RESEARCHES CONCERNING THE SUSTAINABLE CULTIVATION OF HOP IN ROMANIA

CERCETĂRI PRIVIND CULTIVAREA DURABILĂ A HAMEIULUI ÎN ROMÂNIA

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***Abstract**: : In the paper there are presented the results concerning the use of some physical weeds control on the rows of hop without herbicidal use. Also, there were made observations to identify the useful predator fauna of damson-hop aphid, Phorodon humuli Schrank.*

***Rezumat**: În această lucrare prezentăm câteva rezultate privind aplicarea unor operațiuni fizice de control a îmburuienării pe rândurile de hamei fără a utiliza erbicide. Totodată s-au efectuat determinări privind identificarea faunei utile, a prădătorilor păduchelui verde al hameiului Phorodon humuli Schrank*

***Key words:** hop, sustainable cultivation, weeds control, useful fauna*
***Cuvinte cheie**: hamei, cultivare durabilă, controlul îmburuienării, fauna utilă*

INTRODUCTION

The hop plant has been used since old times as food (young sprouts from the stump, before becoming green), for medical purpose and for centuries in beer breeding. At present, the lupulin which forms in the cones (female flowering) of hop represents the prime material which gives the taste, flavor, bitterly, colors, foam, clearness and beer preservation.

In our country, in some areas of Transylvania, there is already a tradition to cultivate this species. Unfortunately, in the past few years, the areas cultivated with hop decreased drastically due to the unfavorable economical situation.

For the future, the assurance of success on the Romanian market and especially the European one, is due to the appliance of as far as possible less polutant, ecological technologies. In this paper there are presented some results concerning this aspects at hop crop.

MATERIAL AND METHOD

The researches carried out in 2005 at Rădeşti (Alba County) on „Brewers Gold" variety. There were made researches concerning the weed decrease in hop crops with the aid of some mechanical methods and also there was studied the useful fauna in order to identify some useful species to biological control of damson-hop aphid, *Phorodon humuli* Schrank.

In the classical technology of hop growing, the control of weeding on hop rows were made with the aid of so called "big hoeing" (a deep hoeing) early in the spring and 2-3 hoeing during vegetation. These manual tillage needed a great work supply, which is difficult to be found and more expensive. According to this it was tried to replace these methods with mechanical means as row coverage or rotative harrow usage of special construction (Fig. 1) on the hop row. The coverage and recoverage on hop rows, can be made with the aid of a tiller on which there are fit up active organs (on the sides) butting plough type. As follows the result was a continuous coverage along the hop row (Fig. 2).

In order to estimate the effect of the applied tillage, besides the classical variant in which there was applied big hoeing and 3 manual hoeing per row, we studied 2 more variants: V2 big hoeing + 2 mechanical coverage + manual intervention on weed areas and V3 big hoeing + 2 mechanical hoeing. We studied the weeding level at the three variants by estimating the weeding level of soil coverage. Weeding determination was made on the 30th July, a month after the weeding control tillage were made. The expression was percentage made, by appreciating the soil coverage with weeds on the total hop row surface (row width=60cm). At the same time there was made a gavimetrical determination concerning the weeding level, by weighting the aerial green parts of the weeds. There were taken samples from several areas in the experimental plots and then was made an average estimate.

Other tillage on hop rows were represented by the usual ones (stump cutting, green tillage, phytosanitary protection and harvest).

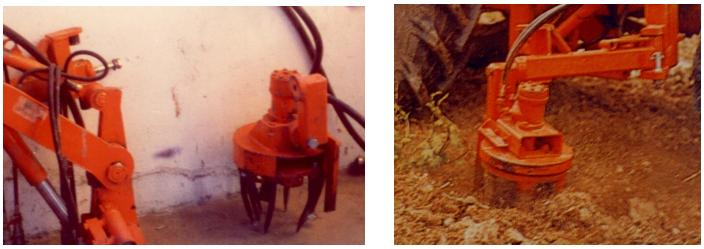

Fig 1. Rotative harrow on hop rows (original)

The experience was organised according to the method of blocks in 4 repetitions. Each experimental plot had 270 m^2 (3 rows x 30 m length/plot). Harvest was made manually, the cones have been weighted separately from each plot and after drying, it has been determined the drying rate. The obtained values from each plot were statistically interrelated with the aid of variance analysis.

Fig. 2 The coverage on hop rows (original)

The damson-hop aphid, *Phorodon humuli* Schrank is the main pest of aerial hop organs (*Humulus lupulus* L.), producing every year great damage in the hop gardens. Because of that, it's necessary the use of some efficacious control methods, avoiding ecosystem pollution.

The predator arthopode fauna means a very important factor to control the numerical density of this aphid. The aim of our researches was the identifying of useful predators by use of 2 methods for aquiring the predators: the direct (manual) collect of predators from infested hop leaves and the shaking-down on a white tarpaulin, under the hop plants.

The first method was used to the direct identifying of the useful predator species of *Phorodon humuli* Schrank. They have been manual collected, with the aid of a pincers from the leaves, then introduced in bottles and brought to laboratory to be identified.

