

Management of rye (*Secal cereal*) in wheat (*Triticum aestivum*) field through preparation of false seed bed on different sowing dates

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ABSTRACT

Rye has lately been acknowledged as an important weed in Iran's wheat farms. In order to determine the most effective method of rye weeds management in wheat farm, the effects of preparing false seedbeds with three different treatments; Gramoxon herbicide, disk plow and no treatment as control on three different sowing dates (۱۱th Oct., ۱th Nov., and ۲۱st Nov.) were studied. The experiment was carried out at the Agriculture and Natural Research Station, Miandoab, during ۲۰۰۷-۲۰۰۸ as split blocks based on complete randomized blocks in three replications. It was found that the presence of rye in wheat field results in reduced dried biomass and kernel yield. Preparation of false seed bed following either methods of applying herbicide or plow disk reduced rye population and increased the kernel yield ۵۱% and ۴۹% compared to control respectively, and more than ۹۲ % of rye seedlings were eradicated by preparation of false seed bed. Delay in sowing date from ۱۱st Oct. to ۲۱st of Nov. resulted in ۴۷% less kernel yield. Among studied treatments combination sowing date on ۱۱st Oct. and stale seed bed using herbicide and plow disk produced the highest kernel yields ۶۳۱۸ and ۶۱۷۸ kg per ha respectively. Late sowing date on ۲۱st Nov. under the control treatment (presence of rye) with ۱۹۷۵ kg per ha produced the lowest yield. Our findings demonstrated that rye management in

wheat farms is indispensable, and in this regard recommended sowing and constructing a false seed bed is effective and worthwhile.

Key words: Wheat, Rye, false Seed Bed, Sowing Date, Yield

INTRODUCTION

Many regions in Iran in which wheat is sowed do experience problems with rye (Baghestani and Atri ۲۰۰۱). Lower nutritional demands, high ability to compete with other plants, morphological and life cycle similarities to wheat all have led to the survival of rye and its expansion in winter wheat farms (Anderson ۱۹۹۲; Pester *et al*, ۲۰۰۰). Many of studies reported on the problem of rye in wheat farms, have been focused on the biology and dynamics of its populations (Anderson, ۱۹۹۸). Different types of wheat have disparate reactions towards the presence of rye. Dianat *et al*, (۲۰۰۷) studied eight different genotypes of wheat and found the wheat genotype Mahdavi as a better competition to rye. Coble and Fay (۱۹۸۰) reported a ۰.۰ percent reduction in wheat yield in Montana and Kansas states. Another study reported a much higher level of reduction in wheat yield up to ۹۲% due to the damage of rye in wheat field (Stump and Westra, ۲۰۰۰). In the absence of sufficient rainfall, rye shows a relatively better competition than wheat, and as a consequence biological and economical yield of wheat is decreased under the effect of competition with rye. It was shown that regarding grain yield every ۰.۳۶ or ۰.۰۱ rye plant has a reverse effect equivalent to a wheat plant (Baghestani and Atri, ۲۰۰۳). Amini *et al*, (۲۰۰۳) found that each ۰.۰ rye plant had a reverse effect equivalent to a wheat plant, reducing grain yield through reduction in the number of kernel per spike, ۱۰۰۰ kernel weight, and total biomass of wheat. Karaminejad *et. al*, (۲۰۰۰) declared the number of spike per plant and ۱۰۰۰ kernel weight as the two criteria receiving the highest impact of rye competition with wheat. An increase in the population of rye causes a significant reduction in the number of fertile tiller, biological yield, number of kernel per spike, and ۱۰۰۰ kernel weight. A higher density of rye up to ۱۰۰ plants per square meter results in ۰۲.۰% reduction in wheat yield (Harivandy *et al*, ۲۰۰۰).

Concerning the management and control of rye in wheat farm and due to the lack of specific herbicides, chemical control is not recommended. It seems that application of cultural management methods like a proper rotation system and increased ability of crops to compete against rye weed would minimize its damages in wheat farms. Among the methods which can increase the level of wheat competition against rye weed includes escalating the seed density, planting most competitor cultivars, and choosing a proper time and right place for the crop.

