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Herbigation in a Cherry Orchard – Efficiency of Pendimethalin

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Abstract

The efficiency of the soil systemic selective herbicide pendimethalin (Stomp 33 EC) was studied when applied in a cherry orchard through the microirrigation system. The investigation was carried out in 2005-2007 on *Fluvisol* with the following variants: 1) application through a system for undertree microsprinkling (MS); 2) application through a drip irrigation system (DI); 3) standard treatment using a backpack sprayer (BS); and 4) non treated control (Ctrl.). Pendimethalin was applied at a rate of 6 Lha^{-1} in the period 20-25 March, before the beginning of vegetation. A proportional dosing pump "Dosatron" was used for injecting the herbicide in the irrigation system. The herbicide efficiency on 16 annual weed species, forming the weed association within the row strip of a young sweet cherry orchard, was estimated every 30th day after the date of treatment using the count-weight method. The effect of the herbicide treatments on soil micro-flora was studied, too. The results showed that microirrigation could be successfully used for herbicide application in orchards. In all treated variants the post-treatment herbicide effect of pendimethalin lasted three to four months, depending on the row strip shadowing by trees. Herbigation had no negative effect on both the tree growth and yielding and the soil microbial activity. The best herbicide efficiency was established in the variant of microsprinkling herbigation. According to the obtained results, herbigation could be considered an efficient and ecologically sound approach for weed control in modern fruit production.

INTRODUCTION

Optimizing the chemical control of weed infestation is an important prerequisite for increasing the efficiency and the ecological soundness of fruit production. Studies on the possibilities of applying herbicides with irrigation water (herbigation) deserve attention because of the possibility for reasonable use of the microirrigation systems and optimizing the chemical control of weed vegetation.

Data for the use of herbigation for weed control were reported by Fisher et al. (1985), Dale (1986), Devine (1988), Fourie (1988), Mannini (1990) and Sujith et al. (2003).

The objective of this paper is the efficiency of the soil systemic selective herbicide pendimethalin (Stomp 33 EC) when applied through the microirrigation system – drip and microsprinkling. Presented results are from an experiment carried out in 2005-2007 on the territory of the Fruitgrowing Institute in Plovdiv, Bulgaria.

MATERIAL AND METHODS

The pendimethalin efficiency was studied on alluvial-meadow soil (*Fluvisol*) in a young sweet cherry orchard with two cultivar/rootstock combinations– 'Bigarreau Burlat'/'Wild Cherry' (6 x 4 m) and 'Lapins'/'Gisela 5' vegetative rootstock (4 x 2m).

Three variants of herbicide application and a non treated control were set in each cultivar/rootstock plot as follows: 1) application through a system for undertree microsprinkling (MS); 2) application through a drip irrigation system (DI); 3) standard treatment using a backpack sprayer (BS); and 4) non treated control (Ctrl.)**.** The herbicide was applied in the period 20-25 March, before the beginning of vegetation. The application rate for all treated variants was 6.0 L ha^{-1}. A proportional dosing pump (DOSATRON INTERNATIONAL, Bodeaux, France) was used for injecting the herbicide in the irrigation system.

The microsprinkling system consisted of one irrigation lateral per row with microsprinklers located at 1.0 m distance along the row; working pressure of 0.2 MPa, discharge 25 l/h and effective radius 1.0 m. Thus, the irrigation water and the agrochemicals dissolved were evenly dispersed within a row strip of 2.0 m width. The drip irrigation system had two parallel irrigation laterals per row, located at 0.5 m on both sides of the trees, with drippers located at 1.0 m along the laterals; discharge of 2.0 l/h and working pressure of 0.1 MPa. Drip irrigation was also planned to wet a row strip of 2.0 m width. The BS and Ctrl variants were drip-irrigated in the same way as in DI variant. The irrigation and herbicide application rates were equal in all the variants.

The herbicide efficiency on 16 annual weed species, forming a weed association within the row strip of a young sweet cherry orchard, was estimated 30, 60, 90 and 120 days after the date of treatment using the count-weight method. For this, the stems of all weed plans in three 1.0 m^2 plots, randomly spread in the row strip of each variant, were counted and then the above-ground parts cut at the soil surface. The plants were separated by species and weighed for estimating of their fresh mass.

