Effect of seeding rate and variety on wild oat (Avena Ludoviciana L.) suppression and yield of spring wheat (Triticum aestivum L.)

Abdol Karim Banisaeidi*, Eskander Zand², Adel Modhj³, Shahram Lak¹, Mohammad Ali Baghestani²

¹Department of Agronomy, College of Agriculture, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran
²Iranian Research Institute of Plant Protection, Tehran, Iran
³Department of Plant Breeding and Agronomy, College of Agriculture, Shoshtar Branch, Islamic Azad University, Shoshtar, Iran

Key words: Weed-crop competition, Integrated weed management, interference.

Abstract

The studies shown that the use of competitive varieties and crop density is a one of the most important strategies to reduce weed competition with crop. During 2010/2011 and 2011/2012, field experiments were performed to study the effect of wheat seeding rate and varieties on competition between wild oat and wheat. The treatments were seeding rates (152, 190, 228 and 266 kg seeds/ha) and wheat varieties (Chamran and Kavir), grown under high weed pressure. The experimental design was factorial with three replications for each treatment. Results showed that increased of seeding rate was able to reduced wild oat shoot biomass and it increased grain yield and number of spike per m². Number grain per spike and 1000-grain weight decreased with increasing seeding rate. Wild oat biomass in terms of competition with Chamran significant decreased than Kavir. Information gained in this study support the concept that increasing seeding rate and application competitive varieties can improve crop competitiveness with weeds.

*Corresponding Author: Abdol Karim Banisaeidi a.banisaeidi@yahoo.com
Introduction

Weeds are an important obstacle to crop production (Murphy et al., 2008). Increasing case of herbicide resistance in weed species, and the need to reduce costs have caused a growing awareness that intensive use of chemical weed control does not fit well in sustainable agriculture systems (Wyse, 1994). A major component of integrated weed management is the use of more competitive crops (Korres and Froud Williams, 2002). Cultural management techniques such as competitive crops, strategic fertilizer placement and high seeding rates can used to suppress and manage weeds in an integrated weed management (Blackshaw, 2005; Paynter and Hills, 2009; Grichar et al., 2004).

Increasing the crop seedling rate is important component of integrated weed management (O’Donovan et al., 2000). Several studies have shown higher suppression of weeds by increased crop densities (Carlson and Hill, 1985; Roberts et al., 2001; Scursoni and Satorre, 2005; Lemerle et al., 2004; Olsen et al., 2012; Stougaard and Xue, 2004). Higher crop seedling rates reduced wild oat (Carlson and Hill, 1985), rye (Roberts et al., 2001) seed production. Scursoni and Satorre (2005) reported Wild oat biomass was reduced by increasing barley seeding rates. Lemerle et al. (2004) suggested that increasing crop density reduced the negative impact of rigid ryegrass (Lolium rigidum L.) on wheat. Olsen et al. (2012) indicate that increased crop density in cereals can play an important role in increasing the crop competitive advantage over weeds. Stougaard and Xue (2004) reported wild oat interference and crop yield loss were reduced by higher crop seedling.

Kristensen et al. (2008) indicate that increased crop density was negative effects on weed biomass and positive effects on crop biomass and yield. High crop densities can reduce weed biomass and seed yield and yield loss of wheat (Triticum aestivum L.) (Cudney et al., 1989) and barley (Hordeum vulgare L.) (Evans et al., 1991).

One of weed control strategies in integrated weed management systems using cultivars with high competitive ability (Pawar, 2009). The competitive ability of crop can be reducing weed seed and biomass production and its ability to maintain performance in competition from weeds, have expressed (Abouziena et al., 2008). Several researchers have shown that differences in competitive ability between varieties of crop against a range of weeds (Zand and Beckie, 2002; Seavers and Wright, 1999; Wicks et al., 2004; Mennan and Zandstra, 2005). Kirkland and Hunter (1991) reported that a case of spring wheat cultivars, Neepawa was better weed suppressor than HY320 and HY 355.

Integrative weed management practices, such as wheat cultivars with high competitive ability and crop density, potentially improve weed management. Nevertheless more information is necessary to ensure that integrated weed control practices may provide a solution for wild oat control. The objective of this study was to determine the competitive ability wheat cultivars and seed rate on wheat yield and wild oat biomass.

