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

S. Sheibani¹, and H. Ghadiri¹∗

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, sulfofuron and two weedy and weed free controls. Compared with the weedy check, iodosulfuran–methyl–sodium plus mesosulfuron–methyl–sodium and sulfofuron 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 ha⁻¹ in 2005/06 and 224.1 kg ha⁻¹ in 2006/07) and the lowest (65.6 kg ha⁻¹ in 2005/06, and 24.0 kg ha⁻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 T₁N₀, T₂N₁, T₃N₀ and no N fertilization at sowing, tillering and stem elongation stages T₁N₀, T₂N₀ and T₃N₀. 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. 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 T₁N½, T₂N½, T₃N₀ and iodosulfuran–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.

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
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 (Jørnsård 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. Jørnsård 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>
<thead>
<tr>
<th>Month</th>
<th>Average temperature (°C)</th>
<th>Precipitation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>November</td>
<td>11.13</td>
<td>12.88</td>
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<tr>
<td>December</td>
<td>9.40</td>
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<tr>
<td>January</td>
<td>3.48</td>
<td>1.60</td>
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<tr>
<td>February</td>
<td>6.58</td>
<td>5.08</td>
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<td>March</td>
<td>8.98</td>
<td>8.33</td>
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<tr>
<td>April</td>
<td>12.11</td>
<td>12.08</td>
</tr>
<tr>
<td>May</td>
<td>17.34</td>
<td>19.02</td>
</tr>
<tr>
<td>June</td>
<td>21.95</td>
<td>23.84</td>
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<tr>
<td>July</td>
<td>27.19</td>
<td>27.77</td>
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<tr>
<td>August</td>
<td>28.58</td>
<td>25.97</td>
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</tbody>
</table>
Integration Split N Herbicide on Weed Wheat

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 T1N0, T2N1 and T3N0 (Table 2). Low N supply should have decreased net photosynthetic rate (Pn), 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 biological yield. On the five sampling dates with two weeks interval during the growing seasons, wheat and weeds were harvested from 0.5 m² 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.

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

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2005/2006</th>
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<tbody>
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<td>Nitrogen</td>
<td>Iodosulfuron methyl sodium + Mesosulfuronmet hysodium</td>
<td>Sulfosulfuron</td>
<td>Weedy</td>
<td>Weed free</td>
<td>Mean</td>
<td>Iodosulfuron methyl sodium + Mesosulfuronmet hysodium</td>
<td>Sulfosulfuron</td>
<td>Weedy</td>
<td>Weed free</td>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>65.6 j</td>
<td>105.6 ij</td>
<td>218.4 ef</td>
<td>0.0 k</td>
<td>97.6 B</td>
<td>24.0 i</td>
<td>25.6 i</td>
<td>104.0 g</td>
<td>0.0 j</td>
<td>38.6 C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>192.0 fg</td>
<td>353.6 d</td>
<td>400.3 c</td>
<td>0.0 k</td>
<td>236.6 A</td>
<td>121.2 ef</td>
<td>224.1 c</td>
<td>238.4 c</td>
<td>0.0 j</td>
<td>146.2 A</td>
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</tr>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>120.0 hi</td>
<td>245.6 e</td>
<td>544.3 a</td>
<td>0.0 ki</td>
<td>227.6 A</td>
<td>70.4 h</td>
<td>112.0 fg</td>
<td>285.6 a</td>
<td>0.0 j</td>
<td>117.3 B</td>
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<td></td>
</tr>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>164.8 gh</td>
<td>308.8 d</td>
<td>455.2 b</td>
<td>0.0 k</td>
<td>232.4 A</td>
<td>184.0 d</td>
<td>131.2 d</td>
<td>265.6 a</td>
<td>0.0 j</td>
<td>145.4 A</td>
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<tr>
<td>Mean</td>
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<td>253.4 B</td>
<td>404.4 A</td>
<td>0.0 D</td>
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Weeds number

