

Effects of trinexapac-ethyl (Moddus) in seed crops of eleven temperate grass species in Central European conditions

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Abstract

In small plot field trials conducted for two years the effects of plant growth regulator (PGR) trinexapac-ethyl (TE) in selected grass species were studied. Eleven temperate grass species were used in trials: Perennial ryegrass, annual ryegrass, meadow fescue, red fescue, Kentucky bluegrass, timothy, cocksfoot, loloid and festucoid type of festulolium, yellow oat grass and tall oat grass. Evaluations were made of lodging, plant height, number of fertile tillers, total seed yield, thousand seed weight, germination, germination energy and number of seed per fertile tiller. In each grass species TE reduced lodging and reduced plant height. Grasses treated by PGR achieved a higher seed yield associated with a higher number of seeds per panicle. Based on trials, Moddus (trinexapac-ethyl 250 g l⁻¹) in rate 0.8 l ha⁻¹ preferably applied at growth stage GS 31-32 or 0.4 l ha⁻¹ applied 2 times (GS 29 and GS 32) has been allowed for minor use in seed crops of each grass species under study in the Czech Republic.

Key words: grasses, PGR, trinexapac-ethyl, seed yield

Introduction

Czech grass seed production has a significant position in European Union, however unfortunately only due to overall area of grass seed crops. The production and seed yields fall under average of EU. The main cause of low yields is poor basic agronomical practices and low inputs. To achieve higher seed yields sufficient supply of nitrogen is necessary which has a significantly effect on the photosynthesis and thereby total productivity of plant. However, increasing of nitrogen supply increases growth and prolongation of stems that are more inclinable to lodging. Lodging has been identified as one of the most important factors reducing grass seed yield. Losses due to lodging have been estimated to be as great as 60 % (Rolston *et al.*, 1997). Lodged stems are exposed to higher competitive for light and nutrients. Developing seeds may abort or fall due to less effective photosynthesis and decreasing of assimilate supply. Lodged stands are also more predisposed to diseases. Last but not least is the complication of harvest and increased seed losses due to no-cutting of lodged stems and increased moisture of thrashed material etc.

In the Czech Republic only chlormequat-chloride (CCC) is registered for stem length shortening and reduction of lodging. CCC works on the beginning of gibberellin biosynthesis by inhibiting of kaurene synthesis (precursor of gibberellins). The plant growth regulator trinexapac-ethyl is widely used on grass seed crops abroad (Chastain *et al.*, 2003, Haldrup 2007, Rijckaert 2007, etc.). Rademacher (2000) claims that trinexapac-ethyl (TE) is inhibiting the activity of enzyme 3- β hydroxylase that the transforms inactive gibberellins form GA₂₀ on highly active forms GA₁

and GA₄. In consequence this inactivation the stem growth is reduced and stalk wall is stronger. Finally, the plant height is lower and the crop is less susceptible to lodging. The main topic of our research was to verify the influence of TE on seed yield of selected temperate grass species and its quality in Central Europe conditions.

Materials and methods

Tests of herbicide selectivity were conducted in small plot trials at Grassland Research Station at Zubri (North-east Moravia, 360 m a.s.l., cambisol, average air temperature 7.5 °C, precipitation 864 mm). The trials were conducted with perennial ryegrass (*Lolium perenne* L.) cv. Olaf, annual ryegrass (*Lolium multiflorum* Lam. var. *westerwoldicum* Wittm.) cv. Jivet, meadow fescue (*Festuca pratensis* Huds.) cv. Roznovska, red fescue (*F. rubra* L.) cv. Tagera, timothy (*Phleum pratense* L.) cv. Sobol, loloid type of *Festulolium* cv. Lofa, festucoid type of *Festulolium* cv. Hykor, cocksfoot (*Dactylis glomerata* L.) cv. Dana, Kentucky bluegrass (*Poa pratensis* L.) cv. Slezanka, tall oat grass (*Arrhenatherum elatius* (L.) Beauv. ex J. S. et K. B. Presl) cv. Roznovsky and yellow oat grass (*Trisetum flavescens* (L.) P. Beauv.) cv. Roznovsky. The plot size was 10 m². Each trial was arranged in a randomized complete block design (with other pesticide treatments) with four replications. Two tested treatments with trinexapac-ethyl (TE) were applied: single application of dose 0.2 l TE ha⁻¹ at GS 31-32 and split application 2 times 0.1 l TE ha⁻¹, 1st application at GS 29 and 2nd application at GS 32.

