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Effect of timing and dosage in herbicide application on weed biomass in spring wheat

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Abstract. The biological efficacy of herbicide Mustang (a.i. florasulam +2.4 D ester 6.25+452.5 g l^{-1}) applied at doses 0.6, 0.45, 0.3 and 0.15 l ha^{-1} as compared to untreated areas was evaluated on the number and biomass of weeds in spring wheat in field trials at the Lithuanian Institute of Agriculture in 2003–2005. Herbicide was applied at the 3- leaf stage, at tilling, and at the beginning of stem elongation of cereals.

The best efficacy on weed mass in all years of the experiments was achieved when the herbicide was applied at the 3-leaf stage and during the tilling stage of spring wheat. The weed biomass decreased by 82 to 92% in 2003 and 2004 and by 74–96% in 2005, from 0.3, 0.45 and 0.6 l ha^{-1} doses. When herbicides were applied using higher doses, 0.45-0.6 l ha^{-1}.,during the spring wheat stem elongation stage (BBCH 31-32), the biomass of weeds decreased by 75–95%. When the lowest dose, 0.15 l ha^{-1} of the herbicide Mustang was applied at the beginning of the stem elongation stage of spring wheat, the efficacy on the total fresh mass of weeds was insufficient.

Key words: weeds fresh mass, 2.4D, florasulam, spring wheat

INTRODUCTION

Considerable research has examined the potential use of dosage at less than that indicated on herbicide labels, as. registered doses are set to ensure adequate control over a wide spectrum of weed species, weed densities, growth stages, and environmental conditions (Zhang et al., 2000). However, the results of experiments indicate the possibility of reducing of herbicide doses by approximately 25 to 40%, while still obtaining effective weed control without a significant decrease in the yield of cultivation plants (Domaradzki & Rola 2003; Talgre et al., 2004). Low doses of herbicide can be applied where weeds are in early growth stage, where there is low infestation of weeds, and where weeds show susceptibility to herbicide usage (Auskalnis, 2003; Domaradzki, 2003; Kieloch & Domaradzki, 2003). The results suggest that the use of reduced doses has fewer implications for weed density than has application of a full dose, in some years, and exclusion of herbicides in other years (Bostrom & Fogelfors, 2002; Kudsk & Streibig, 2003).

The aim of this research work was to evaluate the effect of the timing and dose rate of the application of different herbicides on spring wheat weed growth..

MATERIALS AND METHODS

Field experiments were performed in 2003, 2004 and 2005 at the Lithuanian Institute of Agriculture. The trials were conducted in randomized block design with three replicates. Spring wheat was spread with herbicides florasulam +2,4-D 2-ethyl hexyl ester (Mustang®, 6.25 +452.5 g a.i. l^{-1}; Dow Agrosciences) at BBCH 12-13, 21-22 and 31–32 growth stages. The Mustang® -0,6 l ha^{-1}. Herbicide was used at the recommended full dose and at ¾, ½ and ¼ doses; some blocks were not treated with herbicide. The herbicide was sprayed with a compressed nitrogen gas sprayer using a 2.5 m wide boom, at a pressure of 250 kPa, nozzle, 4110-12, spraying speed 1m s^{-1} and a volume rate of 200 L ha^{-1}. Weed assessments were conducted on individual weed species in 4 x 0.25 m^2 per plot 5 weeks after application.

The efficacy of herbicides by number and by mass of weeds was calculated by the following formula:

$E = (M_1-M_2) / M_1*100$ % , where

M_1 – weed number or mass per m^2 on untreated plots;

M_2 – weed number or mass per m^2 on plots treated with herbicides.

Statistical analysis. The experimental data were compared by using an analysis of variance (ANOVA) and, where the F-ratio was significant, the least significant difference (LSD) was calculated for $P < 0.05$. The experimental findings were processed by the correlation regression analysis method.