Materials and methods

A 2 year field experiment was conducted at the Shoushtar Branch, Islamic Azad University, Iran (32° 3’ N, 48° 50’ E). The soil was a clay loam texture, pH of 7.4 and 0.6 % organic matter content. The 30-yr average annual rainfall is 321.4 mm, average annual air temperature is minimum and maximum 9.5 °C and 46.3 °C, respectively. The experimental design was a randomized complete block with a factorial arrangement and three replicates. The experimental treatments were wheat seeding rates (152, 190, 228 and 266 kg seed/ha) and wheat varieties (Chamran and Kavir). The study areas were fall plowed and disked to prepare the initial seeded. Fertilizer was applied to the study areas on the basis of soil test results. Plots consisted of eight rows at 20 cm spacing, 8 m long and 1.60 m wide, treatment were arranged randomly with blocks with 1 m between plots with each block and 3 m between block. Wheat seed were treated with Carpathian and linden for protection against diseases and insects. The spring wheat seeds were drilled at target densities in
November 9, 2010, and November 11, 2011. Wild oat seeds used in the study were collected from a local source during the year prior to each experiment. Wild oat (Avena ludoviciana L.), at a target density of 100 seeds/m² was seeded at right angles to the wheat by hand on the soil surface before the wheat was drilled. All weed species except A. ludoviciana were removed by hand every week during the growing season. Pest and disease control were not necessary. All plots were well irrigated to avoid water limits. Wheat and wild oat plants at maturity were harvested by hand in a single randomly placed 0.50 m² square in each plot by clipping plant to ground level. Harvested material was oven dried for 48 h at 75 °C to a constant mass. Data collected were wheat grain yield, 1000-grain weight, number of grain spike⁻¹, number of spikes m⁻² and wild oat shoot biomass.

Statistical Analyses
All data were subjected to analysis of variance using SAS statistical software (SAS, Institute, 2000), and means were separated using protected LSD at P=0.05.

Table 1. ANOVA P values for the effect of wheat variety and seeding rate on wheat variables and wild oat biomass.

<table>
<thead>
<tr>
<th>Year</th>
<th>Source</th>
<th>df</th>
<th>Grain yield</th>
<th>1000-grain weight</th>
<th>Number of grain spike⁻¹</th>
<th>Number of spikes m⁻²</th>
<th>Wild oat biomass</th>
<th>P values</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010/2011</td>
<td>Seeding rate (D)</td>
<td>3</td>
<td>0.002</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.002</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wheat variety (C)</td>
<td>1</td>
<td>0.272</td>
<td>0.018</td>
<td>&lt;0.001</td>
<td>0.036</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DxC</td>
<td>3</td>
<td>0.828</td>
<td>0.008</td>
<td>0.035</td>
<td>0.279</td>
<td>0.086</td>
<td></td>
</tr>
<tr>
<td>2011/2012</td>
<td>Seeding rate (D)</td>
<td>3</td>
<td>0.006</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.006</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wheat variety (C)</td>
<td>1</td>
<td>0.393</td>
<td>&lt;0.001</td>
<td>0.034</td>
<td>0.093</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DxC</td>
<td>3</td>
<td>0.809</td>
<td>&lt;0.001</td>
<td>0.031</td>
<td>0.583</td>
<td>0.094</td>
<td></td>
</tr>
</tbody>
</table>

1000-grain weight
Analysis of variance showed that in both years, 1000-grain weight was significantly affected by seeding rates (table1). Grain weight decreased with increasing seeding rates. The maximum wheat 1000-grain weight were recorded in 150 kg seeds/ha while the minimum grain yield were recorded in 266 kg seeds/ha (Table2). With the aggravation of the conditions of competition within an inter-species by increasing crop density coupled with the intra-specific competition out in such a way decreases photosynthesis materials share spike and shorten the period of grain filling will be that, these factors can be decreased 1000-seed weight. Bavar (2008) reported that wheat grain weight decreased with increasing density. 1000-grain weight taken indicated significant
differences among the varieties (Table1). In both years, Chamran was better than the Kavir (Table2). Saliva and Gomes (1990) reported that cultivars were significant differences in seed weight. The interaction of different levels of seeding rate and crop varieties on 1000-grain weight were significant (Table 1). Averaged both years, Chamran by 152 kg seeds/ha were greater than the other treatment (Table 3).

