AFPP – 6e CONFÉRENCE SUR LES MOYENS ALTERNATIFS DE PROTECTION POUR UNE PRODUCTION INTEGRÉE
LILLE – 21, 22 ET 23 MARS 2017

SURVEY OF MULCHES APPLICATION FOR WEED CONTROL IN *MENTHA X PIPERITA* CULTIVATION

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ABSTRACT
Basic features of various mulching materials and the most important characteristics (number and biomass) of each weed species that managed to break through the mulch barriers are presented in this paper. Survey of 9 organic mulches (straw, chopped pieces of the pine bark, sawdust of acacia, cardboard, dry pine needles, chopped maize sedge, chopped pieces of the acacia bark, herbal composts 1 and 2), 1 biodegradable (black mulch film) and 4 plastic mulch films (silver-brown, perforated black, black, black "agrotextil") were tested in *Mentha x piperita* experimental cultivation, located in Serbia. The most common weed species recorded were *Agropirum repens, Avena fatua, Picris hieracioides, Setaria viridis* and *Rumex crispus*. The number and biomasses of all weed species were measured once in a season, prior to the first harvest of *M. piperita*. Comparing to control treatment, 12 out of 14 mulches applied as a weed control method prove to have beneficiary effects in mint cultivation, influencing both, the occurrence (9.7 – 100%) and the weeds biomasses (30 – 100%). Six of them were selected for further investigation.

Keywords: *Mentha x piperita*, mint, weed, mulch film, mulch.

INTRODUCTION

Mint (*Mentha x piperita*) is a perennial, medicinal and aromatic, cultivated plant species belonging to Lamiaceae family. Due to its wide use in pharmaceutical, food and cosmetic industries it is considered as one of the most important aromatic plants in the world.

As to the best of our knowledge, in Serbia, in 2016., ca. 200 ha of the arable soil is covered by this plant species. In comparison to production of other medicinal and aromatic plants (MAPs) in our country, mint takes the second place, after German chamomile (*Chamomilla recutita*). The main problem in its production is a weed control, as during its cultivation no pesticides have been used. This usually cases nearly half of all the losses experienced during mint production. Therefore, the application of ecologically acceptable alternative methods for weed control is prerequisite.

The methods which could be used in MAPs production are the most similar with the principals for weed suppression in organic farming (Radanović and Nastovski, 2002). The use of mulching as a control method already proved its positive effects (Sharma and Sharma, 2003; Singh *et al.*, 2007; Jodaugienė *et al.*, 2012; Parmar *et al.*, 2013; Yeganehpoor *et al.*, 2015). According to the literature data, the main advantages of mulching are reduction of weedness (Parmar *et al.*, 2013) and positive influences on the soil moisture, structure and temperature (Liebman and Dyck, 1993; Unger P., 1978; Sinkevičienė *et al.*, 2009). Since, the mint is Mediterranean plant species which needs enough water during the summer period, mulching is seems to be a good option for saving soil water and preventing its evaporation.

The aim of this study was to evaluate 14 different mulches on weeds suppression in cultivation of *Mentha x piperita* in Serbian agroecological conditions, in order to select the most effective ones for further investigation.

MATERIAL AND METHODS

Field studies were established in Pančevo, Serbia (44°52'20.0"N, 20°42'04.7"E). In order to compare the effects of physical weed control methods, following 9 organic mulches were investigated: straw, chopped pieces of the pine bark, sawdust of acacia, cardboard, dry pine needles, chopped maize sedge, chopped pieces of the acacia bark, herbal composts 1 and 2, biodegradable black mulch film, in addition to following 4 plastic mulch films: silver-brown, perforated black, black and black agrotextil.