<table>
<thead>
<tr>
<th>Number of Avena ludoviciana</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>2.7 d</td>
<td>8.6 c</td>
<td>15.7 b</td>
<td>0.0 e</td>
<td>6.7 B</td>
<td>2.0 ef</td>
<td>5.6 d</td>
<td>11.7 bc</td>
<td>0.0 g</td>
<td>4.8 B</td>
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<tr>
<td>T1N16, T2N16, T3N16</td>
<td>9.3 c</td>
<td>18.0 ab</td>
<td>17.3 ab</td>
<td>0.0 e</td>
<td>11.2 A</td>
<td>8.7 cd</td>
<td>15.0 ab</td>
<td>14.3 ab</td>
<td>0.0 g</td>
<td>9.5 A</td>
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<td></td>
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<tr>
<td>T1N16, T2N16, T3N16</td>
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<td>10.0 c</td>
<td>22.0 a</td>
<td>0.0 e</td>
<td>8.6 B</td>
<td>0.3 fg</td>
<td>6.6 d</td>
<td>18.7 a</td>
<td>0.0 g</td>
<td>6.4 B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>7.7 c</td>
<td>15.2 b</td>
<td>19.3 ab</td>
<td>0.0 e</td>
<td>10.6 A</td>
<td>5.0 de</td>
<td>12.0 bc</td>
<td>16.0 ab</td>
<td>0.0 g</td>
<td>8.2 A</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mean</td>
<td>5.5 C</td>
<td>13.1 B</td>
<td>18.6 A</td>
<td>0.0 D</td>
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<thead>
<tr>
<th>Number of Hordeum spontaneum</th>
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<tbody>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>5.7 def</td>
<td>3.0 h</td>
<td>11.33 b</td>
<td>0.0 i</td>
<td>5.0 B</td>
<td>3.7 cde</td>
<td>3.0 e</td>
<td>5.7 bc</td>
<td>0.0 f</td>
<td>3.1 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>8.7 c</td>
<td>5.0 efg</td>
<td>13.3 a</td>
<td>0.0 i</td>
<td>6.7 A</td>
<td>5.7 bc</td>
<td>3.3 cde</td>
<td>8.0 ab</td>
<td>0.0 f</td>
<td>4.2 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>6.6 d</td>
<td>3.7 gh</td>
<td>11.3 b</td>
<td>0.0 i</td>
<td>5.4 AB</td>
<td>4.7 cde</td>
<td>3.0 de</td>
<td>5.7 b-e</td>
<td>0.0 f</td>
<td>3.3 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1N16, T2N16, T3N16</td>
<td>6.3 de</td>
<td>4.7 fg</td>
<td>11.3 b</td>
<td>0.0 i</td>
<td>5.6 AB</td>
<td>5.3 cde</td>
<td>3.3 cde</td>
<td>9.3 a</td>
<td>0.0 f</td>
<td>4.5 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>6.8 B</td>
<td>4.1 C</td>
<td>11.8 A</td>
<td>0.0 D</td>
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<td></td>
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</table>

*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.
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 T1N0, T2N⅓, and T3N⅔. 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 T1N0, T2N⅓, and T3N⅔, 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≤ 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≤ 0.05). Nitrogen split of T1N0, T2N⅓ and T3N⅔ 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 sulfosulfuron 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 splitting between fall and spring increased
Table 3. Wheat grain and biological yields as affected by N application timing and herbicide use.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain yield (kg ha(^{-1}))</th>
<th>2005/2006</th>
<th>2006/2007</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Herbicide</td>
<td>Control</td>
<td>Herbicide</td>
</tr>
<tr>
<td>Nitrogen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T(_1)N(_0), T(_2)N(_0), T(_3)N(_0)</td>
<td>1650.0 efg</td>
<td>1596.0 efg</td>
<td>528.0 h</td>
</tr>
<tr>
<td>T(_1)N(_0), T(_2)N(_1), T(_3)N(_0)</td>
<td>1618.0 efg</td>
<td>1990.0 de</td>
<td>1188.0 g</td>
</tr>
<tr>
<td>T(_1)N(_0), T(_2)N(_1), T(_3)N(_1)</td>
<td>1756.0 ef</td>
<td>1720.0 ef</td>
<td>1414.0 fg</td>
</tr>
<tr>
<td>T(_1)N(_1), T(_2)N(_1), T(_3)N(_0)</td>
<td>2553.0 bc</td>
<td>2419.0 bcd</td>
<td>1525.0 efg</td>
</tr>
<tr>
<td>Mean</td>
<td>1894.0 B**</td>
<td>1931.0 B</td>
<td>1164.0 C</td>
</tr>
</tbody>
</table>