Table 2. Effect of different wheat variety and seeding rate on wheat grain yield, number of spikes⁻¹, number of grains spike⁻¹, 1000-grain weight and wild oat biomass.

<table>
<thead>
<tr>
<th>Wheat variables</th>
<th>Seeding rate (kg.ha⁻¹)</th>
<th>Grain yield (kg.ha⁻¹)</th>
<th>1000-grain weight (g)</th>
<th>Number of grain spike⁻¹</th>
<th>Number of spikes m⁻²</th>
<th>Wild oat biomass (kg.ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivar</td>
<td>152</td>
<td>2015b</td>
<td>31.3a</td>
<td>31a</td>
<td>300b</td>
<td>9365a</td>
</tr>
<tr>
<td>190</td>
<td>2448b</td>
<td>25.8b</td>
<td>28b</td>
<td>337a</td>
<td>7778b</td>
<td></td>
</tr>
<tr>
<td>228</td>
<td>3158a</td>
<td>24.1bc</td>
<td>27c</td>
<td>364a</td>
<td>4975c</td>
<td></td>
</tr>
<tr>
<td>2010/2011</td>
<td>266</td>
<td>3230a</td>
<td>23.8c</td>
<td>24d</td>
<td>371a</td>
<td>4123c</td>
</tr>
<tr>
<td>LSDₜ</td>
<td>635.43</td>
<td>1.85</td>
<td>0.768</td>
<td>34.7</td>
<td>1346</td>
<td></td>
</tr>
<tr>
<td>Cultivar</td>
<td>Chamran</td>
<td>2832a</td>
<td>26.9a</td>
<td>28a</td>
<td>356a</td>
<td>5692b</td>
</tr>
<tr>
<td>Kavir</td>
<td>2593a</td>
<td>25.1a</td>
<td>26b</td>
<td>329b</td>
<td>7428a</td>
<td></td>
</tr>
<tr>
<td>LSDₜ</td>
<td>449.32</td>
<td>1.31</td>
<td>0.543</td>
<td>24.58</td>
<td>951.9</td>
<td></td>
</tr>
</tbody>
</table>

Means with similar letters in each column are not significantly different according to least significant difference test at the 5% level.

Numbers of grain spike⁻¹
Analysis of the data showed that seeding rates had significant effect on numbers of grain spike⁻¹ (Table1). Numbers grain per spike decreased with increasing seeding rates, 152 kg seeds/ha in both years was higher than other treatments (Table 2). Deressa and Fana (2010) reported that with increasing seeding rate of 120 kg/ha to 150 kg/ha, grains per spike was reduced. The wheat varieties were a significant difference in number s of grains per spike only in 2010/2011. In this year, numbers of grain spike⁻¹ was greater in Chamran than Kavir. There was no difference in number s of grain spike⁻¹ among the wheat varieties in 2011/2012. In both years, the interaction of different level of seeding rates and wheat varieties on numbers of grain spike⁻¹ were significant (Table1). In both varieties, increased seeding rates were reduced the numbers of grains per spike. Numbers of grain per spike were greater in 152 kg seeds/ha and Chamran variety treatment than other treatments (Table3).
Table 3. Effect of the interaction of different wheat variety and seeding rate on 1000-grain weight and number of grain spike–1.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>152</td>
<td>Chamran</td>
<td>33.3a</td>
<td>35a</td>
<td>33a</td>
<td>31a</td>
</tr>
<tr>
<td></td>
<td>Kavir</td>
<td>29.3b</td>
<td>28b</td>
<td>29b</td>
<td>29b</td>
</tr>
<tr>
<td>190</td>
<td>Chamran</td>
<td>26c</td>
<td>27c</td>
<td>29bc</td>
<td>28bc</td>
</tr>
<tr>
<td></td>
<td>Kavir</td>
<td>25.6cd</td>
<td>25d</td>
<td>27c</td>
<td>26cd</td>
</tr>
<tr>
<td>228</td>
<td>Chamran</td>
<td>23.3d</td>
<td>24e</td>
<td>28c</td>
<td>27cd</td>
</tr>
<tr>
<td></td>
<td>Kavir</td>
<td>25cd</td>
<td>24.6ef</td>
<td>26d</td>
<td>25ef</td>
</tr>
<tr>
<td>266</td>
<td>Chamran</td>
<td>23.6f</td>
<td>25de</td>
<td>25ef</td>
<td>26ef</td>
</tr>
<tr>
<td></td>
<td>Kavir</td>
<td>22.6</td>
<td>22.6g</td>
<td>23e</td>
<td>26de</td>
</tr>
</tbody>
</table>