The effect of herbicide treatments on soil micro-flora was studied in dynamics using the method of soil samples (Alef, 1995) from 0-10 cm and 11-20 cm soil layers, after mixing the soil taken in three locations along the row strips. This method is modification of the method of Stotzky, 1965. Soil sampling was done 7, 15, 30 and 60 days after the herbicide application.

RESULTS AND DISCUSSION

The weed species found in the row strip during the three vegetations were as follow: ivy leaf speedwell (*Veronica hederifolia* L.), common chickweed (*Stellaria media L.*), common windgrass (*Apera spica venti L.),* purple deadnettle (*Lamium purpureum L.*), common groundsel (*Senecio vulgaris L.*), common sow thistle (*Sonchus oleraceus L.*), horseweed (*Erigeron canadensis L.*), shepherd's purse (*Capsella bursa pastoris L.*), spiny sow thistle (*Sonchus asper L.*), Henbit deadnettle (*Lamium amplexicaule L.*), redroot amaranth (*Amaranthus retroflexus L.*), rough cocklebur (*Xanthium strumarium L.*), purslane (*Portulaca oleracea L.*), prostrate knotweed (*Polygonum aviculare L.*), green foxtail (*Setaria viridis L.*) and pricky lettuce (*Lactuca serriola L.*).

The efficiency of pendimethalin is illustrated on Figures 1 to 4 as the number and the fresh mass of weed plants per square meter in each cultivar/rootstock plot, averaged for the three experimental years.

Thirty days after the application of pendimethalin, weed plants were not found in all treated variants of both cultivar/rootstock plots (Fig. 1 and 2). For comparison, in the

non-treated control there were 24 weed plants per square meter with total fresh mass of 16 grams. Hence, at that time the herbicide efficiency under microirrigation did not differ from that under the standard treatment.

On the 60-th day, again, there were no weeds in the variant of microsprinkling herbigation – 1 pce m^{-2} with fresh mass of 25 g m^{-2} and 5 g m^{-2} respectively. At that time, the efficiency of drip herbigation was little higher but still comparable with that of the standard treatment – 20 pcs m^{-2} (44 g m^{-2}) and 7 pcs m^{-2} (6 g m^{-2}) respectively for both cultivar/rootstock plots in the DI variant versus 16 pcs m^{-2} (27 g m^{-2}) and 1 pce m^{-2} (1 g m^{-2}) in the BS variant. The weeds found in these treatments were of the species *Erigeron canadensis L.*, *Portulaca oleracea L.* and *Senecio vulgaris L.*. In the control variant there were 40 weed plants per square meter with fresh mass of 38 g m^{-2}. Still the efficiency of microirrigation herbigation is as good as the standard treatment and even better under microsprinkling.

Three months after the herbicide treatment, a tendency towards ending of the herbicide action was observed in all variants of the 'Bigareau Burlat'/'Wild Cherry' plot – 6 pcs m^{-2} (62 g m^{-2}) for MS, 6 pcs m^{-2} (28 g m^{-2}) for DI, and 10 pcs m^{-2} (47 g m^{-2}) for BS versus 19 pcs m^{-2} (119 g m^{-2}) in the Ctrl. At that time, fewer weeds were counted in DI and BS variants compared to the 60-th day because, meanwhile, some of the early-spring species had finished their vegetation. In the 'Lapins'/'Gisela' plot, however, the herbicide efficiency was still very good – 1 pcs m^{-2} (20 g m^{-2}) for MS, 2 pcs m^{-2} (19 g m^{-2}) for DI, and 2 pcs m^{-2} (7 g m^{-2}) for BS variant. The most probable explanation for this was the more effective shadowing of the row strip, which resulted from the higher tree density (4 x 2 m versus 6 x 4 m in 'Bigareau Burlat'/'Wild Cherry' plot). Thus, without direct sun radiation, the action of soil herbicides lasted longer.

Regarding eventual phytotoxic effect of pendimethalin on fruit trees, there was no statistically proven evidence that the growth and the yield were affected by any of the investigated variants of herbicide application.

