meteorological data for this location during the growing seasons for two years are shown in Table 1. Wheat was

Table 1. Meteorological data during the growing season.

Month	Average temperature (˚C)		Precipitation (mm)	
	2005-06	2006-07	2005-06	2006-07
November	11.13	12.88	99.00	3.00
December	9.40	3.58	1.50	100.50
January	3.48	1.60	172.00	37.50
February	6.58	5.08	67.00	97.00
March	8.98	8.33	6.50	49.00
April	12.11	12.08	0.00	185.00
May	17.34	19.02	0.00	1.00
June	21.95	23.84	0.00	0.00
July	27.19	27.77	0.00	0.00
August	26.58	25.97	0.00	0.00

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grown in the experimental field in the previous season. Soil texture was clay-loam with pH= 7.3, EC= 0.28 mmhos cm^{-1}, OC=0.7%, N= 0.046%, P= 16 ppm and K= 270 ppm. Seedbed preparation consisted of moldboard plowing, disking and leveling. The wheat cultivar was Shiraz and was planted 15 cm apart in four rows on raised beds 60 cm apart on 15 November by Hamedani planter at the rate of 180 kg ha^{-1} in both years. No fertilizer was added before planting. Sub plot size was 4×5 m. The experimental design was a split plot based on RCBD with four replications. Main plots consisted of N timing (T_1= Sowing, T_2= Tillering, and T_3= Stem elongation) and splitting (N_0= No N fertilization, N_1= Full N fertilization, $N_{½}$= Half of the N fertilization, $N_{⅓}$= One third of the N fertilization and $N_{⅔}$= Two thirds of the N fertilization). T_1N_0, T_2N_0 and T_3N_0 represent no N fertilization at sowing, tillering, and stem elongation stages, respectively. T_1N_0, T_2N_1 and T_3N_0 represent no N fertilization at sowing, full N fertilization (304 kg urea ha^{-1}) at tillering, and no N fertilization at stem elongation stage, respectively. $T_1N_{½}$, $T_2N_{½}$ and T_3N_0 represent half of the N (152 kg urea ha^{-1}) fertilization at sowing and the other half (152 kg urea ha^{-1}) at tillering and no N fertilization at stem elongation. T_1N_0, $T_2N_{⅓}$ and $T_3N_{⅔}$ represent no N fertilization at sowing, one third of the N (102 kg urea ha^{-1}) at tillering stage and two thirds (202 kg urea ha^{-1}) at stem elongation stage of the wheat. The sub plots consisted of application of two herbicides, iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium at 21g ai ha^{-1} with sitogate oil at 0.2% (V/V) and solfosulfuron at 20.25 g ai ha^{-1} with sitogate oil at 0.2%. Weedy and weed free checks were also included. Herbicides were applied as a broadcast application in 300 L of water per ha with a 20-L knapsack sprayer equipped with one flat-fan nozzle 110-02 at a pressure of 3 kPa at 3-4 leaf stages of weeds in both years.

Wheat was hand harvested from the central 1 m^2 of the middle rows in each plot after maturity to measure seed and biological yield. On the five sampling dates with two weeks interval during the growing seasons, wheat and weeds were harvested from 0.5 m^2 of each plot. Wheat LAI was measured by a leaf area meter (Delta T Device, UK), and dominant weeds in the field (*Avena ludoviciana*, *Hordeum spontaneum*) were counted by species. Wheat and weed samples were oven dried at 65°C for 48 h and their dry weights were measured (data from only one sampling date at 10 weeks after herbicide treatment (WAT) is shown for weed dry weight and number). All data were subject to analysis of variance using MSTAT C and SAS statistical software. Main effects and interactions were tested for significance. Means were separated by Duncan multiple range test (DMRT) at the 0.05 level of significance.

RESULTS AND DISCUSSION

Weeds Biomass

Interaction effects of herbicide use and N splitting on weed dry weight and number were significant. Weeds dry weights were decreased by 58.7% in 2005/06 and 73.6% in 2006/07 in the unfertilized treatments when compared with the T_1N_0, T_2N_1 and T_3N_0 (Table 2). Low N supply should have decreased net photosynthetic rate (P_n), leaf N percentage, plant dry weight and N uptake of both wheat and the weed species and grain dry weight of wheat (Evans *et al.*, 2002).

