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Original scientific paper

THE INFLUENCE OF TREE ROW STRIP MULCHING IN PEAR ORCHARD ON SOIL TEMPERATURE AND MOISTURE, GROWTH AND YIELD OF THE TREES[#]

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The paper presents results of the investigations of the influence of various mulching and covering materials in orchard tree-row on soil characteristics (temperature and moisture) and tree behavior (growth, yield and fruit quality) of Bartlet pear grafted on a quince rootstock. The experimental orchard was established with planting distance 3.2 m × 1.3 m and irrigated with drip irrigation system. The soil surface between the rows was maintained by grassing. The follow mulching materials were used as treatments: straw, conifer sawdust, peat, black plastic foil, cloth of polyester fabric (geotextile). Clean cultivation was used as a control treatment. The obtained results indicated that mulching material has effect on reduction of the soil temperature during summer as well as improvement of soil water conservation. Mulching of the soil improved vegetative growth of the trees, yield, and fruit quality of Bartlet pear.

Key words: pear; mulching materials; water conservation; growth; yield

INTRODUCTION

The maintenance of the soil in orchards under canopy is a big problem because the approach of the machinery to the trunk is obstructed by branches. On the other hand, it is known that most of the roots are located in the vicinity of the trees. The fruit tree absorbs water and nutrients mostly from that area and deterioration of soil quality or weed competition cannot be allowed there. The maintenance of the soil in the orchards should be practicable, without weeds competition, with good structure and reduced erosion potential, the soil should not be a suitable habitat for insects and other pests etc. A way of soil maintaining which meets all these requirements does not exist, but a certain balance of these factors should be made [1]. Usage of synthetic herbicides for reduction of weeds is the most commonly used method for soil maintenance in the rows. The negative side of this method is that the soil structure worsens, the hummus reduces, pH decreases, the root grows in the surface layers where it absorbs the applied soil herbicides which transfer to the fruits [2]. Maintenance of the soil under canopy by tillage is a commonly used method. In such a way, weeds are controlled, the water infiltration in the soil is improved, the soil is aerated and the moisture conservation is increased. However, after several years of usage, the content of hummus is reduced and the soil requires additional organic manure. In the orchards, this strip can be cultivated with side cultivators [3].

Weed management in orchards should favor the safety of the environment, including the quality of soil, and should take into account the effectiveness, costs, and influence on yielding of the crops. Synthetic herbicides are the most effective way of controlling weeds within orchards. The small number of registered herbicides for use in the orchards is an issue in practice [4]. The excessive use of glyphosate based herbicides leads to toxicity, presence of residues in the environment, plants and fruits [5].

[#]Dedicated to academician Gjorgji Filipovski on the occasion of his 100th birthday

The usage of postemergence herbicides facilitated the growth and the yield of plum trees and may be considered a convenient method for floor management under trees in conventional orchards [6].

The increased pressure to reduce pesticide use, fruit growers are forced to require alternatives for control of weeds in orchards. One option is the use of mulches, which may have advantages in improving soil physical properties and tree growth [7].

Mulching the soil in the row with various organic matters has next advantages: prevents erosion, increases water conservation, prevents weed occurrence, increases the activity of the soil microorganisms and earthworms, and increases the content of hummus and nutrients in the soil. Different mulch material in pear orchard have positive effects on soil water conservation, evapotranspiration and water physical characteristics of the soil [8]. Organic mulches are of benefit to soils because they increase their productivity and organic matter content and protect them from excessive solar radiation and moisture loss [9]. The weeds in orchards are successfully controlled with synthetic mulches such as polyethylene plastic, woven polypropylene fabric and nonwoven polyacrylic fabric [10]. Straw, sawdust, compost and peat moss [11], waste and textiles (linen, jute, wool) [12], are used as natural mulches in practice.