* 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.
grain yield, N-use efficiency (NUE), and N uptake efficiency (NUe) compared with fall application in hard red winter wheat under temperate conditions (Mahler et al., 1994; Sowers et al., 1994). López-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: T₁N₃/₃ > T₂N₂/₃ > T₁N₂/₃ > T₁N₁/₃ > T₁N₀/₃ and T₂N₁/₃ > T₁N₀/₃ > T₂N₀/₃ and T₁N₀/₃ > T₂N₀ > T₁N₀ and T₂N₀. However, integration of split N application and herbicides increased wheat grain and biological yield more in T₁N₀ > T₁N₁ > T₁N₂/₃ > T₁N₀/₃ > T₁N₀-1/₃ than T₁N₀ > T₁N₁ > T₁N₂/₃ > T₁N₀-1/₃. 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 T₁N₀, T₂N₀, and T₃N₀ had the lowest LAI, whereas N split of T₁N₀, T₂N₀, and T₁N₀ 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).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Nitrogen</th>
<th>Herbicide</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T₁N₀, T₂N₀, T₃N₀</td>
<td>Iodosulfuron methly Sodium + Mesosulfuronmethylsodium</td>
<td>Solfusulfuron Weedy Weed free Mean</td>
</tr>
<tr>
<td></td>
<td>T₁N₀, T₂N₁, T₃N₁</td>
<td>3.0 h</td>
<td>2.7 i</td>
</tr>
<tr>
<td></td>
<td>T₁N₀, T₂N₂, T₃N₂</td>
<td>3.4 fg</td>
<td>3.7 e</td>
</tr>
<tr>
<td></td>
<td>T₁N₀, T₂N₃, T₃N₃</td>
<td>3.5 ef</td>
<td>2.6 i</td>
</tr>
<tr>
<td></td>
<td>T₂N₀, T₂N₀, T₃N₀</td>
<td>5.2 b</td>
<td>4.2 d</td>
</tr>
<tr>
<td>Mean</td>
<td>3.8 B</td>
<td>3.3 C</td>
<td>2.0 D</td>
</tr>
</tbody>
</table>

* 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.
between the LAI and crop yield, because N
split of T1N0, T2N1, and T3N0 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 (idosulfuron-
methyl–sodium plus mesosulfuron–methyl–
sodium and solfostulfuron) caused 90.0% and
65% increase in LAI, respectively when
compared with the weedy check (Table 4).

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Rate of Crop Growth at Date of Fertilizer N
Application and Fate of Fertilizer N Applied


+ مزوتورن میل سدیم و سولفوسولفورون به ترتیب سبب کاهش (66\%) در سال 85-86 و 87\% در سال 85-87 چون زیر خشکهای هرز نسبت به تیمار شاهد به دست آمد. شیمیایی گردید.

بیشترین (35\%) در سال 85-87 و 24\% در سال 85-87 چون زیر خشکهای هرز در سال 85-87 میزان زیر خشکهای هرز در تیمار شاهد گردید. کارآیی استفاده از نیتروژن توسط گیاه زراعی با مصرف نیتروژن به صورت $T_{1N_0}$, $T_{2N_1}$, $T_{3N_0}$

توجه شود که تقیق تیمارهای تقسیم نیتروژن و علف کش سبب افزایش شاخص علف کش و عملکرد گندم و همچنین کاهش بیشتر بیوماس علف‌های هرز در مقایسه با هر یک از تیمارها به نهایی گردید. تیمار نیتروژن به صورت $T_{1N_0}$, $T_{2N_1}$, $T_{3N_0}$

نیمی از نیتروژن هرمز با کاشت و نیم دیگر در مرحله پنجه زنی) سبب افزایش (91\%) در سال 85-86\% و 75\% در سال 85-86 در عملکرد دانه و 67\%(در سال 85-86 در عملکرد بیولوژیکی و 62\%(در هر دو سال آزمایش) در میزان سطح برگ گندم گردید. کنترل علف‌های هرز برای

مصرف بهینه نیتروژن توسط گیاه زراعی ضروری است. بیشترین برای افزایش عملکرد گندم، تقیق کنترل شیمیایی علف‌های هرز با مصرف تقسیم شده نیتروژن توصیه می‌شود. نتایج به عده‌ای در این مطالعه $T_{1N_0}$, $T_{2N_1}$, $T_{3N_0}$

نشان داد علف کش بود سولفوسولفورون میل سدیم + مزوتورن میل سدیم و تقسیم نیتروژن (بیشترین مصرف نیمی از نیتروژن هرمز با کاشت و نیم دیگر در مرحله پنجه زنی) بهترین

کارآیی را در کنترل علف‌های هرز در گندم داشتند.