Further more reducing the amount of rye seeds from soil seed bank is also of high importance in increasing the ability of wheat to compete against rye weed (Baghestani *et al*, ۲۰۰۴). It is shown that preventing rye from reproduction in wheat farm for five consecutive years would thoroughly clear soil seed bank from this weed (Stump and Westra , ۲۰۰۰). The most important methods of controlling rye in wheat field includes using pure seed, maintaining rotation, applying agronomic and chemical treatment before sowing wheat in a farm (Drew *et al*, ۲۰۰۵). Prevention as the principal rule in weed management in any cropping systems including wheat reduces the costs of controlling weeds and facilitates their control. Weeds that germinate prior to the sowing of main plant are usually eradicated during the preparation of seed bed (Koocheki and Khaje Hosseini, ۲۰۰۸). The method of false seedbed results in the germination of weed seeds prior to the planting of the main crop. Carrying out the cultivation operation before sowing of the main crop provides a chance for weeds to grow. Shortly before sowing of the main crop, the weed's seedlings are eliminated using fire or applying a shallow tillage. The false seedbed clears the soil seed bank in the shallow layer of the soil (Zand *et al*, ۲۰۰۸). Irrigation after the preparation of seedbed and prior to the sowing of the main crop would let weed seeds grow and then be eradicated by applying a shallow tillage. This will result in reduction of seed population in the soil seed bank and ultimately will decrease the number of weeds during the period of wheat growth (Montazeri *et al*, ۲۰۰۵).

The aim of this study was to examine the management of rye in wheat farms by preparing a false seedbed through the use of herbicide, and disc-plow following irrigation and prior to sowing wheat.

MATERIALS AND METHODS

This study was carried out in Miandoab Agriculture Research Station in West Azarbijan during ۲۰۰۷-۲۰۰۸. The geographical longitude of the experiment site was ۴۶ degree and ۹۰ minutes, its geographical latitude was ۳۶ degree and ۵۸ minutes, and its altitude is ۱۳۱۴ meters. The average rainfall was ۲۹۰ mm. Soil samples were prepared from the depth of ۳۰ cm of the experiment farm and soil texture was determined as clay loam, and its pH was ۷.۵ -۸ Ec_e ۲(ds/m^۳).

Fertilizers were utilized based on the analysis of the soil samples to supply for the required of nutrients.

Rye weed seeds were collected from farm in summer 2016. The degree of farm's contamination varied from 0 to 200 plants per m². The average of rye weeds population was determined as 50 plants per m². Prior to the experiment, germination test applied on rye weed seeds, and it was found that the seeds lacks dormancy.

The experiment was laid out in a split block design based on complete randomized blocks with three replications keeping sowing dates in main plots including three sowing dates: 12th Oct., 1st Nov., and 11st Nov.; and sub-plot included: constructing a false seed bed and utilizing Gramoxon herbicide, constructing a false seed bed and utilizing disc-plow, and no treatment and no preparation of false seed bed as the control. Each plot included 12 lines, 2.5 m wide and 7 m long, line to line distance was 20 cm. Zarin cultivar was used for sowing wheat at the rate of 400 seeds per m². Samples were taken from one square meter of the middle of each plot, later yield, yield components, and other interested traits were measured.

More explanation is required on the process of planting wheat and application of Gramoxon or disk-plow (factors a & b). The collected data was analyzed using the software SPSS, EXCEL, and also by comparing means through LSD.

RESULTS AND DISCUSSIONS

Plant number and biomass of rye weed

The results of variance analysis demonstrated that number of rye plants in the beginning and end season was affected by seed bed and sowing date; furthermore, a significant difference was identified (Table 1). Mean comparison (Table 2) indicated that biomass and number of rye plants in check treatment were much higher than the two false seed bed treatments in the beginning and end of season. This resulted from the effect of using Gramoxon herbicide and disc for controlling rye weeds. More than 92 percent of rye weed seedlings were eradicated by preparing a false seed bed. Preparing a false seed bed precipitated seed germination of weeds and also seed reduction from the soil seed bank (Zand *et al.*, 2018). Table 2 illustrates that delayed sowing resulted in substantial increase in biomass and number of rye plants on compared to the other two sowing dates. In comparison with the other two sowing dates, increasing biomass in delayed sowing induced a reduction of wheat spikes as well as the increase of competing ability of rye compared to wheat.

Number of wheat spikes

Data analysis showed significant differences in the number of wheat spikes among different sowing dates at the probability level of $\alpha = 0\%$ and regarding the construction of false seed bed at the probability level of $\alpha = 1\%$ (Table 1). Mean comparisons identified (Table 2) that of spikes in November 1st sowing (432 spikes) compared to October 11th (426 spikes) and November 1st (634 spikes) decreased 4.0% and 32% respectively.

The reduction in number of spikes in delayed sowing was probably resulted from late plant establishment and encounter with winter 's harsh cold. Mahfouzi and Aminzadeh (2003) reported that late sowing led to weak plants which had no chance for acclimatization to the cold, and also against cold stress they became damaged to 20%. The results of Table 2 showed no significant difference of number of wheat spikes between two methods of constructing the false seed beds.

