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WHEAT YIELD COMPONENTS AS AFFECTED DUE TO SEED RATE AND HOLY THISTLE (*Silybum marianum* GAERTN.) DENSITY*

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ABSTRACT

Studies were conducted during 2003-04 and 2004-05 at Agricultural Research Farm NWFP Agricultural University Peshawar to investigate the effect of seed rate and Holy thistle (Silybum marianum) density on the yield components of wheat. The experiments were laid out in randomized complete block design (RCBD) with split plot arrangement. The four seed rate of wheat viz., 100, 120, 140 & 160 kg ha^{-1} were kept in main plots while Silybum density i.e. 0, 3, 6, 9, 12, 15 & 18 m^{-2} were assigned to sub plots. Statistical analysis of the means data showed that spike length, number of grains spike^{-1} and number of spikelets spike^{-1} were significantly affected by seed rate and Silybum density. Significantly higher values in all these traits were recorded in seed rate @ 100 and 120 kg ha^{-1} and lower in seed rate 140 and 160 kg ha^{-1}. Similarly Silybum density at 3 m^{-2} produced the spike length, number of grains spike^{-1} and number of spikelets spike^{-1} that were statistically comparable with the check while increasing the Silybum density above 3 m^{-2} had negative effect on these parameters studied. Thus it can be concluded from these results that increasing the seed rate beyond 120 kg ha^{-1} decrease the yield components of wheat due to intra-specific competition while Silybum density beyond 3 m^{-2} decrease yield components due to inter-specific competition.

Key words: Wheat, *Silybum*, milk thistle, yield components, density interaction

INTRODUCTION

A particular habitat can support a certain limit of plant population. Thus they require optimum resources like water, nutrients, space and sunlight for their growth and development. In our country now farmers use increased seed rate of wheat due to better availability of resources like fertilizer, irrigation water and other inputs. However, the seed rate is usually not adjusted to its optimum level. Optimum seed rate not only increase the final grain yield of wheat but also increase the wheat competitiveness with weeds. As wheat is the major food crop of our country, therefore due importance should be given to increase the per hectare yield by manipulating different management approaches. Weeds are certainly as old as agriculture, and from the very beginning, farmers realized that the presence of those unsown species interfere with the growth of the crop they are intending to produce. This recognition led to the co-evolution of agro-ecosystems and weed management. Competition between the undesired plants and the crop was to be avoided for achieving reasonable yields. Weeds were removed first by hand and then mechanically when new farming tools were developed. Weed researchers have

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attempted to cope with the limitations associated with the exclusive use of herbicides. The problem was approached from two basic points of view: weed control and weed management. Control approaches consider the efficacy of different mechanical and chemical tools to reduce weed infestation. The management approach by contrast, depends on knowledge of weed ecology, in particular, on studies that reveal the strategies that make a plant population successful in a particular agroecosystem. Thus weed management approach is to maintain crops free from effects of competition, and also to obtain the basis for designing practices that maintain an infestation at a level compatible with economically and environmental sustainable production (Radosevich et al., 1997). Several reports address the importance of seed rate in manipulating the crop/weed competition. Blackshaw et al., (2005) reported that establishment of a crop with dense plant distribution can increase its ability to suppress weeds. Mennan et al., (2005) reported that decreasing the seeding rate from 250-200 kg ha^{-1} decreased wheat yield in the presence of weed. Olsen et al., (2005) found in their studies that there was evidence of decreasing grain yield of wheat due to intraspecific competition only at highest seed rate (1000 seed m^{-2}) while weed biomass decreased with increasing crop density.

In view of the importance of Holy thistle (*Silybum marianum*) as major weed in Peshawar valley, these experiments were conducted to investigate the impact of seed rate and *Silybum* density on the yield components of wheat.

