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The impact of different types of organic mulches on weed emergence

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Abstract. A two – factor experiment was carried out in the Experiment Station of Lithuanian University of Agriculture in 2004 – 2005. Different organic mulches, chopped wheat straw, peat, wood chips, grass and wood chips, and wood chips which had been stored for 8 years (only in 2005) were overspead by a layer of 5 cm and 10 cm thickness. The influence of different organic mulches on weed emergence was evaluated. All organic mulches reduced weed germination. The positive effect of mulches was particularly obvious in the period of intensive germination of weeds. Straw, peat and wood chips had the strongest influence on the decrease of weed germination, however, it is important to make sure that mulches are not infected with weed seeds. Mulch of chopped grass is quick to decompose, therefore, repeated mulching is required to protect the crop from weeds.

Key wods: organic mulches, weed emergence, annual weeds, perennial weeds

INTRODUCTION

Weeds remain one of the most significant agronomic problems, especially on organic farms, because weed control can only be carried out without herbicides. There is a strong interest in developing alternative methods of weed control in organic agriculture (Economou et al., 2002). Mulching as a weed control method is used in agriculture throughout the world (Gupta, 1991). Organic mulches are more popular in cropping systems, as they can suppress weeds, while at the same time reducing soil tillage for weed control, under any tillage system implemented (Bilalis et al., 2003). Residue of small grains has been shown to inhibit weed emergence and growth in cropping systems by allelopathy (Putman, et al., 1983; Blum et al., 1997). Since weed seed germination is affected by soil moisture and temperature, mulch not only suppresses weeds, but. also maintains soil moisture at higher levels compared with unmulched soil (Sharma & Achraya, 2000; Edwards et al., 2000). Crop residues overspread on soil surfaces decrease soil temperature in the hot season and maintain it in autumn (Bristow, 1988; Duppong et al., 2004).

The aim of this investigation was to evaluate the influence of different organic mulches on weed emergence.

MATERIALS AND METHODS

The two – factor field experiment was carried out in the Pomological Garden of Lithuanian University of Agriculture (54°53'N, 23°50'E) in 2004–2005. The soil type: *Calc(ar)i-Endohypogleyic Luvisol*. Soil texture: medium clay loams on heavy clay loams and clays. Soil pH_{KCl}-6.3, the content of total nutrients in the soil: 141.3 mg kg^{-1} of phosphorus, 142.8 mg kg^{-1} of potassium.

Scheme of the experiment: 1) no mulching; 2) wheat straw; 3) peat; 4) wood chips; 5) grass; 6) wood chips after storing 8 years (only in 2005).

Individual plot size was 2x6 m^2, with each plot replicated 4 times. In 2004, *Phaseolus vulgaris* L. variety *Baltija,* and in 2005, m .– *Allium cepa* L. variety *Stuttgarten Rysen* in rows with interlinears 0.5 m were grown in each plot.

Botanical surveys were carried out on 0.2x0.5 m areas, four in each plot, every 10 days from 06 10 until 10 10. Weed sprouts were counted and removed.

The means were compared using the least significant difference test at $P_{(level)} < 0.05$ with SYSTAT 10 (SPSS Inc., 2000).

RESULTS AND DISCUSSION

The investigations showed that mulching of soil with various organic mulches is particularly important in the first part of summer. In the second part of summer and in early autumn, weed emergence is weaker in comparison with that in spring and early summer, therefore, mulch has less influence. According to the data of 2004, wood chips have the longest impeding effect on weed germination (Table 1). In the plots that have been mulched with wood chips at the beginning of summer, weed biomass was established to be 5.4–11.4 times lower than that in the plots without mulching. Peat, straw and chopped grass provides different reducing impact on weed germination. Straw mulch has the most obvious reducing impact (3.5–14.1 times) on weed emergence in June.

Table 1. The influence of different organic mulches on weed emergence, sprouts m^{-2} 2004.

Sampling time	Factor A				
	No mulching	Wheat straw	Peat	Wood chips	Grass
06 10	440,6	31,2***	62,6***	38,8***	24,7***
06 20	204,4	58,1***	44,1***	38,1***	26,2***
06 30	233,4	45,9***	46,6***	25,9***	25,9***
07 10	144,0	85,6***	34,1	20,9***	52,5***
07 20	54,7	113,1	38,1	30,0**	66,2
07 30	50,6	33,1	22,2*	11,6***	45,3
08 10	67,5	40,9**	30,9*	23,4**	44,4**
08 20	54,7	33,4*	20,6*	23,4**	38,4
08 30	34,4	20,3*	18,1*	16,9**	32,2
09 10	25,0	13,4	10,3	14,1	23,1
09 20	5,3	5,3	7,5	6,2	18,1
09 30	25,3	15,0	5,3***	15,0*	29,4
10 10	25,6	20,6	5,0***	16,6	31,6
10 20	13,4	6,6*	2,8***	8,1***	12,5
Total	1378,9	522,5*	348,2**	289,0***	469,5**

- 95 % probability level, ** - 99 % probability level, * - 99,9 % probability level*

Table 2. The influence of different organic mulches on weed emergence, sprouts m^{-2}, 2005.