Data concerning the effect of the herbicide application method on the soil microbial activity, expressed as emission of CO_2 from soil for one hour, are presented in Table 1. As for the herbicide efficiency, there were no statistically proven differences found between the variants of treatment and the control for all dates of soil sampling in a 60-day period, except for the microsprinkling in 7^{th} day, where increment of soil respiration was observed, 11.3 mg h^{-1} kg^{-1}. Probably, this is a stimulation effect of the application method of the herbicide.

CONCLUSIONS

The results showed that microirrigation could be successfully used for herbicide application in orchards. In all treated variants the post-treatment herbicide effect of pendimethalin lasted three to four months, depending on the row strip shadowing by trees. Herbigation had no negative effect on both the tree growth and yielding and the soil microbial activity. The best herbicide efficiency was established in the variant of microsprinkling herbigation. According to the obtained results, herbigation could be considered an efficient and ecologically sound approach for weed control in modern fruit production.

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Tables

Table 1. Soil respiration (mg h^{-1} kg^{-1} of soil) by treatments and days after the pendimethalin application – average of two experimental years.

Treatments	Days after application			
	7	**15**	**30**	**60**
Microsprinkling	11.3	7.8	10.8	15.9
Drip irrigation	5.8	6.6	9.2	13.8
Back pack spraying	5	7.2	10	13.3
Non treated control	6.3	7.9	10.4	12.6

Figures

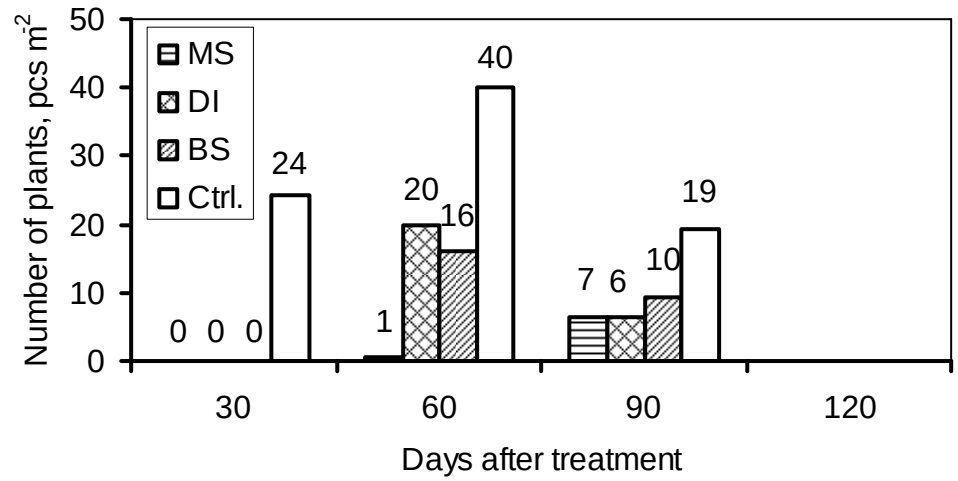

Figure 1. Total number of weed plants per square meter in the 'Bigareau Burlat'/'Wild Cherry' plot 30, 60 and 90 days after the treatment with pendimethalin – average for the three experimental years.

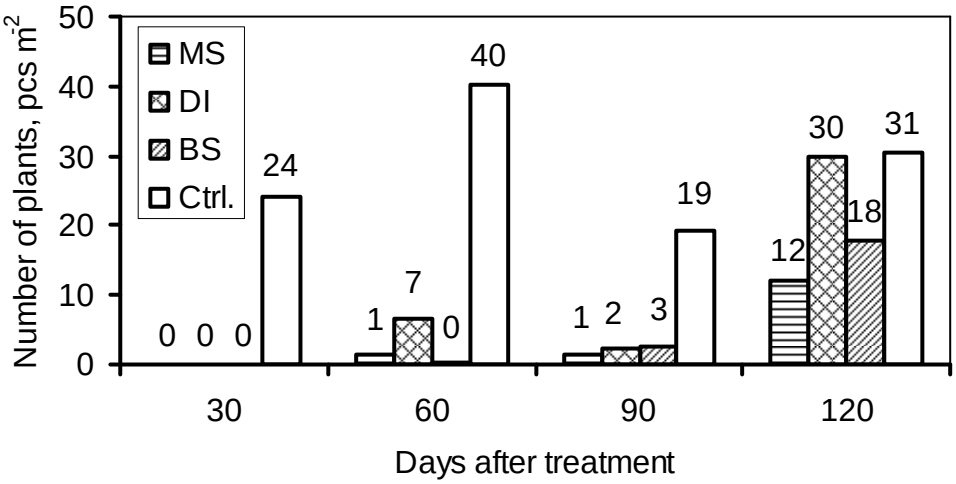

Figure 2. Total number of weed plants per square meter in the 'Lapins'/'Gisela 5' plot 30, 60, 90 and 120 days after the treatment with pendimethalin – average for the three experimental years.