Number of spikes 414 per m² in check treatment compared to false seed bed by herbicide (400 spikes), and disk-plow (644 spikes) decreased 4.1% and 39% respectively.

The reduction of spikes in check treatment in comparison with false seed beds probably resulted from increase of rye spikes and also its effects on wheat establishment and number of wheat spikes. This finding was in agreement with the reports by Amini *et al.*, (2003) and Baghestani *et al.*, (2003) that an increase in rye density contributes to the reduction of the number of wheat spikes in per m².

Number of kernels per wheat spike

Mean comparisons revealed that number of kernels per spike in check treatment (29.2 kernels) compared to false seed bed and use of Gramoxon herbicide (39.4 kernels) and false seed bed and use of disk-plow (33.0 kernels) reduced to 0.1 and 4.3 kernels respectively. The decrease of kernels per wheat spike was probably due to the increase of rye in check treatment. It seems that the higher ability of rye to compete with wheat plants during flowering and insemination stages reduces the number of fertile florets and therefore results in a less number of kernels per wheat spike. Jaafarnejad (2004) and Cudney *et al.*, (1989) stated that the weeds reduce the number of kernels in the main spike.

Amini *et al.* (2003) also reported that the increase of rye in wheat fields reduces the number of kernels in spike.

1000 kernel weight of wheat

Analysis of variance found no significant differences in the 1000 kernel weight of different treatments (sowing date and seed beds) but 1000 kernel weight of wheat was less than normal in delayed sowing whereas in check treatment it was less than false seed beds (Table 3, 4).

Wheat dry weight

The results indicated that wheat dry weight was significantly affected both by the sowing dates and the construction of false seed bed (Table 1). As it is observed in Figure 1, late sowing from October 11th through November 1st and November 21st decreased wheat dry weight 28% and 40% respectively (from 1110 g m⁻² to 780 g m⁻² and 660 g m⁻²). Also wheat dry weight in false seed bed and the use of herbicide, and the use of disk-plow increased 47% and 48% compared to check treatment respectively. No significant difference was found between the false seed beds.

The lowest dry weight resulted from November 21st sowing and the highest dry weight from October 11st. The reduction of wheat dry weight in delayed sowing and check treatment was probably due to the decrease of spikes, wheat height and kernel component yield.

A reduction in wheat biomass due to the presence of rye was previously reported by Diant *et al.* (2004) and Amini *et al.* (2003).

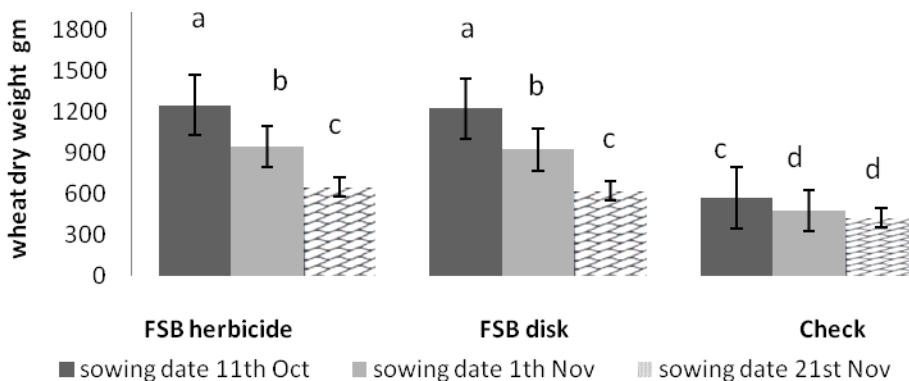


Figure 1: Mean comparison of wheat dry weight under effect of interaction between constructing different seed beds and sowing dates. FSB is used instead of constructing false seed bed. Different letters indicate significant difference among treatments (Lsd $\alpha=5\%$)

Kernel yield

There were significant differences among different sowing dates and different seed beds, as well as interactions between sowing date and seed beds (Table 1). Mean comparison showed a 47% reduction of kernel yield contributing to late sowing date from October 11th (5.66 kg/ha) to

November 21st (2669 kg/ha). Regarding the kernel yield there was no significant difference between the false seed beds; furthermore, compared to check treatment false seed beds treatments, the use of Gramoxon herbicide (450 kg/ha) and application of disk-plow (4033 kg/ha) increased 51% and 49% respectively. wheat yield quantity in November 21st sowing pertaining to false seed bed, use of herbicide and disk-plow was 3131 and 2908 kg/ha respectively.

