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Study of the impact of some soil maintenance systems upon the weeding degree and weed control degree in Jonathan apple tree variety culture

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Abstract Reducing pollution in the orchard ecosystem, by treatments with chemicals made at the optimum time, taking into account the forecast and warning programs and using, of course, suitable substances, in the recommended dose, using a technology as organic growing, with positive effects upon the soil and cultivated fruit species, as well as effective soil maintenance systems: grass alleys on the intervals, mulching the tree rows and use a low number of herbicides, or even its reduction by weed control through mechanical or agro-technical works, are only a few of improved technological links done over time in order to increase production and its quality.

Rational human intervention in the fruit species culture is consciously directing their growth and development through a series of actions, implemented on time, both upon the environment (soil tillage, irrigation, fertilizer application, improved conditions of temperature, light etc.), or directly on fruit species (pruning, treatments, normalization of the fruit load).

By choosing the best soil maintenance system, trees will not compete with weeds for nutrients and water absorption and thus will get constant fruit production.

In this purpose, we established 10 variants of soil maintenance, in which we used both agrotechnical and chemical methods for controlling weeds, such as: mechanical and manual hoes on the tree rows and on the interval, manual hoes on the tree row combined with herbicides, while the interval was either seeded with grass mixture, either just mowed.

In terms of the degree of weed control compared with the control variant, best results were obtained in variants where chemical control methods have been associated with the agrotechnical methods, such as variant 6 (herbicide Roundup 360 SL (3 l/ha) + 2 manual hoes), variant 7 (herbicide Basta 14 SL (5 l/ha) + 2 manual hoes) and variant 8 (herbicide Gallant Super (1 l/ha) + 2 manual hoes), because those weeds that could not be controlled by herbicides, were destroyed by hand hoeing. The percentages of control in these variants were very high, of over 90.00%.

Key words

Jonathan, apples, soil maintaining systems, weeds, control

Among temperate species, the apple holds first place worldwide in terms of both area and production of fruit orchards and will remain a significant share of total national heritage fruit (36,0%) and the total fruit production (51,6%), followed by pear, peach and nectarine, and plum [2]. But as any culture apple culture has some disadvantages, such as: it is a demanding species for soil and moisture, is vulnerable to attack of pests and diseases, genetic predisposition to the alternation of fruition that tackle difficult and requires a lot of work especially for pruning, treatments and harvest [5].

In apple orchards in bearing, the most effective soil maintenance systems are: worked field, alone or combined with cover crops and temporary grass alternating bands (1-3 years) combined with worked field (on land exposed to erosion in areas with sufficient rainfall or irrigation conditions). In such orchards, deep autumn ploughing is done at a depth of 18-20 cm, if we have generative rootstocks and at 10-14 cm for vegetative rootstock, 20-25 days before the leaves fall from trees that were harvested or immediately after harvesting the fruit. In spring, after pruning and treatments, the soil is working with the

grower at 10-12 cm depth during the growing season and applies to 6-8 hoes [3, 4].

Material and Method

The experiment is a monofactorial one, aiming at different soil maintenance systems that can positively or negatively influence the production and its quality of the Jonathan apple tree variety, during the years 2008-2010. The method of arranging the variants was incomplete blocks. The experimental technique of arranging variants is very used in fruit culture because it offers some special advantages: it allows a larger number of variants than other methods and can eliminate errors due to soils' less homogeneity [1].

Ten experimental variants were set as follows:

V1 – no herbicides, no mechanical or manual works – control;

V2 – Roundup 360 SL (3 l/ha) on the tree row, the interval mowed;

V3 – Basta 14 SL (5 l/ha) on the tree row, the interval mowed;

V4 – Gallant Super (1 l/ha) on the tree row, the interval mowed;

V5 – mulching with mowed grass on the interval (cover crops on the interval mixture 1);

V6 – Roundup 360 SL (3 l/ha) + 2 manual hoes on the tree row, cover crops on the interval;

V7 – Basta 14 SL (5 l/ha) + 2 manual hoes on the tree row, cover crops on the interval;

V8 – Gallant Super (1 l/ha) + 2 manual hoes on the tree row, cover crops on the interval;

V9 – *Trifolium repens* on the interval + Roundup 360 SL (3 l/ha) on the tree row;

V10 – 2 manual hoes + 2 mechanical hoes.

In order to establish the weed degree and the floristic composition in the Jonathan orchard, it was first done a weed filling. The weed filing was made before and after doing the herbicide treatments and the manual and mechanical works. After sprayings, the first reading was made at 30 days.

The data were collected by using the quantitative-numeric method, which consists in counting the weed species on the experimental plots surface, a method which is a hustler and sufficiently accurate method. The metric framework used for weed filing has a surface of 0.25 square meters, being a square with the interior side of 0.5 m.

