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The effect of mulches on *Elytrigia repens* spreading under conditions of organic agriculture

Einfluss von Mulch auf die Elytrigia repens*-Ausbreitung im ökologischen Landbau*

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Abstract

Elytrigia repens is the most important and widely spread perennial weed in Lithuania. Infestation with *E. repens* in organic agriculture is an increasing problem in many parts of Europe. Non-chemical weed management strategies against *E. repens*, based on cultivation tactics and different mulching, have received very high attention for many years. The two factor stationary field experiment was carried out at the Experimental Station of the Aleksandras Stulginskis University. The influence of organic mulches and different thickness of mulch layer on weed density was investigated in 2004–2009, the residual effect of the mulches and mulch layer was studied in 2010–2012.

At the beginning of the experiment higher density of *E. repens* was estimated in plots with straw mulch and lower in plots mulched with peat and grass mulch. In 2007–2009 all investigated organic mulches reduced *E. repens* emergence. Peat, sawdust and grass had the strongest influence on the decrease of *E. repens* re-growth. Significantly higher density of *E. repens* sprouts was estimated in experimental plots mulched with 5 cm mulch layer compared with this in plots mulched with 10cm mulch layer during 2004–2009 except 2007.

The residual effect of all examined organic mulches on *E. repens* spreading was unequal. The previously six years used and incorporated organic mulches did not significantly decrease *E. repens* numbers in 2010–2012 because they do not mechanically suppress weed emergence. The residual effect of mulch layers on *E. repens* sprout numbers was not significant. A tendency of decreased densities of *E. repens* was estimated during the first two years of the mulch residual effect studies.

Keywords: *Elytrigia repens*, organic farming, organic mulch, residual effect of mulch

Zusammenfassung

Elytrigia repens ist das wichtigste und am weitesten verbreitete mehrjährige Unkraut in Litauen. Befall mit *E. repens* in der ökologischen Landwirtschaft ist ein zunehmendes Problem in vielen Teilen Europas. Nicht-chemische Managementstrategien gegen *E. repens*, basierend auf ackerbaulichen Maßnahmen und verschiedenen Mulch-Verfahren, haben eine sehr hohe Aufmerksamkeit seit vielen Jahre erhalten. Der Zwei-Faktoren Feldversuch wurde auf der Versuchsstation der Aleksandras-Stulginskis-Universität durchgeführt. Der Einfluss organischer Mulche und unterschiedlicher Dicke der Mulchschicht auf die Unkrautdichte wurde in 2004-2009 untersucht, und im Zeitraum 2010-2012 wurde die Nachwirkung der Mulchauflagen und der Mulchschichtstärken erfasst.

Zu Beginn des Experiments traten höhere Dichten von *E. repens* in Parzellen mit Strohmulch auf, schwächer in Parzellen mit Torf und Grasmulch. In 2007-2009 reduzierten alle angewandten Mulchverfahren die Entwicklung von *E. repens*. Torf, Sägemehl und Gras hatten den stärksten Einfluss auf die Abnahme von *E. repens*. Deutlich höhere Dichten von *E. repens* wurden auf Versuchsflächen mit 5 cm Mulchauflage im Vergleich mit 10 cm Auflage in den Jahren 2004 bis 2009, außer 2007, festgestellt.

Die Nachwirkung aller untersuchten organischen Mulchauflagen auf die Entwicklung von *E. repens* war unterschiedlich. Die vor 6 Jahren ausgebrachten organischen Mulchauflagen verringerten die Dichte von *E. repens* im Zeitraum 2010-2012 nicht signifikant, weil sie das Unkraut nicht mechanisch unterdrücken. Die Nachwirkung der Mulchauflagen auf die Dichte von *E. repens* war nicht signifikant. Eine Tendenz verringerter Dichte von *E. repens* wurde während der ersten zwei Jahre der Mulch-Nachwirkungs-Studien beobachtet.

Stichwörter: *Elytrigia repens*, ökologischer Landbau, organischer Mulch, Restwirkung des Mulchens

Introduction

The use of organic mulches is a traditional weed control method maintaining soil quality (DONGGEUN et al., 2009). The effectiveness of mulch as weed control means was high in preventing emergence of most annual weeds (HOGUE et al., 2003; NEILSEN et al., 2004). The influence of organic mulches on emergence and re-growth of perennial weeds was unequal (PUPALIENĖ et al., 2015). CLINE et al. (2011) reported chopped cereal straw as a good mulching material providing a durable barrier.