All treatments were performed with wheelbarrow sprayer driven by compressed air (Lurmark 01F80 nozzles, a pressure 0.25 MPa, spraying volume 300 l ha⁻¹) in GS 25-29 (mid to end of tillering). The standard treatment (MCPA + clopyralid + fluroxypyr) was used for weed control. Fertilizers application: autumn 45 kg N, 20 kg P₂O₅ and 60 kg K₂O per ha, spring – only nitrogen at dose depending on grass species 80-110 kg N ha⁻¹. The field trials were conducted for 2 years (2007-8). The trials plots were combined directly with plot combine Wintersteiger Elite. Harvested seed was dried and subsequently cleaned by laboratory cleaner Westrup for seed yield determination. Seed quality (TSW, germination) and number of seed per fertile tiller were analyzed in the lab of GRS Zubri. The results were analyzed by ANOVA and Tukey's post hoc test on significance level 95 % (Statistica 8.0). Due to insertion to the randomized blocks with pesticide treatments the number of degree of freedom (27) was satisfactory for statistical analyses.

Results and discussion

The positive effect of trinexapac-ethyl on seed yield was recorded in larger or smaller rate on all of selected grass species. However, there was insignificant decreasing of seed yield of some species in 2007. With regard to dry weather in growing seasons (especially in 2007) the grasses only very few lodged. It is possible to suppose, that if grasses would more lodged the difference in seed yield between untreated plots and plots treated by TE were to be higher. The effect on TE application on seed yield of selected grass species is shown in the Table 1. Thousand seed weight (TSW) was at most grass species insignificant lower on treatments when the TE was applied in comparison with untreated plots. Minimal and also insignificant differences between treatments were recorded in germination and germination energy (data not shown).

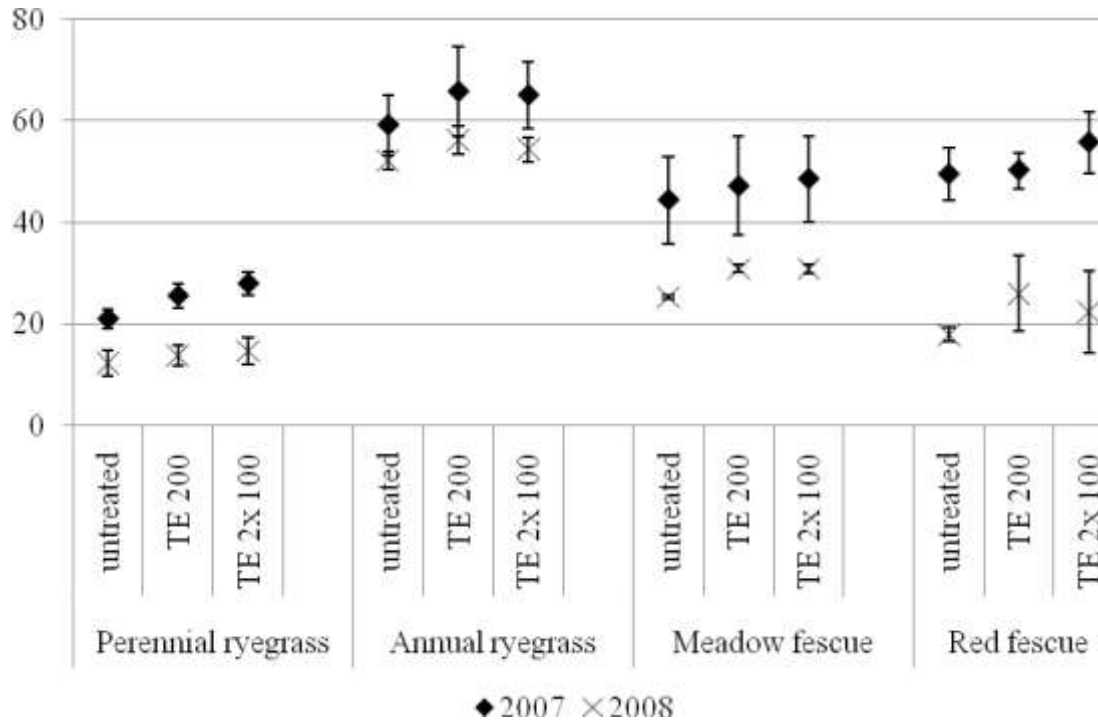
Significant differences were recorded in the number of seed in inflorescence (see. Figure 1). At the most grass species the number of the seed was higher at treated grasses; however, at the some species then number of the seed was lower in consequence with higher number of fertile stems. Positive influence of trinexapac-ethyl application on increase of number of perennial ryegrass seed was observed by Silberstein *et al.* (2002), who found out that TE increases number of created ripe seed, while potential number of seed isn't impressed with. Application TE so has positively effect on Floret site utilization (FSU). According to Young *et al.* (2007) the nitrogen rate increasing has significant effect on increasing of both, actual and potential seed number, but insignificant effect on FSU in perennial ryegrass.

