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TILLERING CAPACITY OF WHEAT AT DIFFERENT SEED RATES AS AFFECTED BY HOLY THISTLE DENSITY

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ABSTRACT

Tillers production is the earliest yield component in wheat and contribute significantly to final grain yield. To assess this concept, field study was conducted during 2003-04 and 2004-05 at Malankandher Research Farm, NWFP Agricultural University Peshawar. The experiment was conducted using randomized complete block design with split-plot arrangement. Seed rates of wheat at 100, 120, 140 and 160 kg ha^{-1} were assigned to main plots while Holy thistle (*Silybum marianum*) densities at 0, 3, 6, 9, 12, 15 and 18 m^{-2} were assigned to sub-plots. Regression analyses of the data showed that at seed rate 100, 120 and 140 kg ha^{-1}, the tillers m^{-2} decreased linearly with the increase in *Silybum* density while seed rate at 160 kg ha^{-1} was affected quadratically. Overall, seed rate at 120 kg ha^{-1} gave maximum tillers. At lower seed rates, interspecific and at higher seed rates intraspecific competition decreased tillers. However, the magnitude of tillers reduction was seed rate and year dependent; greater reduction at lower seed rates rather than at higher seed rate. Similarly the magnitude of tillers reduction was greater during 2004-05 as compared to 2003-04. This year's difference could be attributed to the higher rainfall and low temperature during 2004-05 that favoured the growth of *S. marianum* and thus proved more harmful to the wheat as compared to 2003-04. Thus it can be concluded from the results that seed rate as well as environmental conditions play an important role in manipulating the crop-weed competition and tillers in wheat.

Key words: Density, seed rate, *Silybum*, tillers, wheat

INTRODUCTION

Pakistan's economy is mostly dependent on agricultural productivity. Thus fluctuations in production of major crops like wheat, maize, cotton, rice and sugarcane adversely affect the overall economy of our country. Wheat is the most important cereal and staple food crop grown over an area of approximately 8 million hectares. It accounts for 36% of the cropped area and 30% of the value added by major crops in the country. Among the important wheat growing countries, Pakistan ranks 10^{th} and 59^{th} in terms of area and yield, respectively (Anonymous, 1998). A vast unexploited potential has been missed due to several production constraints, among these weeds are the most important and hidden enemies of crops that cause huge losses to the crop yields, exceeding Rs. 100 billions per annum (Anonymous, 2006). Anwar *et al*., (2004) reported *S. marianum* as among the major weeds of wheat in Peshawar. Blackshaw *et al*. (2005) reported that the establishment of a crop with a more uniform and dense plant distribution can increase its ability to suppress weeds, because of rapid canopy closure that better shades weeds and better root distribution improves access to soil nutrients and water. Donald and Khan (1996) found that increasing Canada thistle density decreased wheat tillers in each of 3 years. Canada thistle also reduced spikes $plant^{-1}$ and seed $spike^{-1}$ to varying extents depending on year. In view of the importance of *S. marianum* as major weed, this study was initiated to see the impact of different seed rates and *S. marianum* density on tillers production of wheat. Thus the detailed study of population dynamics will assist the weed managers to manage this weed so that yield losses could be avoided in wheat.

MATERIALS AND METHODS

Field experiments were conducted at Malakandher Agricultural Research Farm, NWFP Agricultural University, Peshawar for two crop seasons i.e. 2003-04 and 2004-05. The experimental site has mean soil pH of 7.47 with 22.79, 55.69 and 21.52 % clay, silt and sand, respectively. 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 Diammonium phosphate (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 (*S. 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

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had 5 wheat rows, spaced 0.30 m apart. Wheat was sown with the help of hand hoe whereas seeds of *S. marianum* were planted using dimple the same day. To avoid the risk of germination failure, three to five seeds of *S. marianum* were seeded instead of a single seed and then the population adjusted through thinning and or transplantation accordingly. All other weeds were removed manually throughout the crop season on weekly basis. To record the number of tillers m^{-2}, total tillers in two central rows in each treatment were counted at maturity and then converted into tillers m^{-2}. The data recorded was subjected to regression analyses using Excel spreadsheet and the trend lines were fitted accordingly.

