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SPECIES COMPOSITION OF WEED VEGETATION IN DIFFERENT APPLE GROWING TECHNOLOGIES

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Abstract. The investigation was carried out in the period 2001-2003 in an orchard of the Institute of Agriculture, Kyustendil, Bulgaria, created in the spring of 1996 on leached cinnamonic forest soil. The weed populations under four different farming technologies of growing of apple cultivar Florina were investigated. It was established, that the apple growing technologies influence the weed association composition. The highest weed diversity was found in the organic technology - 16 weed species were found. In the application of resource economical and integrated technologies the development of 13-14 weed species was established. The smallest weed diversity was observed in the conventional technology - 8 species, which was due to the twofold herbicide application.

Keywords: apple, weeds, growth technologies, herbicides, soil tillage, fertilization, irrigation

INTRODUCTION

The weed associations are affected by the diversity of the environmental conditions and the various agro-technical treatments – the use of herbicides, soil tillage, fertilization, irrigation and so on (Gomez Aparisi, J. and Zaragoza, C., 1989; Tasseva, V., 2001, 2005; Tasseva, V., Iliev, S., 1992). Significant number of weeds is registered as dominant at the application of certain methods for weed control, and others as resistant to different herbicides (Bulcke, R., Van Himme, V. and Syryckers, J., 1989; Gomez A. J. and Zaragoza, C., 1989; Gressel, Y., 1995; Lipecki, J., 1985; Skroch et al., 1995; Zemanek, J., Martinkova, Z., 1997). Various alternatives methods are suggested for weed control (Link, H., 1997).

The aim of this experiment is to determine the changes, occurred in the weed associations in different apple growing technologies under the conditions of Kyustendil region, Bulgaria.

MATERIALS AND METHODS

The study was carried out in an apple plantation situated in the Institute of Agriculture, Kyustendil - Bulgaria, established in the spring of 1996. The soil is leached cinnamonic forest with slightly acidic pH, low soluble nitrogen and phosphorous content and well supplied with available potassium. The trees apple cultivar Florina were grafted on the MM 106 rootstock and spaced 4.5 x 2.5 m. Before planting in technologies I-III the soil was fertilized with 800 kg/ha P_2O_5 and K_2O. The interrows were maintained in fallow. The irrigation was performed through drip irrigation installation. The experiment was established in 1998 in four

replications, each of them with six trees (24 trees in a variant) under the conditions of the following farming technologies (Radomirska,Il. et al., 2004)

I. Standard (conventional). During the period 1–4 vegetation (intensive growth; initial and rapidly increasing fruit bearing) nitrogen fertilization was not done. The nitrogen fertilization was started in year 2000, with yearly fertilization norm of 180-200 kg/ha N (as ammonium nitrate). During the period 2001-2003 the row strips were maintained by one mechanical soil tillage in early spring (at the end of March – beginning of April), and one treatment with soil herbicide Stomp (6-7 l/ha) and at summer time with foliar herbicide Basta (5 l/ha). The irrigation was with a norm of 100 % ET. The trees were shaped as free growing spindles with 5-6 skeletal branches. The applied plant protection aimed at optimal protection of the trees from pests and diseases.

II. Integrated. The fertilization was based on the results from the foliar diagnostics. During the period 1–4 vegetation nitrogen fertilization was not done. Due to the decrease in the leaf nitrogen concentration, in 2001 fertilization with nitrogen fertilizer (ammonium nitrate) was performed with a dose of 110 kg/ha N. The row strips were maintained by mechanical soil tillages and one treatment with a foliar herbicide Roundup 6 l/ha + ammonium nitrate 10 kg/ha. The irrigation was with a rate of 80 % ET. The trees were shaped as free growing spindles, and in the first four years after planting no pruning was performed, except reduction of the leader and broken branches. After that the skeletal branches were reduced to 8–10 by removing the inappropriate branches. The plant protection was based on the accepted injury - economic threshold and use of selective pesticides.