The results of the present study showed significant differences between herbicide treatments in terms of weeds biomass and number. Iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium decreased weed biomass by 66% in 2005/06 and 55% in 2006/07. Solfosulfuron decreased weed biomass by 37% in 2005/06 and 45% in 2006/07. Baghestani *et al.* (2006) reported that sulfosulfuron at 19.95 and 24.90 g ai ha^{-1} was suitable for broadleaf and grass weed control in wheat. Maximum reduction (70% in 2005/06 and 74% in 2006/07) in

Table 2. Total weeds dry weight as affected by N application timing and herbicide use at 10 WAT.

	Weeds dry weight (g m^{-2})									
	2005/2006					2006/2007				
Treatment	Herbicide		Control			Herbicide		Control		
Nitrogen	Iodosulfuron methyl sodium + Mesosulfuronmet hylsodium	Solfosulfu ron	Weedy	Weed free	Mean	Iodosulfuron methyl sodium + Mesosulfuronmet hylsodium	Solfosulfuron	Weedy	Weed free	Mean
T_1N_0, T_2N_0, T_3N_0	65.6 j	105.6 ij	218.4 ef	0.0 k	97.6 B	24.0 i	25.6 i	104.0 g	0.0 j	38.6 C
T_1N_0, T_2N_1, T_3N_0	192.0 fg	353.6 d	400.0 c	0.0 k	236.6 A	121.2 ef	224.1 c	238.4 c	0.0 j	146.2 A
T_1N_0, $T_2N_{1/3}$, $T_3N_{2/3}$	120.0 hi	245.6 e	544.0 a	0.0 ki	227.6 A	70.4 h	112.0 fg	285.6 a	0.0 j	117.3 B
$T_1N_{1/2}$, $T_2N_{1/2}$, T_3N_0	164.8 gh	308.8 d	455.2 b	0.0 k	232.4 A	184.0 d	131.2 d	265.6 a	0.0 j	145.4 A
Mean	135.6 C	253.4 B	404.4 A	0.0 D		100.4 C	123.2 B	223.4 A	0.0 D	
	Weeds number									
	Number of *Avena ludoviciana*									
T_1N_0, T_2N_0, T_3N_0	2.7 d	8.6 c	15.7 b	0.0 e	6.7 B	2.0 ef	5.6 d	11.7 bc	0.0 g	4.8 B
T_1N_0, T_2N_1, T_3N_0	9.3 c	18.0 ab	17.3 ab	0.0 e	11.2 A	8.7 cd	15.0 ab	14.3 ab	0.0 g	9.5 A
T_1N_0, $T_2N_{1/3}$, $T_3N_{2/3}$	2.3 d	10.0 c	22.0 a	0.0 e	8.6 B	0.3 fg	6.6 d	18.7 a	0.0 g	6.4 B
$T_1N_{1/2}$, $T_2N_{1/2}$, T_3N_0	7.7 c	15.2 b	19.3 ab	0.0 e	10.6 A	5.0 de	12.0 bc	16.0 ab	0.0 g	8.2 A
Mean	5.5 C	13.1 B	18.6 A	0.0 D		4.0 C	9.8 B	15.2 A	0.0 D	
	Number of *Hordeum spontaneum*									
T_1N_0, T_2N_0, T_3N_0	5.7 def	3.0 h	11.33 b	0.0 i	5.0 B	3.7 cde	3.0 e	5.7 bc	0.0 f	3.1 A
T_1N_0, T_2N_1, T_3N_0	8.7 c	5.0 efg	13.3 a	0.0 i	6.7 A	5.7 bc	3.3 cde	8.0 ab	0.0 f	4.2 A
T_1N_0, $T_2N_{1/3}$, $T_3N_{2/3}$	6.6 d	3.7 gh	11.3 b	0.0 i	5.4 AB	4.7 cde	3.0 de	5.7 b-e	0.0 f	3.3 A
$T_1N_{1/2}$, $T_2N_{1/2}$, T_3N_0	6.3 de	4.7 fg	11.3 b	0.0 i	5.6 AB	5.3 bcd	3.3 cde	9.3 a	0.0 f	4.5 A
Mean	6.8 B	4.1 C	11.8 A	0.0 D		4.8 B	3.2 C	7.2 A	0.0 D	

*Means within each column followed by same letters are not significantly different at 0.05 probability level according to DMRT.