RESULTS AND DISCUSSION

Regression analyses of the two year's data revealed that the seed rates of wheat at 100, 120, and 140 kg ha^{-1} were significantly linearly affected by *S. marianum* density (Table 1, Fig. 1a-c). While the highest seed rate (160 kg ha^{-1}) was insignificantly affected (Fig. **1d**) by *S. marianum* density (P=0.38 & 0.24, for 2003-04 and 2004-05, respectively). The intercept (Fig. **1 a-d**, Table 1) showed that the tillers m^{-2} in both the years were in line however, it was seed rate dependent. In both the years, maximum tillers m^{-2} in pure stand of wheat were recorded at seed rate 120 kg ha^{-1} while in all other seed rates, the tillers were decreased. Thus it can be concluded from these results that at lower seed rates of wheat, the interspecific competition and at higher seed rates, the intraspecific competition decreased the tiller m^{-2}. While at medium seed rate (120 kg ha^{-1}) the intraspecific competition was not very severe and thus wheat competed well, hence produced more tillers as compared to other seed rates. The slopes indicate that with the increase in *S. marianum* density, the tillers m^{-2} decreased linearly at seed rate 100, 120 and 140 kg ha^{-1}. While at highest seed rate (160 kg ha^{-1}), the tillers m^{-2} were affected but in slightly quadratic fashion showing the severe intraspecific competition among the crop plants. It was noted in both the years that with the increasing *S. marianum* density, the tillers m^{-2} decreased but the magnitude of reduction was seed rate and year dependent. Greater reduction of tillers m^{-2} were recorded at lower seed rate and lower reduction at higher seed rates. Similarly, the slope indicated that the magnitude of tillers reduction due to *S. marianum* density was greater during 2004-05 as compared to 2003-04. These results show that during 2004-05, the higher rainfall (328 mm) favoured the growth of *Silybum* and thus the wheat was more adversely affected due to interspecific competition. The total rainfall was 140 mm during 2003-04. As higher rainfall cause decrease in temperature and high humidity therefore, probably these factors favoured the growth of *S. marianum*

These results depict that higher seeding rate of wheat can decrease the harmful effects of weeds on tillers production. With the increasing seed rate, the R^2 value decreased showing the suppressing ability of wheat at higher seed rates. All other seed rates decreased final grain yield except 120 kg ha^{-1} (data not given). Due to these facts unproductive tillers m^{-2} were decreased at higher seed rates due to intraspecific competition and at lower seed rate due to interspecific competition. The tiller m^{-2} were decreased due to interspecific competition, intraspecific competition as well as due to the lodging of crop at highest seeding rate was also noted during 2004-05 due to unusual rainfall. Hence it can be concluded from the data that the seed rate at 120 kg ha^{-1} should be used to achieve maximum grain yield of wheat under conditions studied. Several reports address the importance of seed rate, weed density and environmental conditions as the yield determinants. Alam *et al*. (1994) reported that high seed rate effected number of tillers $plant^{-1}$. Our results suggest that optimum seed rate of wheat should be used so that the habitat can support the plant population in term of nutrients, space, moisture and sunlight. In our experiments, the optimum seed rate was determined as 120 kg ha^{-1}. The results of Gaffer *et al*. (1997) support our results. They reported that weed dry weight decreased with increasing seed rate and highest grain yield was obtained with a sowing rate of 125 kg ha^{-1}, rather at higher or lower than 125 kg ha^{-1}. Donald and Khan (1996) observed analogous results that increasing Canada thistle density decreased wheat tillers. As weather and environmental conditions play a vital role in crop husbandry therefore the crop-weed competition can be altered in favour of crop and against the weeds by manipulating the cultural practices. In our experiments, the *S. marianum* decreased the tillers more drastically during 2004-05 as compared to 2003-04 due to the fact that the environmental conditions were more favourable for *S. marianum* as compared to wheat crop and thus tillers decrease was greater. The findings of Chmielewski and Kohn (1999) were similar as stated that weather significantly affected the yield components in the two seasons. Storkey *et al*. (2003) reported that there was considerable variation between years in the competitiveness of black-grass. Analogous results were reported by Pandey *et al*. (1999), they reported that effective tillers were affected by seed rates.

