International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 5, No. 12, p. 166-172, 2014

RESEARCH PAPER OPEN ACCESS

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

Abdol Karim Banisaeidi[1*], Eskander Zand[2], Adel Modhj[3], Shahram Lak[1], Mohammad Ali Baghestani[2]

[1]*Department of Agronomy, College of Agriculture, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran*

[2]*Iranian Research Institute of Plant Protection, Tehran, Iran*

[3]*Department of Plant Breeding and Agronomy, College of Agriculture, Shoshtar Branch, Islamic Azad University, Shoshtar, Iran*

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

http://dx.doi.org/10.12692/ijb/5.12.166-172 Article published on December 14, 2014

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 m^2. 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.

Integrated 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 ^{O} 3´ N, 48^{O} 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/m^2 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 m^2 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-grian weight, number o 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.

Results and discussion

Wheat grain yield

Wheat grain yield in both year, indicated significant (P≤ 0.01) differences amounts the seeding rates but varieties and their interactions were not significant (Table 1). In both years, increasing seeding rate significantly increased grain yield. The maximum wheat grain yield were recorded in 266 kg seeds/ha while the minimum grain yield were recorded in 150 kg seeds/ha (Table2). Increased wheat grain yield by increasing the amount of seeding rate reflects the increasing competitiveness of wheat in competition with wild oat and spike numbers per square meter. Increased seeding rate over of 228 kg seeds/ha was no significant effect on wheat grain yield. Grain yield and yield components at higher densities decreased, due to the change of resource allocation to storage organs under conditions of competition (Satore and Slafer, 1999). Briggs (1975) showed that the increase in seed yield was increased but no significant differences were observed between 70 kg and 90 kg seed/ ha. Xue and Stougaard (2002) reported that increasing the density of spring bread wheat competitiveness with weeds was increased.

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

			Wheat variables				
Year	Source	df	Grain yield	1000-grain weight	Number of grain spike^{-1}	Number of spikes m^{-2}	Wild oat biomass
				P values			
2010/2011	Seeding rate (D)	3	0.002	<0.001	<0.001	0.002	<0.001
	Wheat variety (C)	1	0.272	0.018	<0.001	0.036	<0.001
	D×C	3	0.828	0.008	0.035	0.279	0.086
2011/2012	Seeding rate (D)	3	0.006	<0.001	<0.001	0.006	<0.001
	Wheat variety (C)	1	0.393	<0.001	0.074	0.093	<0.001
	D×C	3	0.809	<0.001	0.031	0.583	0.094

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.

		Wheat variables				
		Grain yield (kg.ha^{-1})	1000-grain weight (g)	Number of grain spike^{-1}	Number of spikes m^{-2}	Wild oat biomass (kg.ha^{-1})
	Seeding rate (kg.ha^{-1})					
	152	2015b	31.3a	31a	300b	9365a
	190	2448b	25.8b	28b	337a	7778b
	228	3158a	24.1bc	27c	364a	4975c
2010/2011	266	3230a	23.8c	24d	371a	4123c
	$LSD_{(0.05)}$	635.43	1.85	0.768	34.7	1346
	Cultivar					
	Chamran	2832a	26.9a	28a	356a	5692b
	Kavir	2593a	25.1a	26b	329b	7428a
	$LSD_{(0.05)}$	449.32	1.31	0.543	24.58	951.9
	Seeding rate (kg.ha^{-1})					
	152	2088b	31.5a	30a	304c	10230a
	190	2545a	26.3b	28b	330bc	7805b
	228	3170a	24.3c	26c	363ab	5035c
2011/2012	266	3181a	23.1d	25c	369a	4152d
	$LSD_{(0.05)}$	657.2	0.58	1.2	37	664.3
	Cultivar					
	Chamran	2821a	27.4a	27a	352a	6254b
	Kavir	2630a	25.2b	27a	330a	7357a
	$LSD_{(0.05)}$	464.7	0.41	0.83	26.1	469.7

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 sprike^{-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}.