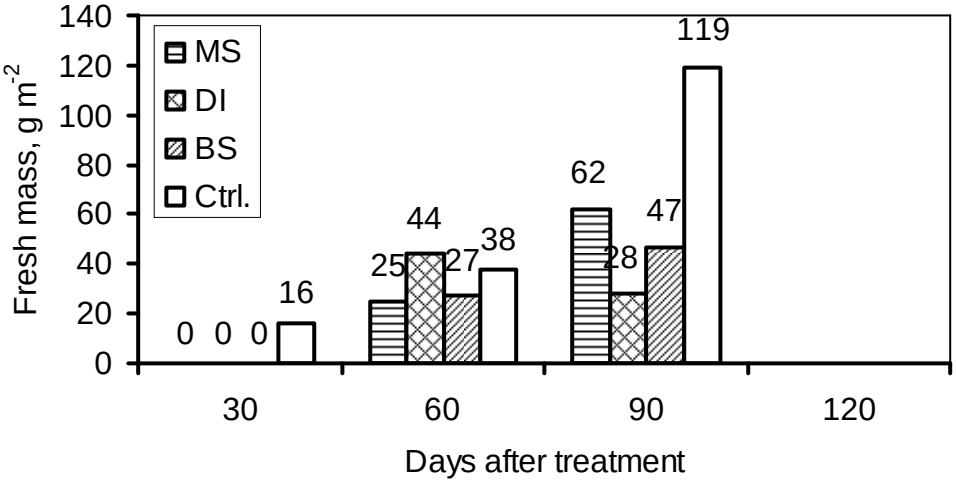

Figure 3. Total fresh mass of the weed plants per square meter in the 'Bigareau Burlat'/'Wild Cherry' plot 30, 60 and 90 days after the treatment with pendimethalin – average for the three experimental years.

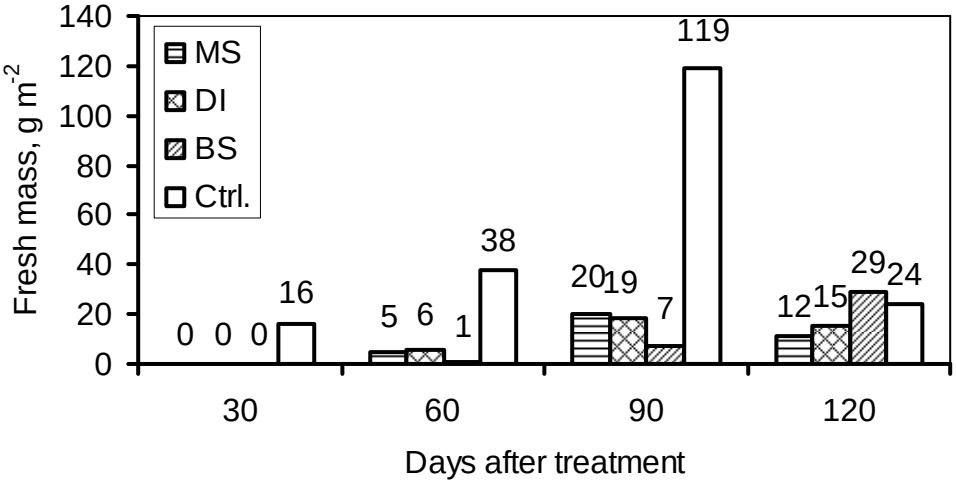

Figure 4. Total fresh mass of the weed plants per square meter in the 'Lapins'/'Gisela 5' plot 30, 60, 90 and 120 days after the treatment with pendimethalin – average for the three experimental years.