The second method was applied by shaking the hop plants on a white tarpaulin, arranged on the ground, early in the morning, to collect the less active predators presents on the plants.

The numerical density of predator species was reported to the numerical density population of damson-hop aphid, *Phorodon humuli* Schrank/hop leaf.

RESULTS AND DISCUSSIONS

After identifying the dominant weeds in the garden have been the following ones: *Chenopodiun album* Linné, *Amaranthus retroflexus* Linné, *Capsella bursa-pastoris* Linné, *Echinochloa crus-galli* Palisot de Beauvois, *Cirsium arvense* Scopoli, *Polygonum aviculare* Linné, *Elymus repens* Gould (sin. *Agropyron repens* Palisot de Beauvois). The annual weeds had a higher level of density, they are easier to control with the aid of mechanical tillage.

The table 1 showed the values of dry hop cones production depending on the weed control method on hop rows.

Table 1

Production of cones (dry) depending on the soil tillage method on hop rows and the level of weeding (Rădeşti – Alba County, 2005)

Tillage	Weeding level % (kg/mp)*	Cones production			Signifi-cance
		kg/ha	Difference		
			kg	%	
1. Manual tillage (big hoeing +3 hoeing)	5 (0,2)	1700	-	100,0	-
2. Big hoeing +2 mechanical coverage + manual intervention on weeds *	15 (0,5)	1665	-35	97,9	-
3. Big hoeing +2 mechanical hoeing	35 (1,1)	1640	-60	96,5	0

DL p5% = 54,8; DL p1% = 76,9; DL p0,1% = 108,7.

* The weeding on hop rows expressed by 2 values: % of soil coverage with weeds and between paranthesis, the avarage mass of weeds kg /m².

After manual collection from the hop leaves and plants shaking-down, there have been identified the following predators: *Coccinella septempunctata* Linné, *Adalia bipunctata* Linné, *Adonia variegata* Goeze, *Propylaea quatuordecimpunctata* Linné, *Exochomus quadripustulatus* Linné (**Coccinellidae** – **Coleoptera**); *Chrysopa perla* Linné, *Chrysopa carnea* Stephens (**Chrysopidae** – **Neuroptera**); *Syrphus ribesii* Linné (**Syrphidae** – **Diptera**); *Forficula auricularia* Linné (**Forficulidae** – **Dermaptera**); *Orius minutus* Linné (**Anthocoridae** – **Heteroptera**). The activity of these predator insects is completed by some spiders, which belongs to the **Araneidae** Family – Order **Aranea**, presents in a large number on hop plants.

After the hop plants shaking-down (3 plants/tarpaulin) 120 predator insects (average) have been collected as it follows: 60 **Coccinellidae**, 40 **Chrysopidae**, 10 **Syrphidae**, 6 **Forficulidae** and 4 **Anthocoridae**. Reported to each analyzed plant, it has been collected 40

predator insects. During the period of researches, the average numerical density of damson-hop aphid, *Phorodon humuli* Schrank, was about 150 insects/hop leaf. Reported to a plant (with an average number of 200 leaves), the average numerical density of aphids was about 30000. That way the report between predators and aphids on a plant, was about 40:30.000 respectively, 1 predator at 750 aphids.

CONCLUSIONS

Refearing the weeding control with the aid of mechanical methods it has been found that:

1. It can be achieved the maintain of weeds under the harm level, especially for the annual ones, applying 2-3 repeating coverages and recoverages on hop rows. The action by soil mobilization must be applied in their first growing phases, when they are easier destroyed.

2. To reduce the weed level density with perennial species, it's needed the interventions with manual or /and chemical local tillage on existent weeds infected areas.

3. The "Big hoe", a tillage with an important manual strength, can be replaced by rotative harrow ob hop row.

Concerning the study of natural predators of damson-hop aphid, *Phorodon humuli* Schrank, it has bben found that:

1. After the direct collect of species from the leaves of hop infected plants and the shaking down of the host-plants on a tarpaulin, the following species have been identified: *Coccinella septempunctata* Linné, *Adalia bipunctata* Linné, *Adonia variegata* Goeze, *Propylaea quatuordecimpunctata* Linné, *Exochomus quadripustulatus* Linné (**Coccinellidae** – **Coleoptera**); *Chrysopa perla* Linné, *Chrysopa carnea* Stephens (**Chrysopidae** – **Neuroptera**); *Syrphus ribesii* Linné (**Syrphidae** – **Diptera**); *Forficula auricularia* Linné (**Forficulidae** – **Dermaptera**); *Orius minutus* Linné (**Anthocoridae** – **Heteroptera**). These insects activity is completed by the spiders actions belonging to the Family **Araneidae -** Order **Aranea**.

2. Concerning the numerical density of predators, compared to *Phorodon humuli* Schrank on a plant, the rate was about 40:30.000.

3. To protect the predatory useful fauna (insects, spiders), the use of only low level toxicity and selective to useful fauna pesticides is recommended.

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