Means with similar letters in each column are not significantly different according to least significant difference test at the 5% level.

**Number of spikes m–2**

Analysis of variance showed that seed rates had a significant ($P \leq 0.01$) effect on number of spikes m–2 (Table 1). Number of spike per m² increased with increasing seed rate, as the maximum and minimum of number of spike per m² were recorded in 266 and 152 kg seeds/ha (Table 2). Increasing the seeding rate by increasing the number of plants has increased the number of spikes per square meter. Chan et al (2008) reported spike density increased with increasing seeding rates. Wheat varieties were significant difference in number of spike per m² in 2010/2011, whereas, there were no significant differences in 2011/2012. (Table 2). Gul and Khan (2007) reported that significant differences in terms of the number of spike per m² in wheat cultivars were evaluated. In both years, interaction of different seeding rates and wheat variety did not affect the number of spike per m² (Table 1).

**Wild oat shoot biomass**

Wild oat shoot biomass was significantly affected by the seeding rate and wheat variety treatments, but their interaction did not affect wild oat shoot biomass (Table 1). Increasing seeding rates was led to a significant ($P \leq 0.01$) reduction in wild oat shoot biomass, as the maximum wild oat shoot biomass recorded in 152 kg seeds/ha and minimum wild oat shoot biomass recorded in 266 kg seeds/ha (Table 2). A result of some study showed that increasing crop density was reduces biomass and seed production in wild oat (Roberts et al., 2001; Scursoni and Satorre, 2005; Lemerle et al., 2004; Olsen et al., 2012). Wild oat shoot biomass was higher at Kavir than Chamran (Table 2). Some studies showed that some wheat varieties were better competitors with weeds than other varieties (Zand and Beckie, 2002; Chan, 1996; Mennan and Zandstra, 2005).

**Conclusion**

The results showed that increased wheat seeding rates and Varieties of competitiveness can play an important role in weed suppression. Increased seeding rates over 228 kg seeds/ha due to the increasing inter-species competition, had no significant effect on wheat grain yield. The increase in spike numbers m² was greater than the decrease in grain numbers spike–1 and 1000-grain weight. Chamran competitiveness was more Kavir. Increased seeding rates reduce weed biomass in 2 yr.

**Reference**


http://dx.doi.org/10.2134/agronj2005.0155
http://dx.doi.org/10.4141/cjps75-058


http://dx.doi.org/10.1614/WS-05-127.R.1


http://dx.doi.org/10.21.34/agronj2007.0198


http://dx.doi.org/10.1016/j.cropro.2004.03.004


http://dx.doi.org/10.1046/j.1365-3180.2002.00302.x

http://dx.doi.org/10.1614/WS-07-0651

http://dx.doi.org/10.4141/cjps91-151

http://dx.doi.org/10.1017/S002185960400454X

Murphy SD, Yakubu Y, Weise SF, Swanton CJ. 1996. Effect of planting patterns and inter-row cultivation on competition between corn (Zea mays L.) and late emerging weeds. Weed Science 44, 865-870.

(Triticum aestivum L.) cultivars and seeding rate on yield loss from Galium aparine (cleavers). Crop Protection 24, 1061-1067.

http://dx.doi.org/10.1015/j.cropro.2005.02.012


http://dx.doi.org/10.1614/WS-D-11-001721


http://dx.doi.org/10.1614/WT-08-0931


http://dx.doi.org/10.1614/WT-03-065R.1


http://dx.doi.org/10.1614/WS-03-007.R1


http://dx.doi.org/10.1046/j.1365-3180.1999.00148.x


http://dx.doi.org/10.1614/WT-03-158.R1


http://dx.doi.org/10.4141/P01-099