The perennial weed *Elytrigia repens* is the most important and widely spread weed in Lithuania. Infestation with *E. repens* in organic agriculture is an increasing problem in many parts of Europe. Non-chemical management strategies against *E. repens*, based on soil cultivation and different mulching, have received very high attention for many years. According to LICZNAR–MALANCZUK (2014), *Elymus repens* (L.) GOULD (or *Elytrigia repens* (L.) NEVSKI) was found to be the most persistent perennial weed species in the field experiment with living mulches.

The aim of this study was to estimate the influence and the residual effect of organic mulches and the thickness of mulch layers on *Elytrigia repens* density in horticultural crops.

Material and Methods

Study site

A two factor stationary field experiment was carried out at the Experimental Station of Aleksandras Stulginskis University (previously Lithuanian University of Agriculture) (54°53'N, 23°50'E). The mean annual temperature of the study site is 6.0-6.5 °C, mean annual precipitation is 600-650 mm and mean annual length of sun shine is 1750-1800 hours (Lithuanian Hydrometeorological Service). The soil type is *Calc(ar)i– Endohypogleyic Luvisol.*

Design of the experiment

The influence of organic mulches and different thickness of mulch layers on weed density was investigated in 2004–2009, in 2010–2012 the residual effect of the mulches and mulch layer was studied. Treatments of the experiment: Factor A – mulch: 1) without mulch; 2) straw mulch (chopped wheat straw); 3) peat mulch (medium decomposed fen peat); 4) sawdust mulch (from various tree species); 5) grass mulch (regularly cut from grass-plots). Factor B – thickness of mulch layer: 1) 5 cm; 2) 10 cm. Randomised design was used. Individual plot size was 2 x 6 m. The experiment involved 4 replications.

Data collection and analysis

Crops were grown in all experimental plots: common bean in 2004, common onion in 2005, red beet in 2006, white cabbage in 2007, potatoes in 2008, common bean in 2009. In 2010 common onion, in 2011 red beet and in 2012 white cabbage were grown.

In 2004–2009 mulch was spread manually in a 5 cm and 10 cm thick layer shortly after sowing (planting). Remains of the mulch were inserted into the soil by ploughing after crop harvest in autumn.

During all periods of the experiment the crops were grown employing common organic crop production technologies. *E. repens* sprouts were counted in each plot in 4 permanent 0.2 × 0.5 m sites. Assessments were done every 10 days from May to October. During each assessment, the *E. repens* were pulled out and counted. The number of *E. repens* shoots was re-calculated into numbers m^{-2}.

The means were compared using Fisher's protected LSD test at *P*(level) <0.05 with ANOVA procedure with SYSTAT 10 (SPSS, 2000). Data transformations lg(x+1) were used as necessary to achieve statistical normality. Probability level: * = 95%, ** = 99%, *** = 99.9%.

Results

The results of our experiments indicated the non-equal influence of organic mulches on perennial weed *Elytrigia repens* density in different agricultural crops. Only one organic mulch from four investigated is evidently suitable for *E. repens* control. The significantly lower number of *E. repens* sprouts was investigated in experimental plots mulched with grass mulch during all experimental period in 2004-2009 (Fig. 1). Grass mulch effect on germination of many weed species prolonged to the middle of summer (JODAUGIENĖ et al., 2006; MUNIKIENĖ et al., 2014), but it had significant effect on *E. repens* density. From the beginning of experiment the tendency of increasing *E. repens* density in plots with straw mulch was established. A lower density of this perennial weed in straw mulched plots was investigated after 4 years from the beginning of experiment. In 2009, significantly lower density of *E. repens* was investigated in all mulched plots. Significantly lower *E. repens* sprout numbers were observed in plots mulched with peat in 2004, 2005, 2008 and 2009.