Results and Discussions

In the present paper we present the average values for each variant obtained in the period 2008-2010.

The degree of weed found in the three years of research has been strongly influenced by climatic conditions, particularly rainfall, and the various methods used for weed control. Knowledge of weeds and weed degree participation in the main premise is necessary to develop an effective strategy to control weeds.

Predominant weed species in the three experimental years were: *Agropyron repens, Cynodon dactylon* and *Convolvulus arvensis*, perennial weeds fought very hard due to their propagation, and *Stellaria media, Veronica hederifolia* and *Amaranthus retroflexus*, widespread annual weeds in the orchard.

Climatic conditions of 2008 have greatly influenced the degree of weed, whereas there were high amounts of precipitation from March (61.4 mm) and very high in June (157.0 mm).

The highest weed control degree in 2008, was obtained in variant 6 (Roundup 360 SL (3 l/ha) + 2 manual hoes on the tree row, cover crops on the interval), being of 96.55%. Very good results were also obtained in variant 9 (*Trifolium repens* on the interval + Roundup 360 SL (3 l/ha) on the tree row), variant 4 (Gallant Super (1 l/ha) on the tree row, the interval mowed) and in variant 8 (Gallant Super (1 l/ha) + 2 manual hoes on the tree row, cover crops on the interval), the percentage being 91.38% weeds controlled, but also in variant 3 (Basta 14 SL (5 l/ha) on the tree row, the interval mowed) with 90.52% controlled weeds (table 1).

All of the other variants of soil maintenance systems gave good results, having a control degree of over 84.00%, just for variant 5 – mulching, the results obtained were lower, of 77.58% controlled weeds and this is due to the fact that the mulch layer was too thin.

Out of table 1 we can see that all of the weed control methods were efficient as they had very significant negative differences to the control variant (no herbicides, no mechanical or manual works), the number of weeds/m^2 found after applying the control methods being way under the control variant.

Table 1

Synthesis of the results concerning the impact of control methods upon the weeding degree of Jonathan variety, 2008

Variant	No.of weeds/m^2	Weed control degree (%)	No.of weeds/m^2 controlled	Significance
V_1 – no herbicides, no mechanical or manual works – control	154.67	0.00	-	mt.
V_2 – Roundup 360 SL (3 l/ha) on the tree row, the interval mowed	22.67	85.34	-132.00	000
V_3 – Basta 14 SL (5 l/ha) on the tree row, the interval mowed	14.67	90.52	-140.00	000
V_4 – Gallant Super (1 l/ha) on the tree row, the interval mowed	13.33	91.38	-141.34	000
V_5 – mulching with mowed grass on the interval (cover crops on the interval mixture 1)	34.67	77.58	-120.00	000
V_6 – Roundup 360 SL (3 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	5.33	96.55	-149.34	000
V_7 – Basta 14 SL (5 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	16.00	89.66	-138.67	000
V_8 – Gallant Super (1 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	13.33	91.38	-141.34	000
V_9 – *Trifolium repens* on the interval + Roundup 360 SL (3 l/ha) on the tree row	13.33	91.38	-141.34	000
V_{10} – 2 manual hoes + 2 mechanical hoes	24.00	84.48	-130.67	000

DL 5%= 14.00 DL1%= 18.92 DL0.1%= 25.20

In 2009, weather conditions have caused a much lower degree of weed, so the initial number of weeds/m^2 was lower than the previous year. Low amounts of precipitation since the beginning of the growing season helped to weaker breeding and emergence of perennial and annual species.

The weed control degree in the 9 experimental variants, compared to the control variant had the highest value in variant 6 (Roundup 360 SL (3 l/ha) + 2 manual hoes on the tree row, cover crops on the interval), of 95.49% (table 2). Good results were obtained in variant 8 (Gallant Super (1 l/ha) + 2 manual hoes on the tree row, cover crops on the interval), with 93.69% controlled weeds and in variants 9 (*Trifolium repens* on the interval + Roundup 360 SL (3 l/ha) on the tree row) and 7 (Basta 14 SL (5 l/ha) + 2 manual hoes on the tree row, cover crops on the interval), in both of these variants the weed control degree being of 92.79%.

