"EFFECT OF REDUCED HERBICIDE RATES ON WEED CONTROL AND GRAIN YIELD OF TRITICALE CROP"

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Introduction

Several studies advocate for developing sustainable cropping systems with a reduced reliance on plant protection products including herbicides [1]. Today, one of the major challenges is to keep the weed community at an acceptable level of control rather than to keep the crop totally free of weeds. In some cases, adequate control of weeds and high yields may be obtained even when herbicides are used fewer times and at lower doses than the ones normally recommended [2,3]. In particular, herbicides at reduced doses and combined with other methods are sometimes sufficient to control weed flora and reduce the farmers' costs [1]. Under that concept, the selection of competitive crop plant species or cultivars could also have a pivotal role [4,5]. It has to be noted that significant differences in the weed competitive ability between crop plant species and cultivars have already been documented [6].

Triticale (*Triticale hexaploide*) is a Man-made cereal grass crop obtained from hybridization of wheat with rye in order to combine the high yields of wheat and the tolerance to the biotic and abiotic stresses of rye [8]. As such, literature is rather inadequate regarding the competitive ability of this species against agronomically important weeds. Therefore, the objectives of this study were to assess the weed competitive ability of triticale and evaluate the effects of reduced rates of the herbicide mesosulfuron–methyl + iodosulfuron–methyl–sodium on the density and growth of the weeds *Avena sterilis* and *Papaver rhoeas.*

Results and discussion

As shown in table 1, weed density was inversely proportional to each herbicide rate. In average, the highest recommended herbicide rate reduced density of *A. sterilis* and *P. rhoeas* by 77 to 92% and 81 to 90%, respectively, compared with the untreated control. On the contrary, the reduction of herbicide rates by 50% resulted to a weed density reduction for *A. sterilis* and *P. rhoeas* ranging from 71 to 83% and from 80 to 81%, respectively. In the case of triticale, the best weed control was achieved with the highest herbicide dose, but lower rates of mesosulfuron + iodosulfuron often provided adequate weed control. The reduction of the upper recommended dose by 50% slightly decreased the control efficiency without any significant differences observed. Table 3 showed that herbicide dose reduced by 50% resulted in the control of *A. sterilis* and *P. rhoeas* up to 77 and 68%, respectively. Similar differences between cultivated plant species and cultivars have been previously reported [12].It has to be noted that in some cases reduced rates of herbicides have been adequately effective against weeds [13]. However, their effectiveness can be further increased and ensured by means of the use of integrated weed management approach and under that view weed competitive crops and cultivars can play a crucial role [14].

Conclusions

Conclusively, Our findings showed that triticale in low herbicide doses can be an effective and realistic way to reduce the overreliance on chemical management for weed such as *A. sterilis* and *P. rhoeas*. In all cases, further experiments with more weed species and herbicides in a wide range of soil and climatic conditions are required.

Year	Herbicide dose (kg ha^{-1})	Weed species	
		A. sterilis	*P. rhoeas*
		-------plants m^{-2} ---------	
2010	0	14.3a*	9.6d
	0.063	5.3b	3.1ef
	0.126	4.1b	1.8ef
	0.25	3.3b	0.9f
2011	0	14.8a	10.6d
	0.063	4.6bc	3.8ef
	0.126	2.5bc	2.1ef
	0.25	1.2c	1.1f

Table 1: *Density of A. sterilis and P. rhoeas in our field experiment and both years (2010 and 2011) for all treatments, of the triticale at 5 WAT. *Means in the same column for each year and species followed by the same letter do not differ significantly using Duncan Multiple Range Test at P≤ 0.05.*

Matherials and methods

A field experiment was conducted during 2010 (and repeated in 2011) in the experimental field of Agricultural University of Athens (37*o* 59' 12'' N, 23*o* 42' 96'' E, 29 m altitude) in order to study the weed competitive ability of triticale (*Triticale hexaploide*). The previous crop was vetch (*Vicia sativa*). *Avena sterilis* and *Papaver rhoeas* were among the dominant plant species. The soil was clay loam [9], with pH 7.29 (1:1 H2O), 15 g/kg organic matter [10] and 160 g/kg CaCO3. All winter cereals were shown on 19 November 2010 and 26 November 2011. A split-plot arrangement of treatments was used with three plots and three replicates in a randomized complete block design. The plot size was 2 X 8 m. In each of the nine plots, four subplots of 2 X 2 m were created. Crop was the main plot factor, while herbicide dose (0, 0.063, 0.126 and 0.25 kg ha-1 of the herbicide product Hussar maxx WG) was the subplot factor. The herbicide used (Hussar maxx WG, Bayer Crop Science AG, Monheim, Germany) was a commercial mixture formulated as a water dispersible granule of mesosulfuron-methyl (3% w/w) and iodosulfuron-methyl-sodium (3% w/w) and mefenpyrdiethyl (9%). Mesosulfuron-methyl is a post-emergence grass weed herbicide for wheat, triticale and rye, providing also control of some broad-leaved weeds. This herbicide is mixed with iodosulfuron-methyl-sodium to complement the control of broad-leaved weeds. Both herbicides belong to the group of sulfonylureas. When crop reached the three to six leaf stage (Zadoks stage Z13 - 16, following Zadoks., *et al.* 1974) [11], applications of the above-mentioned doses of herbicide, using a backpack sprayer delivering 300 l ha-1 spray solution at 3 kg cm-2 pressure.

Weed density was measured in all subplots at 5 WAT. Additionally, at the ear emergence growth stage of the winter cereal, the two dominating weeds were harvested and their aboveground biomass was determined. ANOVA was conducted for all data and differences between means were compared at the 5% level of significance using the Duncan Multiple Range Test at $P \leq 0.05$. Means were averaged across the two years in the case of not significant differences. All statistical analyses were conducted using the Statistica 9 software package (Stat Soft, Inc. 2300 East 14th Street, Tulsa, OK 74104, USA).

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