		1000-grain weight		number of grain spike^{-1}	
		2010/2011	2011/2012	2010/2011	2011/2012
Seeding rate	Wheat variety				
152	Chamran	33.3a	35a	33a	31a
	Kavir	29.3b	28b	29b	29b
190	Chamran	26c	27c	29bc	28bc
	Kavir	25.6cd	25d	27c	26cd
228	Chamran	23.3d	24e	28c	27cd
	Kavir	25cd	24.6ef	26d	25ef
266	Chamran	25cd	23.6f	25de	25ef
	Kavir	22.6	22.6g	23e	26de

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 m^2 increased with increasing seed rate, as the maximum and minimum of number of spike per m^2 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 m^{-2} 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 m^2 in wheat cultivars were evaluated. In both years, interaction of different seeding rates and wheat variety did not affect the number of spike per m^2 (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; Wicks *et al.*, 2004; 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 m^{-2} 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

Abouziena HF, SHarara Faida AA, El-desoki ER. 2008. Effect of cultivar selectivity and weed control treatments on wheat yield and associated weeds in sandy soils. World Journal of Agricultural Sciences **4(3),** 384-389.

Blackshaw RE. 2005. Nitrogen fertilizer, manure, and compost effects on weed growth and competition with spring wheat. Agronomy Journal **97,** 1612-1621. http://dx.doi.org/10.2134/agronj2005.0155

Briggs KG. 1975. Effect of seeding rate and row spacing on agronomic characteristics of Glenlea, Pitic 62 and Neepawa wheat. Canadian Journal Plant Science **55**,363-367.
http://dx.doi.org/10.4141/cjps75-058

Bavar M. 2008. Effects of planting date density on growth indices and yield component of hull- less barley. The Thesis of M.Sc. degree. University of Agriculture Sciences and Natural Resources of Gorgan, 62p.

Barker DC, Knezevic SZ, Martin AR, Walters DT, Lindquist JC. 2006. Effect of nitrogen addition on the comparative productivity of corn and velvetleaf. Weed science **54(2)**, 354-363.
http://dx.doi.org/10.1614/WS-05-127.R.1

Carlson HL, Hill JE. 1985.Wild oat (*Avena fatuva* L.) competition with spring wheat: plant density effect. Weed science **33**, 176-181.

Cudney DW, Jordan LS, Holt JS, Reints JS. 1989. Competitive interactions of wheat (*Triticum aestivum* L.) and wild oats (*Avena fatua* L.) grown at different densities. Weed Science **37**,538-543.

Chen C, Neil K, Wichman D, Westcott M. 2008. Hard red spring wheat response to row spacing, seeding rate and nitrogen. Agronomy Journal **100**, 1296-1302.
*http://dx.doi.org/*10.21.34/agronj2007.0198

Deressa H, Fana G. 2010. Integrated effect of seed rate, herbicide rate and application timing on durum wheat (*Triticum turgidum* L. var durum) yield, yield components and wild oat (*Avena fatua* L.) control in South Eastern Ethiopia. Middle-East Journal of Scientific Research **5(3)**,184-190.

Evans RM, Till DC, Rapia L, Shaffi B, Lish JM. 1991. Wild oat (*Avena fatua L.*) and spring barley (*Hordeum vulgare L.*) density effect spring barley grain yield. Weed Technology **5(1)**, 33-39.

Grichar Wj, Besler BA, Brewer KD, Minton BW. 2004. Using soil applied herbicides in combination with glyphosate in a glyphosate-resistant cotton herbicide program. Crop Protection **23**, 1007-1010.
http://dx.doi.org/10.1016/j.cropro.2004.03.004

Gul H, Khan H. 2007. Effect of wild oats (Avena fatua) density on wheat yield and its components under varying nitrogen regimes. Pakistan Journal of Botany **39(7)**, 2585-2594.