RESULTS AND DISCUSSION

In 2003, weed density in spring wheat was medium to low, on average. The main weeds in untreated plots were *Stellaria media, Lamium purpureum, Chenopodium album, Galium aparine and Viola arvense*. *Stellaria media* was very sensitive to all dosage of herbicides applied at all three growth stages of spring wheat, except for the 0.15 l ha^{-1} dose at the beginning of spring wheat stem elongation (Fig 1). In general there was no difference in the efficacy on weed mass in spring wheat when the herbicide was applied at the three-leaf stage and at the beginning of tilling. Spraying at growth stage BBCH 31-32 of spring wheat was insufficient. At this time most weeds had more than 6 leaves and were experiencing medium water stress. Only *Stellaria media* and *Chenopodium album* were sensitive to 2,4 D and florasulam.

In 2004, *Chenopodium album, Sonchus arvensis, Euphorbia helioscopia and Silene pratensis* were the most prevalent weeds in spring wheat. Conditions after herbicide application were favourable. All weed species were sensitive to 0.45 and 0.6 l ha^{-1} herbicide Mustang doses sprayed at the 3-leaf and tilling stages (Fig 2). 2.4D and florasulam applied at the spring wheat stem elongation stage were ineffective against *Silene pratensis, Fallopia convolvulus* and *Euphorbia helioscopia*. Results indicate a strong correlation (R = 0,81**) between herbicide dose and efficacy on total weed mass reduction; the relation was expressed by equation $Y = 80.69+4.415 \cdot lgx$.

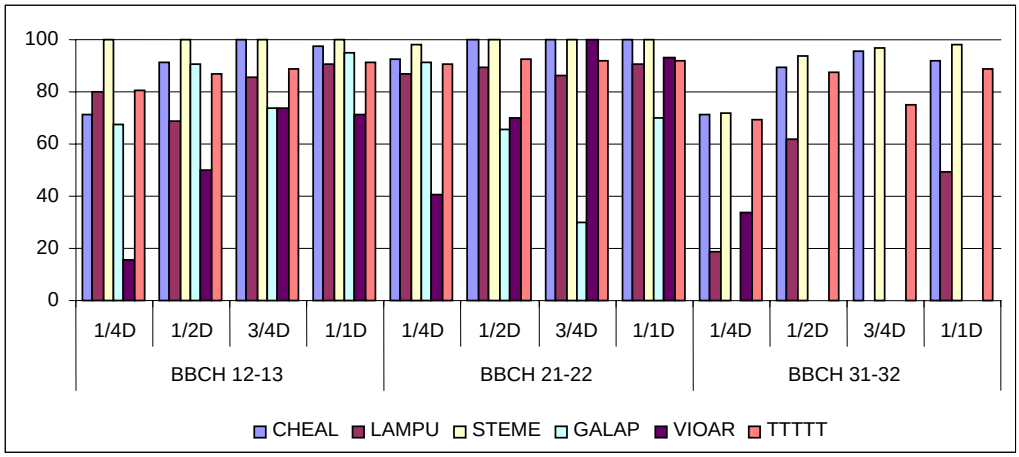

Fig. 1. Efficacy of herbicide on the percentage of fresh weed mass 5 weeks after application in 2003. CHEAL-*Chenopodium album*, LAMPU-*Lamium purpureum*, STEME-*Stellaria media*, GALAP-*Galium aparine*, VIOAR- *Viola arvensis*, TTTTT-total weeds.