Table 2

Synthesis of the results concerning the impact of control methods upon the weeding degree of Jonathan variety, 2009

Variant	No.of weeds/m^2	Weed control degree (%)	No.of weeds/m^2 controlled	Significance
V_1 – no herbicides, no mechanical or manual works – control	148.00	0.00	-	mt.
V_2 – Roundup 360 SL (3 l/ha) on the tree row, the interval mowed	18.67	87.39	-129.33	000
V_3 – Basta 14 SL (5 l/ha) on the tree row, the interval mowed	20.00	86.49	-128.00	000
V_4 – Gallant Super (1 l/ha) on the tree row, the interval mowed	21.33	85.59	-126.67	000
V_5 – mulching with mowed grass on the interval (cover crops on the interval mixture 1)	26.67	81.98	-121.33	000
V_6 – Roundup 360 SL (3 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	6.67	95.49	-141.33	000
V_7 – Basta 14 SL (5 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	10.67	92.79	-137.33	000
V_8 – Gallant Super (1 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	9.33	93.69	-138.67	000
V_9 – *Trifolium repens* on the interval + Roundup 360 SL (3 l/ha) on the tree row	10.67	92.79	-137.67	000
V_{10} – 2 manual hoes + 2 mechanical hoes	22.67	84.68	-125.33	000

DL5%= 9.26 DL1%= 12.52 DL0.1%= 16.68

All of the other variants of soil maintenance systems gave good results, having a control degree of over 84.00%, just for variant 5 – mulching, the weed control degree was 81.98%. Out of table 2 we can see that, the same as in 2008, in 2009 all of the weed control methods were efficient as they had very significant negative differences to the control variant (no herbicides, no mechanical or manual works), the number of weeds/m^2 found after applying the control methods being way under the control variant.

The weed degree in 2010 was much higher than the previous two years, whereas the amounts of precipitation were higher in April (56.6 mm), May (118.0 mm) and June (131.3 mm). Earlier this year, weed percentage was lower due to regenerative capacity of plants in the presence of sufficient moisture in soil.

The highest weed control degree in 2010, was obtained, the same in the past two years, in variant 6 (Roundup 360 SL (3 l/ha) + 2 manual hoes on the tree row, cover crops on the interval), being of 94.91%, followed by variant 7 (Basta 14 SL (5 l/ha) + 2 manual hoes on the tree row, cover crops on the interval) with 94.07% controlled weeds (table 3).

All of the other variants of soil maintenance systems gave good results, having a control degree of over 80.00%, just for variant 10 – 2 manual hoes + 2 mechanical hoes, the results obtained were lower, of 77.12% controlled weeds and this is due to the fact that the perennial weeds were able to regenerate in conditions of high rainfall quantities.

Out of table 3 we can see that, the same as in 2008 and 2009, in 2010 all of the weed control methods were efficient as they had very significant negative differences to the control variant (no herbicides, no mechanical or manual works), the number of weeds/m^2 found after applying the control methods being way under the number of weeds/m^2 found in the control variant.

Table 3

Synthesis of the results concerning the impact of control methods upon the weeding degree of Jonathan variety, 2010

Variant	No.of weeds/m^2	Weed control degree (%)	No.of weeds/m^2 controlled	Significance
V_1 – no herbicides, no mechanical or manual works – control	157.33	0.00	-	mt.
V_2 – Roundup 360 SL (3 l/ha) on the tree row, the interval mowed	24.00	84.75	-133.33	000
V_3 – Basta 14 SL (5 l/ha) on the tree row, the interval mowed	25.33	83.90	-132.00	000
V_4 – Gallant Super (1 l/ha) on the tree row, the interval mowed	26.67	83.05	-130.66	000
V_5 – mulching with mowed grass on the interval (cover crops on the interval mixture 1)	29.33	81.36	-128.00	000
V_6 – Roundup 360 SL (3 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	8.00	94.91	-149.33	000
V_7 – Basta 14 SL (5 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	9.33	94.07	-148.00	000
V_8 – Gallant Super (1 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	10.67	93.22	-146.66	000
V_9 – *Trifolium repens* on the interval + Roundup 360 SL (3 l/ha) on the tree row	12.00	92.37	-145.33	000
V_{10} – 2 manual hoes + 2 mechanical hoes	36.00	77.12	-121.33	000

DL5%= 12.38 DL1%= 16.73 DL0.1%= 22.28

Table 4

Synthesis of the results concerning the impact of control methods upon the weeding degree of Jonathan variety, average of the years 2008-2010

Variant	No.of weeds/m^2	Weed control degree (%)	No.of weeds/m^2 controlled	Significance
V_1 – no herbicides, no mechanical or manual works – control	153.33	0.00	-	mt.
V_2 – Roundup 360 SL (3 l/ha) on the tree row, the interval mowed	21.78	85.80	-131.55	000
V_3 – Basta 14 SL (5 l/ha) on the tree row, the interval mowed	20.00	86.96	-133.33	000
V_4 – Gallant Super (1 l/ha) on the tree row, the interval mowed	20.44	86.67	-132.89	000
V_5 – mulching with mowed grass on the interval (cover crops on the interval mixture 1)	30.22	80.29	-123.11	000
V_6 – Roundup 360 SL (3 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	6.67	95.65	-146.67	000
V_7 – Basta 14 SL (5 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	12.00	92.17	-141.33	000
V_8 – Gallant Super (1 l/ha) + 2 manual hoes on the tree row, cover crops on the interval	11.11	92.75	-142.22	000
V_9 – *Trifolium repens* on the interval + Roundup 360 SL (3 l/ha) on the tree row	12.00	92.17	-141.33	000
V_{10} – 2 manual hoes + 2 mechanical hoes	27.56	82.03	-125.78	000

DL5%= 6.74 DL1%= 9.10 DL0.1%= 12.13

The average value of the three studied years in the orchard of Jonathan apple tree variety shows 153.33 weeds/m^2 in the control variant, while in the variants where chemical or agrotechnical methods for weed control were applied the number of weeds /m^2 was lower.