Reduction in plant height and lodging was recorded on all the treated plots. Application of trinexapac-ethyl on cool season grass seed crops can significant increases seed yields mainly due to number of seed increasing. There is slight variation in the increasing of seed yield between grass species, but average increasing of seed yield is about 12-15 %. Based on trials the PGR Moddus (trinexapac-ethyl 250 g l⁻¹) at 0.8 l ha⁻¹ preferably applied at growth stage GS 31-32 or 0.4 l ha⁻¹ applied 2 times (GS 29 and GS 32) has been allowed for minor use in seed crops of each grass species under study in the Czech Republic.

Table 1 The effect of trinexapac-ethyl on seed yield selected grass species

species	treatment	Seed yield					
		2007		2008		average	
		kg ha ⁻¹	Tukey	kg ha ⁻¹	Tukey	kg ha ⁻¹	rel.
Perennial ryegrass	untreated	933.6	d	554.6	e	744.1	100
	TE 200	1230.1	ab	708.0	a	969.1	130
	TE 2x 100	1238.2	ab	696.0	abc	967.1	130
Annual ryegrass	untreated	1748.4	a	1655.0	c	1701.7	100
	TE 200	1792.8	a	1842.6	ab	1817.7	107
	TE 2x 100	1860.2	a	1757.5	a	1808.8	106
Meadow fescue	untreated	718.8	de	356.2	ab	537.5	100
	TE 200	765.1	cd	378.2	ab	571.7	106
	TE 2x 100	800.8	bcd	521.4	a	661.1	123
Red fescue	untreated	902.0	ab	1194.5	bc	1048.3	100
	TE 200	995.4	a	1348.8	a	1172.1	112
	TE 2x 100	982.7	a	1227.0	ab	1104.9	105
Kentucky blue grass	untreated	346.3	bcd	517.0	b	431.7	100
	TE 200	471.3	a	676.0	a	573.6	133
	TE 2x 100	413.7	ab	628.7	ab	521.2	121
Timothy	untreated	834.7	a	640.0	ab	737.3	100
	TE 200	859.1	a	706.6	a	782.8	106
	TE 2x 100	903.0	a	729.2	a	816.1	111
Cocksfoot	untreated	838.3	abcd	625.5	ab	731.9	100
	TE 200	799.8	abcd	762.8	a	781.3	107
	TE 2x 100	862.0	abc	694.7	ab	778.4	106
Festulolium Lofa	untreated	893.8	bcdef	734.9	bc	814.4	100
	TE 200	1055.4	abc	767.0	ab	911.2	111
	TE 2x 100	998.1	abcde	877.2	a	937.6	115
Festulolium Hykor	untreated	938.4	a	952.4	abc	945.4	100
	TE 200	937.2	a	1099.1	a	1018.1	107
	TE 2x 100	950.6	a	1147.9	a	1049.2	111
Tall oat grass	untreated	516.6	bc	367.4	c	442.0	100
	TE 200	671.5	a	506.1	ab	588.8	133
	TE 2x 100	549.3	b	513.7	a	531.5	120
Yellow oat grass	untreated	266.8	c	207.6	a	237.2	100
	TE 200	285.1	a	231.3	a	258.2	109
	TE 2x 100	302.9	b	239.2	ab	271.0	114

Figure 1 Effect of trinexapac-ethyl on number of seed per inflorescence in selected grass species including confidence intervals ($p=0.05$)



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