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Avena ludoviciana number was observed with iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium. In addition, maximum reduction (65% in 2005/06 and 55% in 2006/07) in *Hordeum spontaneum* number was observed with sulfosulfuron. Results showed that iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium provided better control of *Avena ludoviciana* and sulfosulfuron provided better control of *Hordeum spontaneum.* Therefore, iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium was the best treatment in this study since it provided the best control of *Avena ludoviciana* which was the most dominant weed in the field.

Weeds biomass increased with all N treatments when compared with the unfertilized control, indicating that weed growth responded positively to increased levels of soil N. Among the N treatments, the highest weed biomass was obtained from the N split of T_1N_0, $T_2N_{1/3}$ and $T_3N_{2/3}$. This may be the effect of N on the emergence of the second flush of the weeds in the field. Nitrogen fertilizer is known to break the dormancy of certain weed species and thus may directly affect weed densities (DiTomaso, 1995; Fawcett and Slife, 1978).

Integration of split N application and herbicides caused an increase in the weed biomass with both herbicide treatments when total N was applied at tillering stage as compared to T_1N_0, $T_2N_{1/3}$ and $T_3N_{2/3}$ which had the highest weed biomass in the weedy check. This might be due to the higher N use efficiency of the weeds than the crop at higher N levels. Foster (1996) showed that higher N levels stimulate the competitive ability of wild oats (*Avena* sp), green foxtail (*Setaria viridis*) and barnyard grass (*Echinochloa crus-galli*). The competitive ability of the other weed species might be limited by N levels that are adequate for crop growth. In our study, herbicides caused significant decrease in the weeds biomass, indicating that weed control was the essential factor causing N fertilizer to show its positive effect on grain yield.

Wheat Yield

The interaction effect of year by treatment was significant ($P \leq 0.05\%$). Wheat grain yield (61% in 2005/06, 75% in 2006/07), and wheat biological yield (76% in 2005/06, 94% in 2006/07) increased with the N treatments as compared with the unfertilized control (Table 3). The interaction effect of nitrogen by herbicide was also found to be significant ($P \leq 0.05$). Nitrogen split of $T_1N_{1/2}$, $T_2N_{1/2}$ and T_3N_0 had the highest wheat grain and biological yield in all herbicide treatments in both years. Buchholz and Schaeffer, (1990) found that splitting the application of N between fall and spring growth periods improved winter wheat yields over all-fall and all-spring applications, particularly under intermediate to higher yield conditions. Split application of N has been suggested as a strategy to improve wheat N use efficiency (Alcoz *et al*., 1993). Many factors affect the influence of N in the field and their interactions are very complex. Therefore, sufficient N use may create the need for more intensive management, using proper weed control. Grain and biological yields differed significantly between the two study years; the highest grain yield (7,170.0 kg ha^{-1}) was obtained in 2006/07 as the wheat stand was better because of the lower weed density.

Iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium increased wheat grain yield by 63% in 2005/06, and 193.0% in 2006/07; and solfosulfuron increased wheat grain yield by 66% in 2005/06, and 143% in 2006/07 when compared with weedy check. Wheat biological yield was affected in a similar manner. In weedy check plots, wheat height increased at the expense of its grain yield because of the competition between the crop and weeds for light (such as wild oat and wild barley that had higher growth rates and height than the wheat). Under weed free conditions, wheat grain yield increased above that of the unfertilized control with all three N treatments (Table 3). In other studies, N spliting between fall and spring increased

Table 3. Wheat grain and biological yields as affected by N application timing and herbicide use.