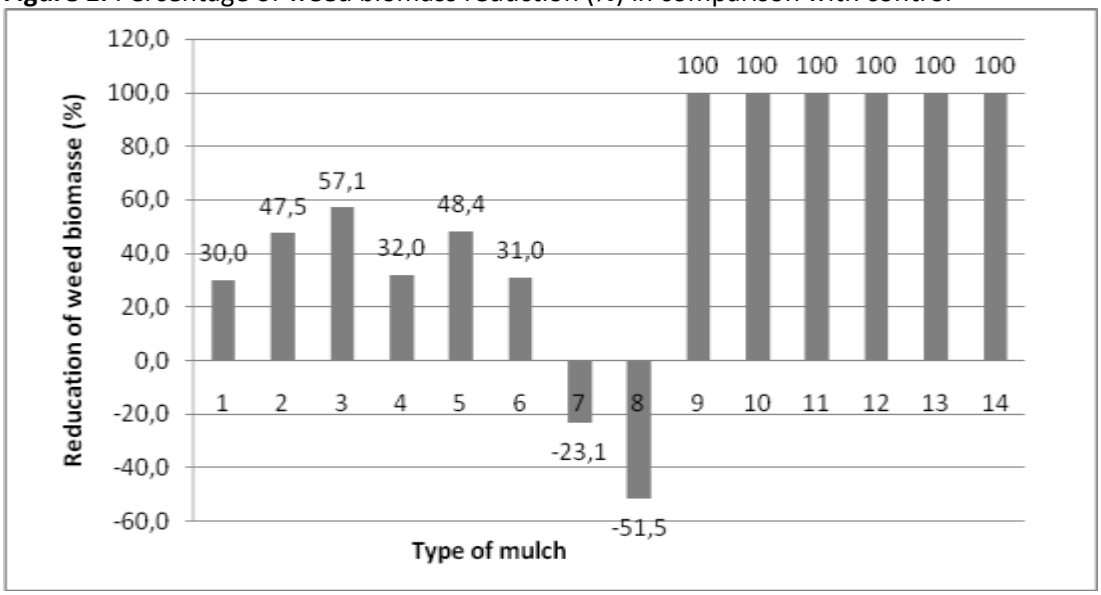
Experimental cultivation of *M. piperita* was established in the fall of 2014., by planting its stolons in the rows (spacing 0,7 m). The mulches layers ranged from 5 to 10 cm, and they were spread over the soil surface between the rows with mint, in the early spring of 2015.

In the treatments, the weeds were left intact till the first *M. piperita* harvest, while the control treatment was kept intact during the entire mint production period (no weed removal). The weed samples were collected from randomly chosen 1 m^2, from each treatment in 3 replicates. In the samples, the weed species were determined in laboratory conditions. The individual plants were first counted, and then the entire dry biomass per weed species was separately measured for each sample (repetition). The positive effects of applied mulches were estimated based on weed biomass reduction (%), while the numbers of individual plants belonging to different weed species collected between the mint rows were compared with the control treatment.

RESULTS AND DISCUSSION

The results of the most abundant weed species in the weed biomass collected between the mint rows covered by 14 different mulches and films, are presented in Figures 1 & 2, as well as in Table 1.

Figure 1. Percentage of weed biomass reduction (%) in comparison with control

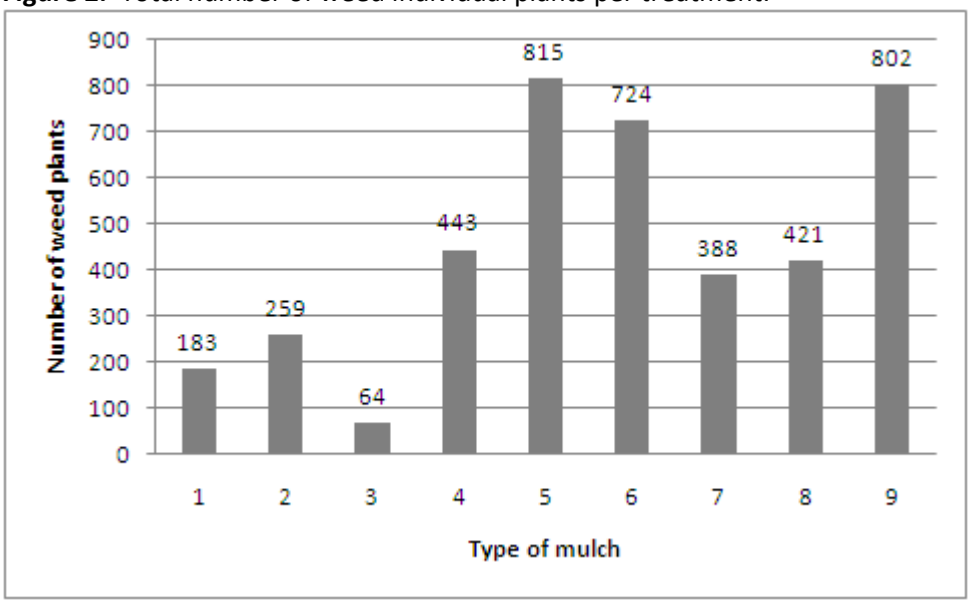


Legend: 1 – straw; 2 – chopped pieces of the pine bark; 3 – sawdust of acacia; 4 – dry pine needles; 5 – chopped maize sedge; 6 – chopped pieces of the acacia bark; 7 – herbal compost 1; 8 – herbal compost 2; 9 – cardboard; 10 – biodegradable film; 11- silver-brown film; 12 - perforated black film; 13 – black film; 14 – black "agrotextil".