This result identified that the presence of rye in November 21st sowing reduced the yield thoroughly, which was probably due to rye characteristics that had a better resistance to the cold compared to wheat. In this condition, wheat competition ability decreased. Yield components included number of spike, kernels per spike and 1000 kernel weight. The number of spike is the most important of the yield components. Therefore its reduction in delayed sowing resulted in the decrease of kernel yield. Preparing a false seed bed precipitated rye germination; and the application of herbicide and disk-plow eradicated the rye that resulted in the increase of yield compared to check treatment.

Figure 3 displays the relation between rye density at end season and wheat yield and through the increase of rye number at end season, wheat kernel yield at all three sowing dates (11th Oct., 1th Nov., and 21st Nov.) decreases. The most yield was found in October 11th and the preparation of false seed beds, whereas the least was found in check treatment in November 21st.

Baghestani and Atri (2003) reported that rye weed reduced the kernel yield.

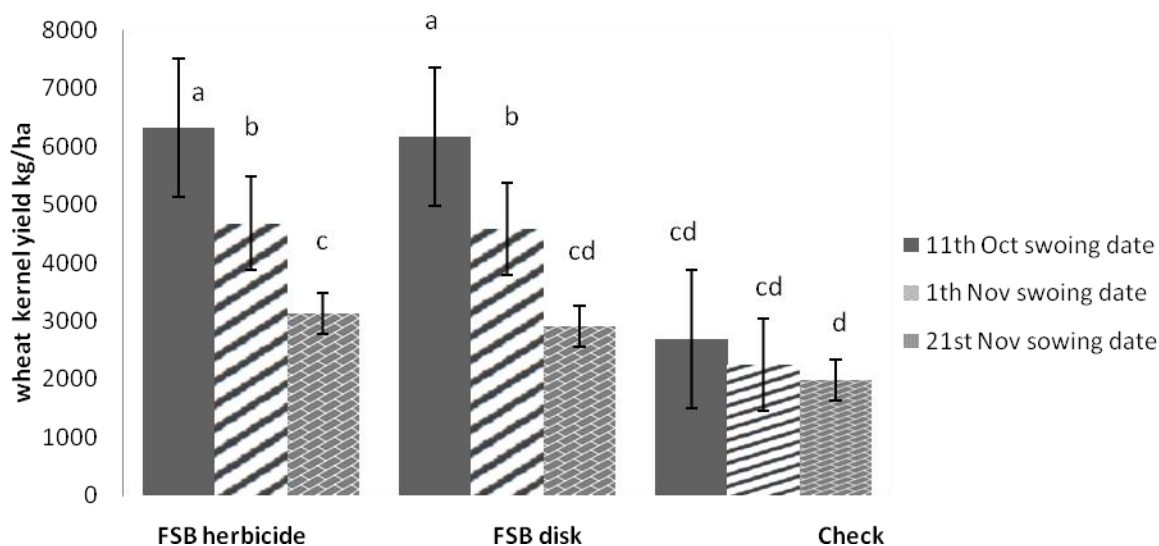


Figure 7: Mean comparison of wheat kernel yield under effect of interaction between constructing different seed beds and sowing dates. FSB is used instead of constructing false seed bed. Different letters indicate significant difference among treatments (Lsd $\alpha=5\%$)

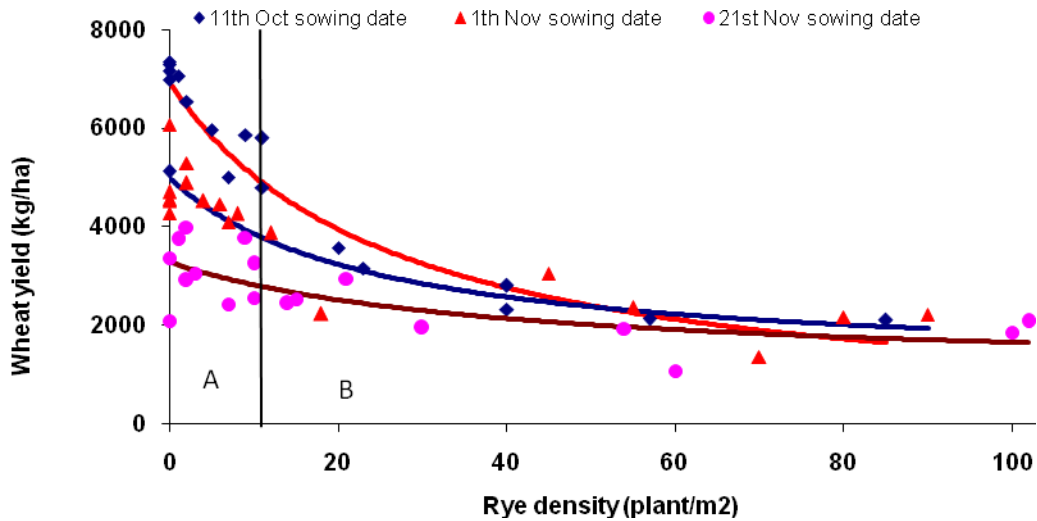


Figure 7: The relation between rye density in end season and wheat yield in three sowing dates.

