CREŞTEREA ŞI FRUCTIFICAREA MĂRULUI ÎN DEPENDENŢĂ DE MULCIREA SOLULUI ŞI FORMAREA DIRECŢIONATĂ A SISTEMELOR RADICULARE

APPLE GROWIN AND FRUCTIFICATION DEPENDING ON GARDEN SOIL MULCHING AND DIRECTIONAL FORMATION OF ROOT SYSTEMS

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Abstract
Article presents data on trunk thickness and fructification of apple-trees depending on different options of garden soil mulching and directional formation of root systems. Garden soil mulching, is insured by covering with polyethylene film removed from one position to another (once per 12-16 days). The directional formation of roots is insured by limitation of their expansion by means of cutting

***Key words*:** apple-trees, soil mulch, vegetation residues, polyethylene film, root systems, directional formation.
Cuvinte cheie: măr, mulcirea solului, resturi vegetale,peliculă de polietilenă,sistem radicular, formare direcţionată.

1. Introduction

Systems of soil maintenance constitute an important part of the set of agro technical measures used in gardens. If care over tree tops is adjusted relatively satisfactorily from technological point of view to requirements of the current stage of horticulture development, soil maintenance requires yet considerable researching efforts for rationalization. It is necessary to determine the priority direction for improvement of the soil maintenance technology taking into account climatic conditions of the Republic of Moldova trending to manifest themselves in most extremely way (significant reduction of atmospheric precipitates, persistent long-term high-temperature periods, hot and dry weather) in the plant vegetation period [1, 2]. Therefore, currently, in the opinion of horticulture researchers, revolution of problem concerning as much as possible efficient mineralization of water evaporation from soil by covering its surface with mulching materials is in the foreground. Purpose of researches undertaken by us within above described experiments was to reveal optimal options of soil mulching ensuring substantial reduction in consumption of mulching materials and prevention of their deterioration in the moment of technologic transfer among intervals between rows of trees by agricultural machines aggregated with tractors [3, 4]. Elaboration of agricultural methods intended to provide horticulturists with assistance in avoidance of soil exhaustion in strips of land within operated orchards, where location of tree rows (following removal of old ones) of the new future orchards is envisaged, is considered to be the prospective direction of researches. As an approach in new researches, the procedure of directional formation of tree rooting system by limitation of radial distribution of horizontal roots is proposed [5, 6].

2. Materials and methods

In this context, experiments no. 3 and 4 were carried out in order to study an impact of the character of radial distribution limitation of horizontal roots on apple trees.

The present article contains data on the trunk thickness and fructification of apple-trees depending on garden soil mulching and directional formation of root systems. Experimental plot no.1 with regard to soil mulching was established in 1987 in apple-tree plantation planted in 1985 in the agricultural holding ,,Fructovâi Donbas" (district of Dubăsari) and contains the following options:

1. Reference plot – with no mulching;
2. Covering of the strip of land near the line of the row of trees with vegetal mass;
3. Periodic relocation of the polyethylene film on the soil surface in intervals between rows. Relocation is performed in the direction toward the end of row and back. Film remains in its position for 12-16 days (depending on the frequency of atmospheric precipitates, irrigation and intensity of weed growth) ;
4. Covering of soil with polyethylene film from the part of the row of trees. One edge of film is embedded in soil for the whole period of use, while another one is left on the soil surface with slight fixation. Thus, every film represents some leaf which can be easily „opened-closed" (relocated) to the left and to the right in relation to the foil edge embedded in soil. Periodicity of position change – once per 12-16 days;

5. Periodic relocation around the tree trunk of some piece representing polyethylene film fixed by the wooden frame. Periodicity of relocation – once per 12-16 days;
6. Periodic relocation around the tree trunk of some piece representing vegetal mass fixed by the wooden frame.

Idared, Spartan and Golden Delicious varieties grafted on MM-106 were studied.

Distance of planting - 5m x 3m.

Soil – alluvial, grassland soil of black colour, clayed soil of gaunt clay.

Experimental plot no.2 contains the same six options of mulching and was established for industrial studies in conditions of the agricultural holding

,,Nicolae Munteanu" (community of Cojuşna, district of Străşeni). Distances of planting trees of Idared variety: 5m x 3m (for trees grafted on MM-106) and 4m x 2m (for trees grafted on M-9). Soil– ordinary black earth soil. Options were studied starting from the year of 2002 and up to the year of 2007 in the garden planted in 1999.

Field experiment no.3 with apple trees of Golden Delicious, Idared and Spartan varieties was set up in the year of 1987 on plantations established in 1985. Distance of tree planting – 5 m x 3 m. Stock – MM-106. Alluvial grassland soil of black color loamy soil rich in clay. Level terrain.