	Grain yield (kg ha^{-1})									
	2005/2006					2006/2007				
Treatment	Herbicide		Control			Herbicide		Control		
Nitrogen	Iodosulfuron methyl sodium + Mesosulfuronmethylsodium	Solfosulfuron	Weedy	Weed free	Mean	Iodosulfuron methyl sodium + Mesosulfuronmethylsodium	Solfosulfuron	Weedy	Weed free	Mean
T_1N_0, T_2N_0, T_3N_0	1650.0 efg*	1596.0 efg	528.0 h	2196.0 cd	1493.0 C	3102.0 g	2874.0 g	1251.0 h	3890.0 f	2779.0 D
T_1N_0, T_2N_1, T_3N_0	1618.0 efg	1990.0 de	1188.0 g	2740.0 ab	1884.0 B	5281.0 cd	4266.0 ef	1591.0 h	6478.0 b	4141.0 C
T_1N_0, $T_2N_{1/3}$, $T_3N_{2/3}$	1756.0 ef	1720.0 ef	1414.0 fg	2356.0 bcd	1812.0 B	5137.0 cd	3869.0 f	1792.0 h	5764.0 c	4404.0 AB
$T_1N_{1/2}$, $T_2N_{1/2}$, T_3N_0	2553.0 bc	2419.0 bcd	1525.0 efg	3103.0 a	2400.0 A	5570.0 c	4843.0 de	1882.0 h	7170.0 a	4866.0 A
Mean	1894.0 B**	1931.0 B	1164.0 C	2599.0 A		4773.0 B	3963.0 C	1629.0 D	5825.0 A	
	Biological yield (kg ha^{-1})									
T_1N_0, T_2N_0, T_3N_0	5175.0 fgh	3838.0 hi	3088.0 i	5583.0 efg	4421.0 C	6238.0 g	6013.0 gh	3250.0 i	8213.0 f	5928.0 C
T_1N_0, T_2N_1, T_3N_0	7500.0 cd	8900.0 b	4500.0 gh	10380.0 a	7819.0 A	10540.0 d	10410.0 de	3530.0 i	15540.0 ab	10000.0 B
T_1N_0, $T_2N_{1/3}$, $T_3N_{2/3}$	5700.0 efg	5863.0 efg	5075.0 fgh	6605.0 de	5811.0 B	920.0 ef	9963.0 de	4813.0 h	14400.0 bc	9594.0 B
$T_1N_{1/2}$, $T_2N_{1/2}$, T_3N_0	8663.0 bc	7438.0 cd	6375.0 def	8745.0 bc	7805.0 A	13700.0 c	11020.0 d	4975.0 gh	16430.0 a	11530.0 A
Mean	6759.0 B	6509.0 B	4759.0 C	7827.0 A		9919.0 B	9352.0 C	4142.0 D	13650.0 A	

* Means within each column followed by same letters are not significantly different at 0.05 probability level according to DMRT.

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grain yield, N-use efficiency (NUE), and N uptake efficiency (NUpE) compared with fall application in hard red winter wheat under temperate conditions (Mahler *et al.*, 1994; Sowers *et al.*, 1994). Lo´pez-Bellido (2005) reported that the best grain yield response was obtained when half or one third of the total N fertilizer rate (150 kg N ha^{-1}) was applied at stem elongation. He also indicated that splitting of the total N rate between sowing and tillering prompted a lower yield than when half or one third of the total N fertilizer rate (150 kg N ha^{-1}) was applied at stem elongation; yield was the lowest when the total rate of 150 kg N ha^{-1} was applied at sowing (except when zero N was applied). Our results were different because N use was affected by weed competition. N split between sowing and tillering improved wheat growth and its competitive ability against weeds. Initially weed germination was increased by N use at sowing date. Then, the applied herbicides controlled most of the weeds. Also, the second flush of weeds might have been at a lower density without the nitrogen use after wheat tillering.