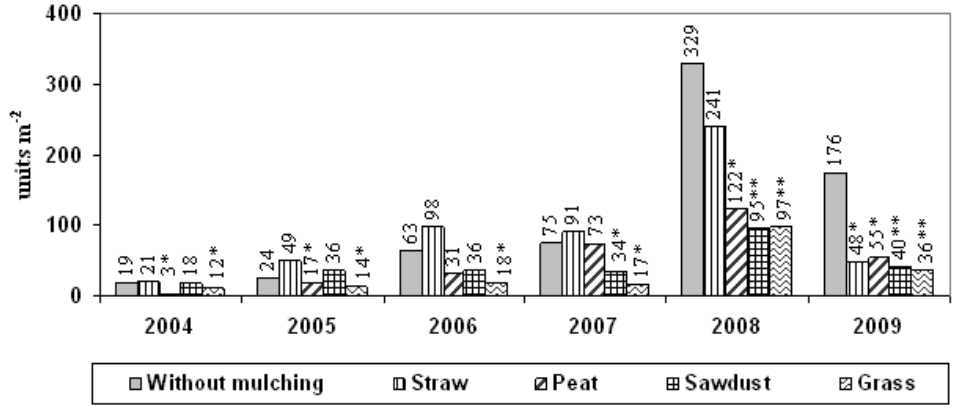

Fig. 1 The influence of organic mulches on *Elytrigia repens* density, 2004-2009. * = 95% probability level, ** = 99% probability level.

Abb. 1 *Einfluss von organischem Mulch auf die Dichte von Elytrigia repens 2004-2009. * = 95 % Wahrscheinlichkeit, ** = 99 % Wahrscheinlichkeit.*

Sawdust mulch was indicated as organic mulch suppressing no weeds but also agricultural plants (SINKEVIČIENĖ et al., 2009). The density of *E. repens* was significantly lower in plots mulched with sawdust in 2007-2009. At the beginning of the experiment a significant influence of sawdust mulch on *E. repens* density was not established.

The thicker 10 cm mulch layer is a good mean for *E. repens* control in organic farming system. Significant differences of *E. repens* sprout numbers were obtained between experimental plots mulched with 5 cm mulch layer and 10 cm mulch layer except 2007 (Fig. 2).

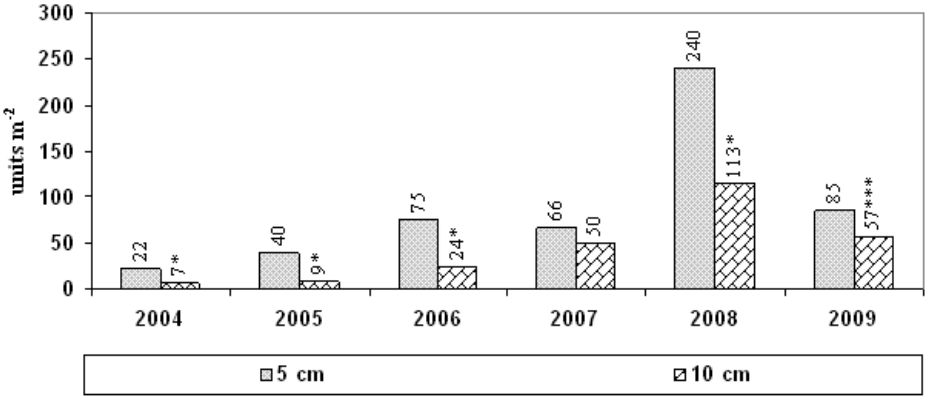

Fig. 2 The influence of different thickness of mulch layer on *Elytrigia repens* density, 2004-2009. * = 95% probability level, *** = 99.9% probability level.

Abb. 2 *Einfluss der Stärke der organischen Mulchlage auf die Dichte von Elytrigia repens, 2004-2009. * = 95 % Wahrscheinlichkeit, *** = 99,9 % Wahrscheinlichkeit.*

During the period when the residual effect of organic mulches was examined the *E. repens* density in not-mulched plots and plots mulched with organic mulches varied (Fig. 3). It belonged not only on mulch type, but also on other reasons. Such as agricultural crop and its smothering ability, meteorological conditions, crop density in experimental plots. White cabbage in 2012 suppressed weeds better than common onion in 2010 or red beet in 2011.

The tendency of lower *E. repens* density in plots previously mulched with sawdust was investigated. The significant residual effect of sawdust on *E. repens* density was observed in 2011. The number of *E. repens* sprouts in plots previously mulched with straw became higher in 2010, the first year without organic mulches. The lower number of *E. repens* sprouts in plots previously mulched with straw was obtained in 2011 and 2012. The tendency of lower density of *E. repens* in plots with grass mulch prolonged by 3 years of experiment.