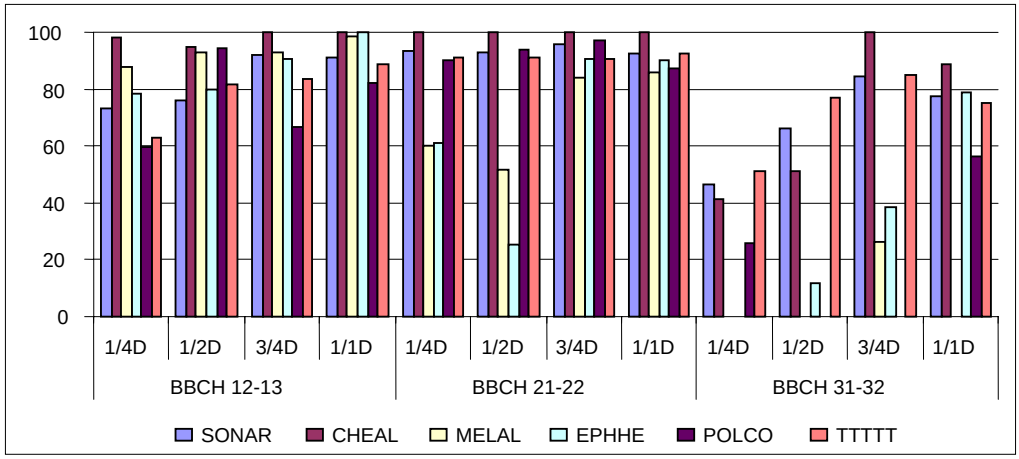

Fig. 2. Efficacy of herbicide on the fresh weed mass 5 weeks after application in 2004. SONAR-*Sonchus arvensis*, CHEAL-*Chenopodium album*, MELAL-*Silene pratensis*, EPHHE-*Euphorbia helioscopia*, POLCO- *Fallopia concolvulus*, TTTTT-total weeds.

In 2005, the main weeds in untreated spring wheat were *Chenopodium album* and *Euphorbia helioscopia* -50 and 25% of total weed mass. Fresh mass of *Chenopodium album* herbicide was reduced from 79 to 100%. Application of herbicides at different growth stages of spring wheat had no significant influence on efficacy of total weed mass. *Euphorbia helioscopia* fresh mass was effectively reduced when 2,4D and florasulam were applied at BBCH 12-13 and BBCH 21-22 growth stages of spring wheat. When herbicides were sprayed at the beginning of spring wheat stem elongation, *Euphorbia helioscopia* was effectively controlled only at full dosage of herbicides (Fig. 3).

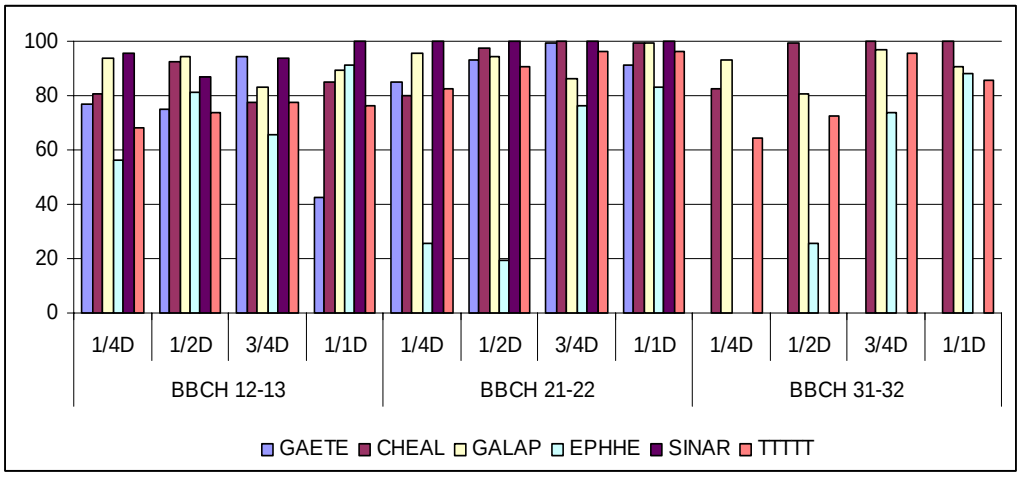

Fig. 3. Efficacy of herbicide on the fresh mass of weeds 5 weeks after application in 2005. GAETE-*Galeopsis tetrahit*, CHEAL-*Chenopodium album*, GALAP-*Galium aparine*, EPHHE- *Euphorbia helioscopia*, SINAR-*Sinapis arvensis*, TTTTT-total weeds.

CONCLUSIONS

The best efficacy on total weed mass in all years of the experiments was achieved when herbicide was applied at the 3-leaf stage and during the tilling stage of spring wheat The most sensitive to the herbicide Mustang (florasulam + 2.4–D 6.25+452.5 g l^{-1}) were *Stellaria media, Chenopodium album, Galeopsis tetrahit* and *Sinapis arvensis*. The total biomass of weeds decreased effectively only byusing higher doses of herbicide 0.45–0.6 l ha^{-1} when it was applied during the spring wheat stem elongation stage. The efficacy of herbicide on fresh mass of *Lamium purpureum, Galeopsis tetrahit, Silene pratensis* and *Polygonum convolvulus* was insufficient when applied after the spring wheat stem elongation stage.

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