Korres NE, Froud Williams RJ. 2002. Effects of winter wheat cultivars and seed rate on the biological characteristics of naturally occurring weed flora. Weed Research **42(6)**, 417-428.
http://dx.doi.org/10.1046/j.1365-3180.2002.00302.x

Kristensen L, Olsen J, Weiner J. 2008. Crop Density, Sowing Pattern, and Nitrogen Fertilization Effects on Weed Suppression and Yield in Spring Wheat. Weed Science **56**, 97–102.
http://dx.doi.org/10.1614/WS-07-0651

Kirkland KJ, Hunter JH. 1991. Competitiveness of Canada prairie spring wheats with wild oat (*Avena fatua* L). Canadian Journal of Plant Science **71**, 1089–1092.
http://dx.doi.org/10.4141/cjps91-151

Lemerle D, Cousens RD, Gill GS, Peltzer SJ, Moerkerk M, Murphy CE, Collins D, Cullis BR. 2004. Reliability of higher seeding rates of wheat for increased competitiveness with weeds in low rainfall environments. Journal of Agricultural Science **142**, 395–409.
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.

Mennan H, Zandstra BH. 2005. Effect of wheat

(*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

O'Donovan J, Neil Harker K, Clayton GW, Hall LM. 2000. Wild Oat (*Avena fatua* L.) Interference in Barley (*Hordeum vulgare* L.) is influenced by Barley Variety and Seeding Rate. Weed Technology **14(3),** 624-629.
doi:
http://dx.doi.org/10.1614/0890037X(2000)014[0624:WOAFII]2.0.CO;2

Olsen JM, Griepentrog HW, Nielsen J, Weiner J. 2012. How important are crop spatial pattern and density for weed suppression by spring wheat? Weed Science **60,** 501-509.
http://dx.doi.org/10.1614/WS-D-11-001721

Paynter BH, Hills AL. 2009. Barley and rigid ryegrass (*Lolium rigidum L.*) competition is influenced by crop cultivar and density. *Weed Technology* **23,** 40-48.
http://dx.doi.org/10.1614/WT-08-0931

Pawar RK. 2009. Weed management. Oxford Book Company 300 p.

Roberts JR, Peeper TF, Solie JB. 2001. Wheat (*Triticum aestivum L.*) row spacing, seeding rate, and cultivar affect interference from rye (*Secale cereal* L.). Weed Technology **15,** 19-25.
http://dx.doi.org/10.1614/0890037X(2001)015[0019:WTARSS]2.0.CO;2

Scurson JA, Satorre EH. 2005. Barley (*Hordeum Vulgare* L.) and wild oat (*Avena fatua* L.) competition is affected by crop and weed density. Weed Technology **19,**790-795.
http://dx.doi.org/10.1614/WT-03-065R.1

Stougaard RN, Xue Q. 2004. Spring wheat seed size and seeding rate effects on yield loss due to wild oat (*Avena fatua L.*) interference. Weed Science **52,** 133-141.
http://dx.doi.org/10.1614/WS-03-007.R1

Seavers GP, Wright KJ. 1999. Crop canopy development and structure influences weed suppression .Weed Research **39,** 319-328.
http://dx.doi.org/10.1046/j.1365-3180.1999.00148.x

Silva DB, Gomes AC. 1990. Spacing and sowing densities in irrigated wheat in cervado region. Pesquisa Agropacuaria Brasileira **25(3),** 305-315.

Satorre HE, Slafer GA. 2000. Wheat, Ecology and physiology of yield determination. Published by Food Product Press, 503 p.

Wyse DL. 1994. New technologies and approaches for weed management in sustainable agriculture systems. Weed technology **8,** 403-407.

Wicks GA, Nordquist, PT, Baenziger PS, Klein RN, Hammons RH, Watkins JE. 2004. Winter wheat cultivar characteristics affect annual weed suppression. Weed Technology **18,** 988-998.
http://dx.doi.org/10.1614/WT-03-158.R1

Xue Q,Stougaard RN. 2002. Spring wheat seed size and seeding rate affect wild oat demographics. Weed Science **50,** 312-320.
http://dx.doi.org/10.1614/00431745(2002)050[0312:SWSSAS]2.0.CO;2

Zand E, Beckie H. 2002. Competitive ability of hybrid and open pollination canola (*Brassica napus* L.) with wild oat (*Avena fatua* L.). Canadian journal of Plant Science **82,** 473-480.
http://dx.doi.org/10.4141/P01-099