In studies, following options were assumed:

- V1 (check) – without limitation of radial distribution of horizontal roots;
- V2 – radial distribution of horizontal roots from two adjacent rows of trees is oriented in direction toward common interval; limitation is performed by cutting using machine of ,,Vibrolaz 80-E" type;
- V3 - radial distribution of horizontal roots in strips within 2.5 m range from tree trunks; limitation is performed by cutting using Vibrolaz 80-E machine);
- V4 - radial distribution of horizontal roots from two adjacent rows of trees is oriented in direction toward common interval; limitation is performed by application of polyethylene film;
- V5 - radial distribution of horizontal roots is oriented into strips of lands from tree trunks with 2.5 m width; limitation is performed by application of polyethylene film;
- V6 - radial distribution of horizontal roots from two adjacent rows of trees is oriented in direction toward common interval; mixed limitation (by application of polyethylene film in the year of planting; subsequently, by cutting starting from third year following planting).

In second, third and sixth options, first cutting for limitation of rooting was performed in spring 1987, second one - in spring 1989, while third one - in spring 1991.

Filed experiment no.4 has covered apple trees of Yanvarskoe, Slava Pobeditelyam and 1-11-157 varieties and was set up in plantations established in the year of 1996. Distance of tree planting – 4.5 m x 3.0 m. Stock – MM-106. Soil – argillaceous carbonate black earth rich in clay. Relief –slope with small inclination (4^0) and Southern-Eastern exposure. In studies, following options were assumed:

- V1 (check) – without limitation of radial distribution of horizontal roots;
- V2 - radial distribution of horizontal roots from two adjacent rows of trees is oriented in direction toward common interval; first cutting for rooting limitation - in 1998 (autumn); second one - in 2000; third one - in 2002; fourth one - in 2004; fifth one - in 2006;
- V3 - radial distribution of horizontal roots from two adjacent rows of trees is oriented in direction toward common interval; first cutting for rooting limitation - in 1998 (autumn); second one - in 2001; third one - in 2004; fourth one - in 2007;
- V4 - radial distribution of horizontal roots from two adjacent rows of trees is oriented in direction toward common interval; first cutting for rooting limitation - in 1998 (autumn); second one - in 2002; third one - in 2006 ;
- V5 - radial distribution of horizontal roots is oriented into strips of lands from tree trunks with 2.5 m width; limiting cutting is performed from both sides of tree row; first one - in 1998 (autumn); second one - in 2000; third one - in 2002; fourth one - in 2004; fifth one - in 2006 ;
- V6 - radial distribution of horizontal roots is oriented into strips of lands from tree trunks with 2.5 m width; limiting cutting is performed from both sides of tree row; first one - in 1998 (autumn); second one - in 2001; third one - in 2004;
- V7 - radial distribution of horizontal roots is oriented into strips of lands from tree trunks with 2.5 m width; limiting cutting is performed from both sides of tree row; first one - in 1998 (autumn); second one - in 2002; third one - in 2002.

In all options, agrofund in experiments was maintained just the same. Maintenance system - "black" fallow. Fertilizers were not applied from the moment of establishment of orchards. Studies were carried out under methods accepted for the performance of experiments with horticultural crops.

3. Results and discussions

In accordance with the Table, options of mulching in respect of tree trunk thickness growth have manifested themselves as follows. Fourth, fifth and third options providing mulching of soil in a

arden by its covering with polyethylene film periodically removed from one position to another ensure the maximal growth of trunk of apple-trees. Trees have demonstrated positive response to the

sixth option as well. Specificity of this experiment consists in that reference option (except Idared variety) with regard to the trunk thickness remains significantly lagging as compared with other studied options.

For example, with Golden Delicious variety, the tree trunk thickness in the seventh year following planting has achieved the level of 120 mm (fourth option); growth amounted to 37 mm ($DL_{0,\ 95}$ – 7 mm). With regard to fructification of trees, it was revealed just the same disposition of options studied one by one under data featuring summarized crop (kg/tree) for the period of 1978-1988.

Data obtained in experiment no.2 of industrial research confirms the disposition of options studied one by one under data concerning the trunk thickness and summarized crop (kg/tree) recorded in experiment no.1. For example, the largest summarized crop was recorded with trees under option 4 – 138 kg/tree (MM 106) and 5 – 94 kg/tree (M-9).

Productivity of apple trees depending on the character of limitation of radial distribution of roots is presented in Tables 2 and 3.

In experiment no.3 (Table 2), with apple trees of Golden Delicious variety, the largest yield per tree (sum for the period of 1988 – 1997) was obtained in option V5 – 370.8 kg/tree amounting to more than 12.0 kg as compared with check option. Limit calculated difference amounts to 57.2 kg/tree.

The smallest yield was obtained in option V_2 – 300.3 kg/tree, i.e. by 58.5 kg less as compared with check option. This difference is significant, since it exceeds the limit difference. By this index, options V3, V4, and V6 fall behind the check option with difference amounting from 28.5 kg to 54.0 kg. With Idared variety, largest yield was obtained from trees under option V4 (318.3 kg/tree) exceeding the check option by 7.5 kg. This difference is not significant. The smallest yield of fruits was recorded in option V_2. With regard to productivity, Spartan variety has demonstrated response to options of limitation of radial distribution of rooting being similar with one of Golden Delicious variety.