These findings suggest that optimum crop plant population should be established in fields. Because optimum plant population not only cause increased grain yield but also suppress weeds. However the suppressing ability of wheat plants are dependent on seed rate, *S. marianum* density and meteorological conditions.

Table 1. Numerical values of the equations obtained after fitting trendlines.

Seed rate (kg ha^{-1})	Intercept		Slope (b)		Slope (c)		R2		P value	
	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05
100	252.53	251.39	-4.65	-	-		85	84	0.002	
			5.29						0.001	
120	282.16	287.20	-3.30	-	-		90	77	0.001	
			4.06						0.008	
140	245.92	241.12	-1.99	-	-		57	62	0.05	0.035
			3.90							
160	247.05	234.98	+0.22	-	-5.01		38	50	0.38	0.24
			2.62		+0.09					

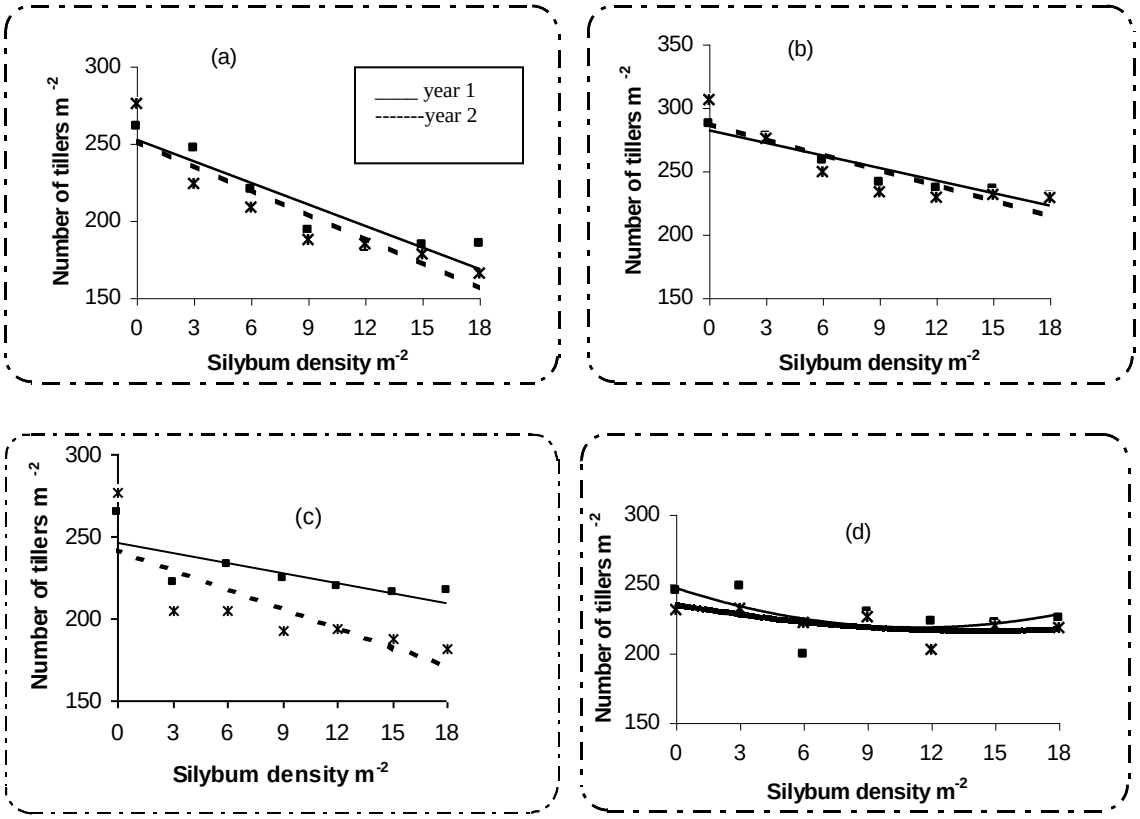

Fig. 1. Effect of *Silybum* densities on seed rate at (a) 100, (b) 120, (c) 140 and (d) 160 kg ha^{-1} during 2003-04 & 2004-05.

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