II. Resource economical. During the growing period nitrogen fertilizers were not applied, because the leaf nitrogen level was optimal. The row strips were maintained by mechanical soil tillages. The irrigation was done with a norm of 60% ET. The trees were shaped as free growing spindles with unlimited number of skeletal branches (minimal pruning). The plant protection was performed in the same way as in the integrated technology.

IV. Organic. The application of mineral fertilizers (phosphorus and potassium) after planting of the trees was excluded. However, farmyard manure was incorporated in the soil when planting the trees with a norm of 40 t/ha, and green manuring was performed with rye-peas mixture, sown in the autumn of 2002. The row strips were maintained by several superficial cultivations. The irrigation was with a norm of 80 % ET. The trees were shaped as free growing spindles. The use of pesticides was not allowed – against the pest only bioproducts were used.

The weed species composition was determined on plots of 1 m^2, in the middle of the interrow, between two neighbouring trees.

RESULTS AND DISCUSSIONS

The measurements taken in the row strips during the period 2001-2003 show that 23 weed species are presented within the experiment: annual and perennial, mono- and dicotyledons weeds (Table 1). During this period the spread of 8 weed species in technology I, 13 - in technology II, 15 - in technology III, and 16 - in technology IV was determined, hence the highest weed diversity was found in the organic technology, and the lowest – in the conventional technology.

In all studied technologies the perennial dicotyledons species had the greatest importance, and mainly - *Convolvulus arvensis* and partly - *Cirsum arvense*, because the weed control against them is difficult. The first of the mentioned species was found in all years

(with the exception of 2002) in all experimental treatments - it was not exterminated by the herbicides and soil cultivations. The second weed species - *Cirsum arvense* was not found in technology I, where one spring application with Stomp and one summer treatment with Basta were applied. The other three representatives of this group were less distributed. In the last year of the experiment single plants of *Taraxacum officinale* were found in technology II, *Rumex crispus* L. – in technology III, and *Trifolium arvense* – in technology IV.

The group of the annual dicotyledons species had the highest number representatives – 13 species. Among them, in technology IV 11 weeds were established, in technology III – 8, and in technology I–II – 6 weeds. High distribution was detected for *Capsela bursa pastoris* – found in all years of the experiment in technologies I and IV. The rest of the weed species were relatively poorly distributed – only in particular years. Single plants of *Portulaca oleraceae* L. were present in technology III, and *Galium tricorn*e Wth. and *Vicia ssp*. – in technology IV.

The group of the annual monocotyledons species was represented by 5 weeds, with a wider spread of *Echinochloa crus galli* (in all technologies, but separate years) and *Panicum sanguinale* (mainly in technologies II and IV).

The perennial monocotyledons weeds were poorly distributed. Only in 2001 in technology III the presence of couch-grass was established.

The analysis of the species composition of weed vegetation in the different experimental treatments showed that the highest number of weed species was established in the organic technology, where pre-planting organic fertilization was done, the weed control was carried out with soil cultivations and the irrigation norm was 80% ET. Among them more important were: the perennial creeping roots weed *Convolvulus arvensis*, as well as the annual monocotyledons *Panicum sanguinale*, and dicotyledons *Amaranthus retroflexus* L. and *Capsela bursa pastoris*. In contrast to the preceding three years, the number of the weeds decreased – from 19 to 16 species (Tasseva, V. (2005).

Under the conditions of technology III pre-planting mineral fertilization was performed, the weed control was carried out through soil cultivations, and the irrigation norm was 60% ET, 14 weed species were found. Among them the most significant was the perennial creeping root *Convolvulus arvensis*, as well as the annual *Sonchus oleraceus* and *Panicum sanguinale* (distributed in the first two years of the experiment). In comparison with the preceding three years of cultivation, the weed species number in this treatment did not change (Tasseva V., 2005).

In technology II, where pre-planting mineral fertilization was done, followed by application of fertilizers when the leaf nitrogen content decreased below its optimal values, and in the weed control scheme was included an application of foliar herbicide, lower amount of weeds were found - 13 species. Here the main weed was also the annual monocotyledon species *Panicum sanguinale*. In the last two years of the experiment the development of the perennial creeping root *Convolvulus arvensis* and the annual monocotyledons species *Echinochloa crus galli* was determined (Tasseva V., 2005).