Sampling time	Factor A					
	No mulching	Wheat straw	Peat	Wood chips	Grass	Wood chips after storing 8 years
06 10	207,5	4,1***	65,6***	43,5***	6,3***	43,3***
06 20	436,3	14,1***	65,9***	56,0***	23,4***	90,4***
06 30	95,6	22,8***	36,6***	45,9***	16,6***	57,9**
07 10	76,3	22,5***	18,1***	38,4**	8,8***	20,8***
07 20	25,6	15,6	24,7	29,0	5,3**	10,0*
07 30	41,3	13,4***	5,6***	18,4***	16,7***	10,0***
08 10	30,0	10,1***	6,3***	11,6***	7,8***	3,8***
08 20	43,8	6,6***	5,3***	7,5***	40,3	9,5***
08 30	66,3	11,9***	14,0***	11,6***	56,3	14,6***
09 10	31,0	6,6**	11,0**	4,7***	30,0	7,1**
09 20	77,5	26,3**	17,8***	20,3***	84,7	17,0***
09 30	126,3	19,1*	82,2	9,4**	209,4	5,8**
10 10	95,6	22,8	31,3	7,5	158,1	14,2
Total	1353,1	195,8*	384,4**	303,8**	663,7*	304,4**

- 95 % probability level, ** - 99 % probability level, * - 99,9 % probability level*

Later, however, after the abundant appearance of *Tripleurospermum perforatum* (Merat.) L., the seeds of which have infected the mulch, the weed biomass is higher than that in the soil without mulch (July 20). After most seeds of *Tr. perforatum* have germinated, the positive influence of mulch is apparent once again. At the beginning of summer, peat has a slightly weaker impeding effect on weed emergence (4.2–7.0 times), but is uniform during the entire investigational period. The positive effect of grass mulch is manifested at the beginning of the investigations and reduces weed germination from 17.8 to 2.7 times. Later, after decomposition of grass has started, this mulch has no important influence. In the soil mulched with various organic mulches, the number of weeds that germinate in one square meter during the entire vegetation period varies from 289.0 to 522.5. In the soil without mulch this number reaches 1378.9 sprouts. Experiments conducted in Hungary indicated that mulching with straw, grass and other materials showed good results in weed control (Radics & Bognar, 2004).

Even stronger positive influence of mulches on the decrease of weed emergence was determined in 2005. In contrast to that in previous years, straw mulch was the best to reduce weed germination, as the mulch itself was not infected with weed seeds (Table 2). A number of studies have documented that straw mulch is a good means of decreasing weed emergence (Petersen & Röver, 2005; Ramakrishna et al., 2005). Although Döring et al. (2005) stated that there was no significant effect of straw mulch on the number of weeds, they explain that it was mainly attributed to the small amounts of straw applied.

The number of weeds that germinated in the beginning of summer in mulched soils was by 30.9–50.6 times lower than that in the soils without mulch. Later, this positive influence weakened, but remained for the entire vegetation period. Peat had a similar influence to that in the previous years of investigations. Peat, both fresh and stored for 8 m, had a similar important influence on the reduction of weed germination

during the entire vegetation period. During the vegetation period, 303.8–304.4 weeds germinated in the soil covered with wood chips, while in the soil without mulch this number was larger by 4.4 times (1353.1 sprouts m^{-2}).

The effect of chopped grass remained until the first week of August, the number of germinated weeds being significantly smaller (by 2.0–32.9 times) than that in the soil without mulch. Later, however, the weed emergence became equal and even started increasing, due to the rapid germination of *Poa annua* L., which might have infected the mulch used. During the entire vegetation period, grass mulch decreased the germination of weeds by 2.0 times in comparison to that in the soil without mulch.

CONCLUSIONS

All organic mulches reduce weed germination. The positive effect of mulches is particularly obvious in the period of intensive emergence of weeds. Straw, peat and wood chips have the strongest influence on the decrease of weed germination, however, it is important to make sure that mulches are not infected with weed seeds.

Mulch of chopped grass is quick to decompose, therefore, repeated mulching is required to protect the crop from weeds.

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