In weedy plots, wheat grain and biological yields in N split treatments decreased in this order: $T_1N_{\frac{1}{2}}$, $T_2N_{\frac{1}{2}}$ and T_3N_0> T_1N_0, $T_2N_{\frac{1}{3}}$ and $T_3N_{\frac{2}{3}}$> T_1N_0, T_2N_1 and T_3N_0> T_1N_0, T_2N_0 and T_3N_0. However, integration of split N application and herbicides increased wheat grain and biological yield more in T_1N_0, T_2N_1 and T_3N_0 than T_1N_0, $T_2N_{\frac{1}{3}}$ and $T_3N_{\frac{2}{3}}$. Lower weed density obtained from herbicide application has obviously provided a better condition for N use of the wheat crop. Also, early N application at planting and tillering stages of the wheat was more effective on grain and biological yields than the late N application that was more effective on grain quality. During the crop growth period, N-use efficiency can considerably vary. Nitrogen applied to a growing crop in spring is used more efficiently than N applied in autumn (Hayward *et al.* 1993; Jackson & Smith 1997). In spring, Nitrogen use efficiency of winter wheat was increased in this order: start of spring growth< stem elongation< ear emergence, if water supply was not limited for yield performance and the uptake of N at later growth stages (Recous *et al.*, 1988; Destain *et al.*, 1993; Retzer, 1995).

Wheat LAI

Effect of year on wheat LAI was not significant. Therefore, data for two years were combined and analyzed. Integration of split N application and herbicides significantly increased the wheat LAI. Competition between weeds and wheat reduced wheat LAI in the weedy check. Unfertilized treatments and N split of T_1N_0, $T_2N_{\frac{1}{3}}$ and $T_3N_{\frac{2}{3}}$ had the lowest LAI, whereas N split of $T_1N_{\frac{1}{2}}$, $T_2N_{\frac{1}{2}}$ and T_3N_0 increased LAI by 62%, 57% respectively (Table 4). Results showed the positive correlation

Table 4. Wheat LAI as affected by N timing and herbicide use at flowering (2005/2006-2006/2007).

Treatment	Herbicide		Control		
Nitrogen	Iodosulfuron methyl Sodium + Mesosulfuronmethylsodium	Solfosulfuron	Weedy	Weed free	Mean
T_1N_0, T_2N_0, T_3N_0	3.0 h	2.7 i	1.5 j	4.4 d	2.9 C
T_1N_0, T_2N_1, T_3N_0	3.4 fg	3.7 e	1.6 j	4.6 c	3.3 B
T_1N_0, $T_2N_{\frac{1}{3}}$, $T_3N_{\frac{2}{3}}$	3.5 ef	2.6 i	1.7 j	4.3 cd	3.0 C
$T_1N_{\frac{1}{2}}$, $T_2N_{\frac{1}{2}}$, T_3N_0	5.2 b	4.2 d	3.2 gh	6.3 a	4.7 A
Mean	3.8 B	3.3 C	2.0 D	4.9 A	

* Means within each column followed by same letters are not significantly different at 0.05 probability level according to DMRT.

** Means with same capital letters in rows are not significantly different at 0.05 probability level according to DMRT.

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between the LAI and crop yield, because N split of $T_1N_{½}$, $T_2N_{½}$ and T_3N_0 also had the highest grain yield. Evans *et al*. (2002) reported that additional N application improved early season corn growth due to increased leaf area, biomass, and plant height, which improved the competitive ability of the corn against weeds. Reductions in maximum corn leaf area and height due to weed interference usually began earlier and were more extensive at reduced rates of N. In the current study, herbicides use (iodosulfuron–methyl–sodium plus mesosulfuron–methyl–sodium and solfosulfuron) caused 90.0% and 65% increase in LAI, respectively when compared with the weedy check (Table 4).