A: Range of false seed bed by herbicide and disk-plow

B: Range of check treatment

CONCLUSION

The results of this research demonstrated that normal date sowing compared to delayed sowing showed a better competition against rye. Constructing false seed bed due to the reduction of rye population decreased the damage to the rye weed. Thus preparing false seed bed and Gramoxon herbicide or disk-plow are recommended in order to control rye in wheat fields.

Table 1. combined variance analysis of characters.

Source of variation	df	Wheat				Rye			
		No. Spike	No. Grain/spike	1000 grain weight	Grain yield	dry weight	No.rye of beginning season	No.rye of end season	dry weight
Year (Y)	1	10894.2 ^{ns}	237.4*	74.2 ^{ns}	8771327.2*	217777 ^{ns}	394.7 ^{ns}	17.1 ^{ns}	1977.7 ^{ns}
R/Y	4	20772.9	29.2	12.2	747979.4	34999.4	280.7	3	773.9
sowing date (S)	2	407330.0*	11.3 ^{ns}	19.2 ^{ns}	20747381.4*	910911.2*	10.7 ^{ns}	2.1 ^{ns}	440.1 ^{ns}
S*Y	2	4904.4 ^{ns}	12.4 ^{ns}	9.7 ^{ns}	1324377.4 ^{ns}	37017.7 ^{ns}	47.8 ^{ns}	2.1 ^{ns}	210.1 ^{ns}
R/Y*S	8	710.4.3	0.7	3.8	437393.9	17370.8	74.4	0.97	327.18
FSB (F)	2	400093.7**	130.3*	12.7 ^{ns}	3270.4870.7*	1177370.0*	7220.0**	108.9**	24079.8**
F*Y	2	1876.7 ^{ns}	7.7 ^{ns}	4 ^{ns}	22817.4 ^{ns}	1760.2 ^{ns}	134.0 ^{ns}	0.81 ^{ns}	040.8 ^{ns}
R/YF	8	1422.7	7.1	2.3	170832.9	7970.3	321.8	3.27	840.7
S*F	4	18719.9 ^{ns}	3.7 ^{ns}	0 ^{ns}	3191787.2**	104271.7**	147.9 ^{ns}	1.8 ^{ns}	30.4.9 ^{ns}
S*F*Y	4	9177.9**	1.8 ^{ns}	2.1 ^{ns}	144300.4 ^{ns}	2811.2 ^{ns}	39.0 ^{ns}	1.01 ^{ns}	170.4 ^{ns}
R/YSF	16	1779.4	3.3	4.9	172383.9	4717	88	0.998	330.0

* and ** significant at 1% and 0% probability levels, respectively
n.s : Non significant and FSB is used instead of constructing false seed bed

Table ۶. Mean comparison of characteristics affected by false seed beds

	False seed bed		
	Herbicide	disk-plow	check
Number of wheat spikes	۷۰۰.۰ a	۶۶۷ a	۴۱۴ b
Number of kernels per wheat spike	۳۴.۳a	۳۳.۰a	۲۹.۲b
No.rye of beginning season	۱.۶a	۱ a	۴۹.۶b
No.rye of end season	۴.۷a	۴.۱a	۰۰ b
Rye dry weight	۶ a	۰.۱a	۶۹.۰b
۱۰۰۰ kernel weight of wheat	۴۱.۴a	۴۱.۰a	۴۰ ab

Different letters indicate significant difference among treatments

(Lsd $\alpha=۰\%$)

Table ۷. Mean comparison of wheat spike number affected by sowing date

	Sowing date		
	October ۱۱ th	November ۱ st	November ۲۱ st
Number of wheat spikes per m^۲	۷۲۰.۰ a	۶۳۴.۳ a	۴۳۱.۶ b
۱۰۰۰ kernel weight of wheat	۴۱.۹ a	۴۱.۱ a	۳۹.۹ ab

Different letters indicate significant difference among treatments

(Lsd $\alpha=۰\%$)

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