The smallest number weed species - 8, developed in the conventional technology, where pre-planting mineral fertilization was done, followed by application of nitrogen fertilizer, and the irrigation norm was the highest (100%), the weed control was performed through one soil cultivation and one foliar herbicide. In this technology three permanent weed species were found - perennial creeping root *Convolvulus arvensis* and the annual dicotyledons *Capsela bursa pastoris* and *Matricaria chamomilla*. This considerable reduction of weed diversity was obviously due to the herbicide applications.

CONCLUSIONS

The apple growing technologies influenced the weed associations composition. The highest weed diversity was found in the organic technology. In the period 2001- 2003 in this treatment 16 weed species were found. In the resource economical and integrated technologies the development of 13-14 weed species was established. The least weed diversity was observed in the conventional technology - 8 species, which was due to the twofold herbicide application.

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REZUMAT

COMPOZIŢIA FLORISTICĂ A UNEI POPULAŢII DE BURUIENI ÎN CAZUL DIFERITELOR TEHNOLOGII DE CULTIVARE A MĂRULUI

Studiul s-a realizat în perioada 2001-2003 într-o livadă a Institutului de Agricultură Kyustendil, Bulgaria, înfiinţată în primăvara anului 1996 pe un sol brun luvic de pădure. Au fost investigate populaţiile de buruieni în cazul a patru tehnologii de cultură, la soiul de măr Florina. S-a stabilit că tehnologiile de cultură a mărului influenţează semnificativ structura asociaţiilor de buruieni. Cea mai mare diversitate de buruieni (16 specii) a fost observată în cazul tehnologiei organice. La aplicarea tehnologiilor cu resurse economice şi integrate s-au dezvoltat 13-14 specii de buruieni. Cea mai redusă diversitate de buruieni (8 specii) a fost observată în cazul tehnologiei convenţionale, fapt datorat celor două tratamente de erbicidare aplicate.

Table1

Weed Species Under Different Farming Technologies of Apple

Weeds	I. Standard technology			II. Integrated technology			III. Resource-economical technology			IV. Organic technology		
	2001	2002	2003	2001	2002	2003	2001	2002	2003	2001	2002	2003
Annual monocotyledons												
Avena fatua L.						♦						
Echinochloa crus galli L. Beau.		•			•	♦		•			•	♦
Hordeum murinum L.									♦			
Panicum sanguinale L.				*	•	♦	*	•		*	•	♦
Poa annua L.						♦						
Total	0	1	0	1	2	4	1	2	1	1	2	2
Annual dicotyledons												
Amaranthus retroflexus L.					•			•		*	•	♦
Anthemis arvensis (L.)									♦			♦
Capsela bursa pastoris (L.) Med.	*	•	♦							*	•	♦
Chenopodium album L.			♦		•			•		*	•	
Galinsoga parviflora Cav.		•	♦			♦		•		*	•	
Galium tricorne With.												♦
Matricharia chamomilla	*	•	♦			♦			♦			♦
Portulaca oleraceae L.								•				
Solanum nigrum L.		•	♦							*		
Senecio vulgaris L.			♦			♦		•				

Sonchus oleraceus						♦	*	•				♦
Vicia ssp.												♦
Xanthium strumarium L.										*		♦
Total	2	4	6	0	2	4	1	6	2	6	4	8
Perennial monocotyledons												
Cynodon dactylon (L.) Pers.							*					
Total	0	0	0	0	0	0	1	0	0	0	0	0
Perennial dicotyledonse												
Cirsum arvense L.				*	•	♦	*		♦	*		♦
Convolvulus arvensis L.	*	•	♦	*		♦	*	•	♦	*	•	♦
Rumex crispus L.									♦			
Taraxacum officinale Web.						♦						
Trifolium arvense												♦
Total	1	1	1	2	1	3	2	1	3	2	1	3
Number weed species	**3**	**6**	**7**	**3**	**5**	**11**	**5**	**9**	**6**	**9**	**7**	**13**