MATERIALS AND METHODS

Field trials were conducted at Malakandher Agricultural Research Farm, NWFP Agricultural University, Peshawar for two crop seasons i.e. 2003-04 and 2004-05 to investigate the wheat yield components reduction due to seed rate and Holy thistle (*Silybum marianum*) density. Peshawar lies between 71^0–$27^/$ and $72^0 - 47^/$ east longitude and $33^0 - 40^/$ and $34^0 - 31^/$ north latitude. It is located at 317 m height above sea level (Shah et al, 2004). The experimental site has mean soil pH of 7.47 with 22.79, 55.69 and 21.52 % clay, silt and sand, respectively (Bhatti et al., 1993). Before sowing of experiments, seedbed was prepared by ploughing the field twice followed by harrowing. All other cultural practices were kept uniform for all the treatments. Nitrogen and phosphorus fertilizers in the form of Urea and DAP were applied at the rate of 135:50 NP. Half N and full dose of P was applied at sowing and remaining N was applied at second irrigation in each experiment. The experiments were conducted using a Randomized Complete Block (RCB) design with split-plot arrangement, having four replications. The main plots consisted of four seed rates of wheat i.e. 100, 120, 140 and 160 kg ha^{-1}, while sub-plots had seven densities of Holy thistle (*Silybum marianum)* i.e. 0, 3, 6, 9, 12, 15 and 18 plants m^{-2}. The size of a main plot was 52.5 m^2 while the size of each sub-plot was 5 x 1.5 m^2. Sub-plot had 5 wheat rows, spaced 0.30 m apart. Wheat was sown with the help of hand hoe whereas seeds of *Silybum marianum* were planted manually the same day. To avoid the risk of germination failure, three to five seeds of *Silybum marianum* were seeded instead of a single seed and then the population adjusted through thinning accordingly. All other weeds were removed manually throughout the crop season on weekly basis.

To record the data of spike length, ten spikes were randomly selected from each sub-plot to measure spike length from the base of the rachis to the tip of the uppermost spikelet. Ten randomly selected spikes from each sub-plot were threshed individually to determine the number of grains spike^{-1}. Spikelets spike^{-1} were determined by randomly selecting ten spikes from each sub-plot.

Table 1. Weather data (temperature and precipitation) of experimental site during the wheat growing seasons 2003-04 & 2004-05.

Year	Month	Temperature (^{0}C) Max (mean)	Temperature (^{0}C) Min (mean)	Precipitation (mm)
2003-04	December	21.2	6.0	9.5
	January	18.0	4.2	55.1
	February	23.1	6.3	39.4
	March	28.6	10.7	00.0
	April	31.0	16.5	36.7
	Mean	**24.8**	**8.74**	**Total 140.7**
2004-05	December	20.7	6.3	25.8
	January	16.9	3.3	75.9
	February	16.4	5.1	97.4
	March	22.1	10.8	108.5
	April	29.3	12.54	9.3
	Mean	**21.1**	**7.6**	**Total 316.9**

Source: Weather Station, NWFP Agricultural University Peshawar, Pakistan

RESULTS AND DISCUSSION

Spike length (cm)

Statistical analysis of the data showed that in the both years, the spike length (cm) of the wheat was significantly ($P \leq 0.001$) affected by the seed rate as well as by *Silybum* density (Table 2). In 2003-04 and 2004-05, maximum spike length was recorded in seed rate @ 100 and 120 kg ha^{-1} while minimum spike length was recorded in seed rate 140 and 160 kg ha^{-1}. Where the values were statistically at par with each other. These results indicated that at lower seed rates the resources like water, nutrients, space and sunlight were enough to support these crop populations while increasing population adversely effected the spike length due to intra-specific competition. The results of both the years were in line which confirmed the results of the first experiment. As spike length plays an important in grain yield of wheat, therefore it is suggested that the seed rate of wheat should be kept 120 kg ha^{-1} instead of 100 kg ha^{-1} because at 100 kg ha^{-1} the crop plants will face inter-competition with weeds and above 120 kg ha^{-1} there will be intra-specific competition thus both in both the situations, the grain yield will be reduced. Similarly, by increasing density of *Silybum* there was decrease in spike length of wheat. However, in both the years, maximum reduction was noted at the *Silybum* density 12 m^{-2}. Increasing the *Silybum* density above 12 had no significant effect on spike length. It might be due to the fact that at *Silybum* density 12 m^{-2}, the intra-specific competition among the *Silybum* plants starts. Analogous results were reported by Alam et al., (1994), who reported that spike length decreased with increasing seed rate of wheat. Yenish and Young (2004) reported that spikelet biomass was reduced approximately 70 and 30% in the same respective years due to weeds.