In experiment no.4 (Table 2), the largest summarized yield for the period of 2000-2006 with selection form 1-11-157 was obtained in option V_2 (271.1 kg/tree) exceeding by 1.9 kg the yield in the check option. This difference is significant, since it exceeds the limit difference.

With Slava Pobeditelyam variety, the largest yield was obtained from trees under option V_3 (193.7 kg/tree), while the smallest one – under option V4 (178.5 kg/tree).

With Yanvarskoe variety, the largest yield was obtained in the check option (253.2 kg/tree). Other options have demonstrated behavior similar with selection form 1-11-57.

4. Conclusions

Mulching of soil in the garden of apple-trees of Idared, Spatran and Golden Delicious varieties grafted on MM-106 and M-9 by covering polyethylene film, which is relocated periodically from one position to another, ensures maximal growth of the trunk thickness and high fructification of fruit trees. Periodic relocation around the trunk of vegetal remains used as mulching material had the same positive effect over fruit trees.

Obtained experimental data demonstrate that, in plantations with apple trees grafted on MM 106 (with planting distances of 5.0 x 3.0 m and 4.5 x 3.0 m), it is reasonable to orientate radial distribution of horizontal roots of two adjacent rows of trees in the direction of common interval or in strip of land of 2.5 m width from tree trunks applying limitation by cutting using agricultural machines of ,,Vibrolaz-80E" type.

Limitation cutting of horizontal roots can be performed without consequences for trees in spring or autumn through one, two and three years starting from the third year following planting.

5. References

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Table 1. Growth and productivity of apple trees depending on garden soil mulching.

Option	Experimental plot no.1, agricultural holding ,,Fructovâi Donbas"						Experimental plot no. 2, Agricultural holding ,,Nicolae Munteanu" (industrial studies)			
	Idared grafted on MM-106		Spartan grafted on MM-106		Golden Delicious grafted on MM-106		Idared grafted on MM-106		Idared grafted on M-9	
	A^x	B^x	A^x	B	A^x	B^x	C^x	D^x	C^x	E^x
1 reference	87	81	73	75	83	85	110	109	81	79
2	81	78	78	80	87	88	104	107	84	83
3	93	91	89	83	108	94	112	119	88	85
4	113	109	112	103	120	113	129	138	91	90
5	95	98	109	95	116	100	117	125	97	94
6	105	101	103	88	94	99	123	130	94	91
$LD_{0,95}$	5.9	9.7	8.5	7.8	7.0	8.6				

x- A- the trunk thickness, mm (in 1991, the 7 year following planting)
B-total crop for 1988-1991, kg/tree
C-the trunk thickness, mm (in 2007, the 9 year following planting)
D-total crop for 2003-2007, kg/tre
E-total crop for 2002-2007, kg/tree

Table 2. Productivity of apple trees depending on the character of limitation of radial distribution of horizontal roots. Agricultural holding ,,Fruktovyi Donbas". Data for the period of 1988 – 1997 (Experiment no.3)

Option	Golden Delicious		Idared		Spartan	
	Yield/tree summarized for 1988-1997 (kg/tree)	Average yield (t/ha)	Yield/tree summarized for 1988-1997 (kg/tree)	Average yield (t/ha)	Yield/tree summarized for 1988-1997 (kg/tree)	Average yield (t/ha)
1. Check	358.8	23.9	310.8	20.7	292.8	19.5
2.	300.3	20.0	270.3	18.0	264.3	17.6
3.	321.3	21.4	274.7	18.3	268.8	17.9
4.	330.3	22.0	318.3	21.2	279.3	18.6
5.	370.8	25.0	294.3	19.6	288.3	19.2
6.	304.8	20.3	273.3	18.2	267.3	17.8
$DL_{0.95}$	57.2		39.9		23.8	

Table 3. Productivity of apple trees depending on the character of limitation of radial distribution of horizontal roots. Experimental holding of the Institute of Pomiculture. Data for the period of 2000 – 2006 (Experiment no. 4).

Option	1-11-157		Slava Pobeditelyam		Yanvarskoe	
	Yield/tree summarized for 2000-2006 (kg/tree)	Average yield (t/ha)	Yield/tree summarized for 2000-2006 (kg/tree)	Average yield (t/ha)	Yield/tree summarized for 2000-2006 (kg/tree)	Average yield (t/ha)
1. Check	269.2	28.5	191.8	20.3	253.2	26.8
2.	271.1	28.7	189.9	20.1	252.2	26.7
3.	248.5	26.3	193.7	20.5	239.0	25.3
4.	240.0	25.4	178.5	18.9	232.4	24.6
5.	261.7	27.7	186.1	19.7	243.7	25.8
6.	265.4	28.1	183.3	19.4	246.5	26.1
7.	235.2	24.9	182.3	19.3	223.9	23.7
$DL_{0.95}$	25.1		11.0		12.7	