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اثرات تلفیق کاربرد تقسیطی نیتروژن و علف‌کش بر کنترل علف‌های هرز و عملکرد گندم

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چکیده

آزمایش مزرعه‌ای جهت بررسی برهمکنش زمان کود دهی و نحوه تقسیط کود سرک نیتروژن و دو علف کش مزوماکس + یودو سولفورون متیل سدیم و سولفوسولفورن برکنترل علف‌های هرز گندم و عملکرد آن در دو سال زراعی ۸۵-۱۳۸۴ و ۸۶-۱۳۸۵ در دانشگاه شیراز انجام گرفت. طرح آزمایشی به صورت طرح کرت‌های یکبار خرد شده بود که فاکتور اصلی شامل نیتروژن در چهار نحوه تقسیط به صورت T_1N_0, T_2N_0, T_3N_0; T_1N_0, T_2N_1, T_3N_0; $T_1N_{\frac{1}{2}}$, $T_2N_{\frac{1}{2}}$, T_3N_0; T_1N_0, $T_2N_{\frac{1}{3}}$, $T_3N_{\frac{2}{3}}$ و فاکتور فرعی شامل علف‌کش یودو سولفورون متیل سدیم + مزوسولفورون متیل سدیم، و سولفوسولفورون همراه با شاهد با علف هرز و بدون علف هرز در چهار تکرار بود. مصرف علف‌کش یودو سولفورون متیل سدیم

+ مزوسولفورون متیل سدیم و سولفوسولفورون به ترتیب سبب کاهش (۶۶٪ در سال ۸۵-۸۴ و ۵۵٪ در سال ۸۶-۸۵، و ۳۷٪ در سال ۸۵-۸۴ و ۴۵٪ در سال۸۶-۸۵) در زیتوده علف‌های هرز نسبت به تیمار شاهد بدون مبارزه شیمیایی گردید. بیشترین (۳۵۳/۶ در سال ۸۵-۸۴ و ۲۲۴/۱ کیلوگرم در هکتار در سال ۸۶-۸۵) و کمترین (۶۵/۶ در سال ۸۵-۸۴ و ۲۴/۵ کیلوگرم در هکتار در سال ۸۶-۸۵) میزان زیتوده علف‌های هرز در تمامی تیمارهای کاربرد علف‌کش به ترتیب در تیمارهای نیتروژنی T_1N_0, T_2N_1, T_3N_0 و T_1N_0, T_2N_0, T_3N_0 مشاهده گردید. کارآیی استفاده از نیتروژن توسط گیاه زراعی با مصرف نیتروژن به صورت تقسیط افزایش یافت. بنابراین شاخص سطح برگ و عملکرد گندم افزایش یافت اما میزان این افزایش در حضور علف‌های هرز کمتر بود. نتایج نشان دادند که تلفیق تیمارهای تقسیط نیتروژن و علف‌کش سبب افزایش بیشتر شاخص سطح برگ و عملکرد گندم و همچنین کاهش بیشتر بیوماس علف‌های هرز در مقایسه با هر یک از تیمارها به تنهایی گردید. تیمار نیتروژن به صورت $T_1N_{1/2}$, $T_2N_{1/2}$, T_3N_0 (یعنی مصرف نیمی از نیتروژن همزمان با کاشت و نیم دیگر در مرحله پنجه زنی) سبب افزایش (۶۱٪ در سال ۸۵-۸۴ و ۷۵٪ در سال ۸۶-۸۵) درعملکرد دانه و (۷۶٪ در سال ۸۵-۸۴ و ۹۴٪ در سال ۸۶-۸۵) در عملکرد بیولوژیکی و (۶۲٪ در هر دو سال آزمایش) در میزان سطح برگ گندم گردید. کنترل علف‌های هرز برای مصرف بهینه نیتروژن توسط گیاه زراعی ضروری است. بنابراین برای افزایش عملکرد گندم، تلفیق کنترل شیمیایی علف‌های هرز با مصرف تقسیط شده نیتروژن توصیه می شود. نتایج به‌دست آمده در این مطالعه نشان داد علف کش یودو سولفورون متیل سدیم + مزوسولفورون متیل سدیم و تقسیط نیتروژن $T_1N_{1/2}$, $T_2N_{1/2}$, T_3N_0 (یعنی مصرف نیمی از نیتروژن همزمان با کاشت و نیم دیگر در مرحله پنجه زنی) بهترین کارآیی را در کنترل علفهای هرز در گندم داشتند.