As it could be seen from the Figure 1., the presence of weed species in mint cultivation, depends on the applied mulch type; following 6 mulches proved to be best in reduction of weed biomass (100%): 9 – cardboard; 10 – biodegradable film; 11- silver-brown film; 12 - perforated black film; 13 – black film; 14 – black "agrotextil". Other 6 mulches (1 – straw; 2 – chopped pieces of the pine bark; 3 – sawdust of acacia; 4 – dry pine needles; 5 – chopped maize sedge; 6 – chopped pieces of the acacia bark) were also effective in weed suppression, though in incidence ranging from 30 to 57,1%, depending on the mulch type. Since, under mulches presented in the figure 1 with numbers from 9 – 14, no weeds ever appeared, counting of the weed species never happened. On the other hand, two mulches – the herbal composts 1 and 2, expressed negative effects on weeds reduction in mint cultivation. Generally, the main problem with all herbal composts is their frequent contamination by the seeds of other plants, whether they are cultural plants or weeds (Božić *et al.*, 2015). This feature makes them not so appropriate for a weed - suppression mulch in any organic cultivation, though Kamariari *et al.* (2014) showed the opposite in cultivation of two medicinal plants, *Sideritis scardica* and *Echinacea purpurea*.

Our results closely match findings of many other researchers studying the effect of different organic mulches on weed suppression (Duppong *et al.*, 2004; Döring *et al.*, 2005; Fontana *et al.*, 2006; Broschat, 2007; Błażewicz-Woźniak *et al.*, 2011; Filipović *et al.*, 2012; Ascard *et al.*, 2014; Matković *et al.*, 2015). Numerous studies have been devoted to application of the straw mulch in vegetable crops, as one of the best known and most commonly used; Jodaugiene *et al.* (2006) examined it in cultivation of beans and onions, while Ramakrishna *et al.* (2005) in peanuts, and in both studies the weeds has been significantly reduced. In our study, the straw mulch proved to have the worst positive effect achieved in reduction of the weed biomass in comparison to control treatment (Figure 1). Although it proved efficacy, the majority of mulches used in our experiment showed better results. The main reason for such a weak reduction achieved by the straw is a partial losing of this mulch caused by the strong wind present in our experimental area, in Pančevo.

Figure 2. Total number of weed individual plants per treatment.



Legend: 1 – straw; 2 – chopped pieces of the pine bark; 3 – sawdust of acacia; 4 – dry pine needles; 5 – chopped maize sedge; 6 – chopped pieces of the acacia bark; 7 – herbal compost 1; 8 – herbal compost 2; 9 – control treatment.

Although, the weed biomass reduction was not low for chopped maize sedge (48,4 %), a number of present weed species was the highest under it (Figure 2). This can be explained by the fact that present plants during the sampling were just germinating or were seedlings. For example, *Setaria viridis* is presented in the Table 1., with a huge number of individual plants (589) but they were all seedlings, which is also obvious from its low dry biomass (91 g). Similarly, in the treatment with chopped pieces of the acacia bark mulch, a large number (350) of *Agropyrum repens* plants was present as seedlings whose total dry biomass was only 132,5 g. Contrary to result obtained for the chopped maize sedge mulch, all other treatments showed lower total number of weed individuals in comparison to the control treatment (Table 1, Figure 2).

Table 1. Amount of the most common weed species per treatments.

Weed species	**Treatments**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Control**
Agropyrum repens	21	18	7	96	103	**350**	115	115	**616**
Avena fatua	43	19	5	30	14	21	57	26	18
Picris hieracioides	0	3	0	10	29	27	0	4	20
Setaria viridis	8	115	3	223	**589**	252	52	136	84
Rumex crispus	6	2	1	3	0	2	1	3	6

1 – straw; 2 – chopped pieces of the pine bark; 3 – sawdust of acacia; 4 – dry pine needles; 5 – chopped maize sedge; 6 – chopped pieces of the acacia bark; 7 – herbal compost 1; 8 – herbal compost 2.

CONCLUSION

Most of the mulches (12 out of 14) tested in this experiment may be considered as a choice for a weed control in *Mentha piperita* cultivated in Serbia. Their efficacy ranged from 30-100% and proved to depend on their properties. In our study, following 6 mulches proved very promising results (100% efficiency in comparison to the control treatment): cardboard, biodegradable film, silver-brown film, perforated black film, black film, and black "agrotextil", so we will include them in our further studies.

ACKNOWLEDGEMENT

We are grateful to the Ministry of Education, Science and Technology of Republic of Serbia for supporting this investigation (Project III46008).

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