All of the variants had very significant negative differences to the control variant (no herbicides, no mechanical or manual works), the number of weeds/m^2 found after applying the control methods being way under the number of weeds/m^2 found in the control variant.

We remark variants 6 (Roundup 360 SL (3 l/ha) + 2 manual hoes on the tree row, cover crops on the interval), 7 (Basta 14 SL (5 l/ha) + 2 manual hoes on the tree row, cover crops on the interval), 8 (Gallant Super (1 l/ha) + 2 manual hoes on the tree row, cover crops on the interval) and 9 (*Trifolium repens* on the interval + Roundup 360 SL (3 l/ha) on the tree row) where the average weed control degree was over 92.00%. Good results were also obtained in the other variants, the weed control degree being of over 80.00% (table 4 and figure 1).

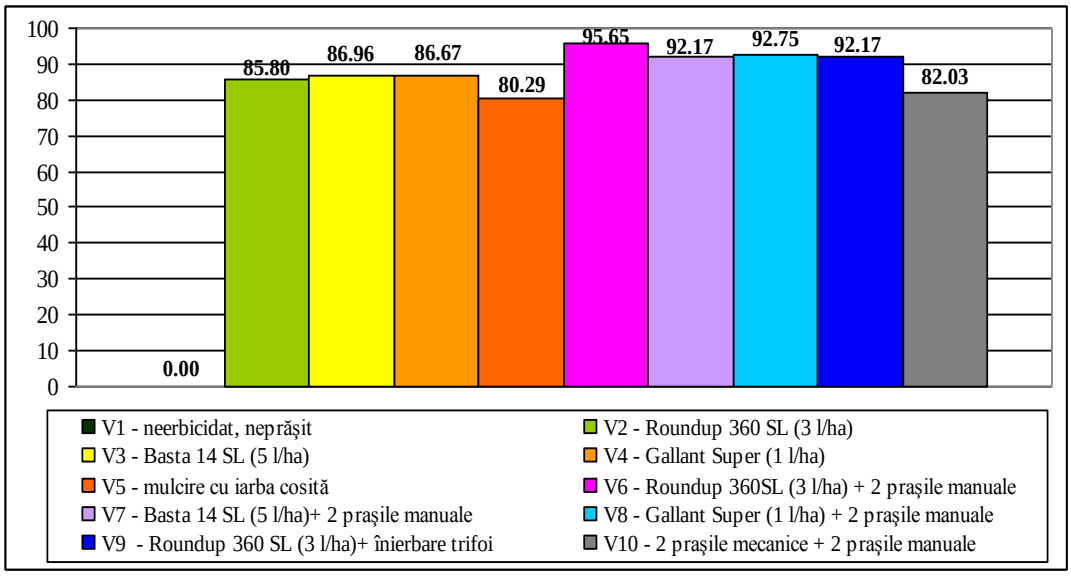

Fig.1. The weed control degree (%) of Jonathan apple tree variety, average of the years 2008-2010

Conclusions

The degree of weed found in the three years of research has been strongly influenced by climatic conditions, particularly rainfall, and the various methods used for weed control. Knowledge of weeds and weed degree participation in the main premise is necessary to develop an effective strategy to control weeds.

Predominant weed species in the three experimental years were: *Agropyron repens, Cynodon dactylon* and *Convolvulus arvensis*, perennial weeds fought very hard due to their propagation, and *Stellaria media, Veronica hederifolia* and *Amaranthus retroflexus*, widespread annual weeds in the orchard.

Climatic conditions of 2008 have greatly influenced the degree of weed, whereas there were high amounts of precipitation from March (61.4 mm) and very high in June (157.0 mm). In 2009, weather conditions have caused a much lower degree of weed, so the number of weeds/m^2 was lower than the previous year. Low amounts of precipitation since the beginning of the growing season helped to weaker breeding and emergence of perennial and annual species. The degree of weed in 2010 was much higher than in the previous two years, whereas the amounts of precipitation were higher in April (56.6 mm), May (118.0 mm) and June (131.3 mm). This year the weed percentage was lower due to regenerative capacity of plants in the presence of sufficient moisture in soil.

Concerning the weed degree control, best results were achieved in the variants in which chemical control methods (herbicides) were associated with agro-technical methods of control (hoeing), which was more than 90.00%.

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