Number of grains spike^{-1}

Number of grains spike^{-1} is an important trait of wheat contributing to yield. Statistical analyses of the data showed that the seed rate significantly ($P<0.001$) affected the number of grains spike^{-1}. In 2003-04, maximum number of grains spike^{-1} (47.39 and 47.29) was recorded in seed rate 100 and 120 kg ha^{-1} (Table 2). Similarly in 2004-05, maximum number of grains spike^{-1} (46.57 and 46.89) were recorded in seed rate 100 and 120 kg ha^{-1} while lowest value (41.18) was recorded in seed rate 160 kg ha^{-1}. The response of number of grains spike^{-1} to seed rate was similar in both the years. However, number of grains spike^{-1} in higher seed rate i.e. 140 and 160 kg ha^{-1} were significantly were comparatively lower than 2003-04 due to the fact that higher rainfall and low temperature (Table 1) in 2004-05 favoured the growth and development of *Silybum* and thus due to strong interspecific competition, reduced all the yield related traits of wheat. Means of the data showed that *Silybum* density significantly decreased the number of grains spike^{-1}. *Silybum* density up to 3 m^{-2} had no significant effect on the number of grains spike while increasing the density beyond 3 significantly decreased the number of grains spike^{-1}. In 2003-04 maximum reduction was noted when the *Silybum* density was 12 m^{-2} while in 2004-05, maximum reduction was noted in *Silybum* density 15 m^{-2}. These results indicated that there was potential in *Silybum* plants to decrease the number of grains spike^{-1} in 2003-04 but the limitation of resources restricted and retarded the growth of *Silybum*. While in 2004-05, the *Silybum* gained maximum vegetative growth and thus decreased the number of grains spike^{-1} more than 2003-04. Thus it can be concluded from the data that *Silybum* can prove more harmful to the wheat crop if irrigation interval is decreased or frequent rainfall occur during the growing season. These results are in analogy with the work of Donald and Khan (1996) who found that increasing Canada thistle density decreased wheat stand in each of 3 years. Canada thistle also reduced spikes plant^{-1} and seed spike^{-1} to varying extents depending on year.

Number of spikelets spike^{-1}

Analyses of variance showed that different seed rates and *Silybum* density had significant effect on the number of spikelets spike^{-1}. The data in Table 2 depicted that in both the years, the seed rate @ 100, 120 and 140 kg ha^{-1} produced statistically similar values while the value in seed rate 160 kg ha^{-1} was significantly lower than the others. These results showed that due to intra-specific competition at the highest seed rate i.e. 160 kg ha^{-1} the number of spikelets spike^{-1} were decreased. Again the values of number of grains spike^{-1} were lower in 2004-05 as compared to 2003-04 due the high rainfall in 2004-05 which provided more water and low temperature which is an ideal environment for *Silybum* growth. In year 2003-04, total rainfall during the crop season was 140 mm as compared to 328 in 2004-05 (Table 1). The effect of *Silybum* density on number of spikelets spike^{-1} showed that in 2003-04 and 2004-05, maximum reduction was noted in *Silybum* density 9 m^{-2} while increasing the density above 9 had no significant effect on the number of spikelets spike^{-1}. This decrease in spikelets might be due to severe competition of *Silybum* with the wheat crop for nutrients, light, water and space. As *Silybum* was inherently taller than wheat therefore the *Silybum* closed canopy above the wheat crop and thus the crop was deprived of sunlight which play an important role during spike initiation stage as reported by Sabine and Jeuffroy (2004). They reported that in wheat, spike growth prior to anthesis is a key period influencing kernel set. Incident radiation and crop N status affect the accumulation of dry matter (DM) and nitrogen (N) in the spike, as observed at anthesis. Tessema and Tanner (1997) concluded that weed species significantly affected grains spike^{-1} and spike length while Chmielewski and Kohn (1999) found that yield components were strongly influenced by weather.

Table 2. Yield components of wheat as affected by seed rate and *Silybum* densities.

	Spike length (cm)		No. of grains spike^{-1}		No.of spikelets spike^{-1}	
	2003-04	2004-05	2003-04,	2004-05	2003-04	2004-05
Seed rate (Kg ha^{-1})						
100	7.96 ab	7.98 a	47.39 a	46.57 a	17.14 a	16.07 a
120	8.19 a	7.88 a	47.29 a	46.89 a	17.71 a	16.43 a
140	7.48 b	7.21 b	43.25 b	44.64 b	16.61 a	15.32 a
160	6.58 c	6.09 c	42.25 b	41.18 c	14.89 b	13.71 b
LSD	0.697	0.6086	1.638	1.908	1.205	1.181
***Silybum* Density m^{-2}**						
0	8.30 a	8.656 a	49.31 a	48.90 a	18.06 a	17.81 a
3	8.02 ab	7.963 b	47.94 a	47.88 a	17.56 a	16.88 ab
6	7.72 abc	7.475 bc	45.25 b	45.06 b	17.19 ab	16.00 b
9	7.48 bc	7.319 c	44.44 bc	44.13 bc	16.25 bc	14.75 c
12	7.35 bc	6.688 d	43.31 bc	42.75 c	16.00 bc	14.13 c
15	7.04 c	6.581 d	42.50 c	42.44 c	15.69 c	14.38 c
18	6.96 c	6.369 d	42.56 c	42.56 c	15.38 c	13.75 c
$LSD_{0.01}$	0.7787	0.5398	2.343	2.096	1.276	1.062

Values followed by different letters in the respective category significantly different at $P \leq P_{0.01}$ by LSD test.

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