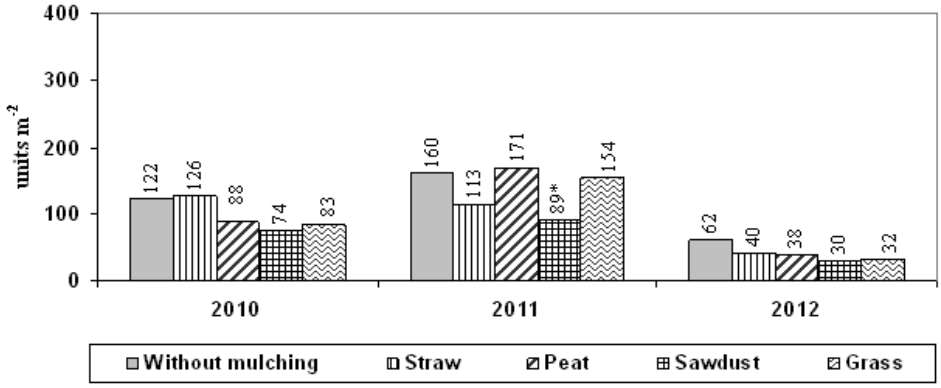

Fig. 3 Residual effect of organic mulches on *Elytrigia repens* density, 2010-2012. * = 95 % probability level.

Abb. 3 *Nachwirkung von organischem Mulch auf die Dichte von Elytrigia repens, 2010-2012. * = 95 % Wahrscheinlichkeit.*

The residual effect of mulch layers on *E. repens* sprout number was not significant. In the first and the second year of the investigation of residual effect of mulch layers the density of *E. repens* sprouts was 8.4 – 11.5% lower in plots mulched with thicker mulch layer (Fig. 4). In 2012 the density of *E. repens* sprouts was equal in plots previously mulched with different mulch layers.

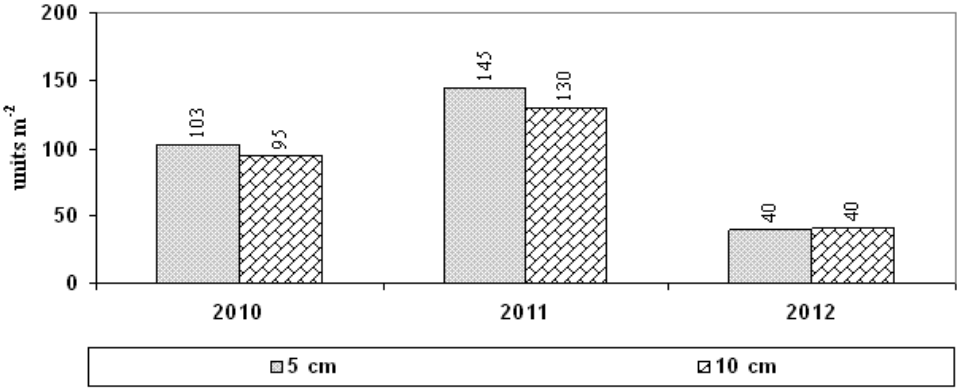

Fig. 4 Residual effect of the thickness of organic mulch layer on *Elytrigia repens* density, 2010-2012. P > 0.050.

Abb. 4 *Nachwirkung der Stärke der organischen Mulchlage auf die Dichte von Elytrigia repens, 2010-2012. P > 0,050.*

The organic mulches' effect as a barrier is more important for the control of this perennial weed compared with allelopathic effects.

Discussion

At the beginning of the experiment higher density of *E. repens* was investigated in plots with straw mulch and lower in plots mulched with peat and grass mulch. In 2007–2009 all investigated organic mulches reduced *E. repens* emergence. But there is an opposite opinion: PUSZTAI (2010) summarized the results of a six years' field experiment and concluded that only plastic foil mulch as soil cover can be a possible solution for non-chemical weed control of *E. repens*. Organic mulches (grass, weed clippings, legume clippings) did not significantly reduce *E. repens* density in tomato crop. Legume clippings mulch and grass clippings mulch were competitive mulching methods regarding total yield of tomato but their weed management effect was weak. Other investigated organic mulches (peat, sawdust and grass) had a stronger influence on the decrease of *E. repens* re-growth. GAISLER et al. (2008) recommended grass mulching applied at least twice a year as suitable way for non-chemical restriction of perennial weeds such as *Cirsium arvense* or *Elytrigia repens*. Significantly higher number of *E. repens* sprouts was investigated in experimental plots mulched with 5 cm mulch layer compared with this in plots mulched with 10 cm mulch layer during 2004–2009 except 2007. The residual effect of all examined organic mulches on *E. repens* spreading was unequal. The previously six years' use and incorporation of organic mulches did not significantly decrease *E. repens* density in the following years 2010–2012 because they do not mechanically suppress weed emergence. The residual effect of mulch layers on *E. repens* sprout numbers was not significant. A tendency of decreased density of *E. repens* was observed during the first two years of the mulch residual effect studies.

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