Covering the soil with black foil keeps the soil moisture, but there is not possibility of aeration and the temperature of the soil during the summer is very high [13]. Under plastic mulch, soil properties like soil temperature, moisture content, bulk density, aggregate stability and nutrient availability improved. Plant growth and yield are also positively influenced by the plastic mulch due to the modification of soil microclimate. Even though it has many advantages, high initial cost, removal and disposal of plastic materials are some of the limitations experienced by the farmers. To overcome these limitations photo and biodegradable plastic mulches can be used for sustaining the productivity as well as controlling environmental pollution due to the use of plastics [14].

The protection of the environment, should be priorities when the weeds are treated. Also the efficiency, the price and the impact on the yield should be taken into consideration. The integral weed control should be based on rational use of herbicides and alternative methods [4]. Given the limited number of herbicides available for organic production, orchard floor management takes on a more critical role for organic fruit growers [15]. In the organic orchards, the so-called Swiss sandwich system is often used, which covers different ways of maintaining the surface in the form of strips [16].

The problems that occur from the excessive use of agrochemicals in the fruit production make the use of integrated and organic production necessary. The soil maintenance is also part of the program of these concepts of fruit production. The aim of the research was to determine the effect of mulching the soil under canopy in pear orchards on growth, yield and fruit quality, as well as examination of the influence of different mulch materials on the temperature of the soil and water conservation as an alternative way of production adaptation to the climate changes and the lack of water for irrigation.

MATERIAL AND METHODS

The study was conducted in pear orchard located in Kumanovo region, north-eastern part of R. Macedonia. The soil type of the experimental field was Fluvisol. Bartlet pear orchard was established in 2010, with distance of 3.2 × 1.3 m (2400 trees/ha). The trees were grafted on quince rootstock MA and Beurre Hardy was used as an interstock. The tree crowns were trained as a slender spindle. White anti-hail net with shading of 15 % was installed in the orchard. The irrigation was scheduled according to long-term average daily evapotranspiration of pear orchards for Kumanovo region (Table 1). The long-term average (LTA) crop evapotranspiration was calculated by FAO software CROPWAT using crop coefficient (K_c) and stage length adjusted for the local conditions. Drip irrigation system was installed in the pear orchard and daily evapotranspiration was decreased by 30-35% (coefficient of the coverage-application of the water only on part of the total surface).

Table 1. Long-term average daily and monthly evapotranspiration for pear orchard in Kumanovo region calculated by FAO software CROPWAT

Months	May	June	July	August
Evapotranspiration, mm/day	2.12	3.94	5.82	5.0
Evapotranspiration, mm/month	65.81	118.21	180.64	150.15

The soil between rows was maintained by grassing and multiple mulching. Manually cultivation at depth of 10 cm had been used for maintaining tree row in orchard (a strip with a width of 0.9 m) till we have established the field trial. Investigation of influence of various soil mulching materials on temperature and water conservation in the soil as well as growth, yield and fruit quality of pear trees was conducted in the two consecutive years (6^{th} and 7^{th} leaf of the trees) at the cultivar Bartlet.

Mulching of the soil in row under the trees, in a 0.9 cm wide strip was made at the beginning of first year of the experimentation. The following treatments were included in the experimental field:

1. Mulching with wheat straw with layer of 15 cm (Straw),
2. Mulching with conifers sawdust with layer of 10 cm (Sawdust),
3. Mulching with peat with layer of 10 cm (Peat),
4. Covering with black polyethylene foil with thickness 0.07 mm (Foil),
5. Covering with gray colored polyester fabric (Geotextile) with thickness 3 mm (Geotextile),
6. Clean cultivation on 10–12 cm depth, used as control (Control).

The treatments were applied in completely randomized blocks with 3 replications and 8 trees on the plots (24 trees per treatment). Mineral fertilization and plant protection were carried out according to current recommendations for commercial pear orchards.

Potential evapotranspiration in the treatments (ETP) was determined by the soil water balance method using direct measurements of soil moisture in the soil layer 0–100 cm [17, 18]. Monitoring of soil water income during the growing period and the active soil moisture at the end of vegetation period was used in this estimation. The soil water income was determined by estimation of the initial or active soil moisture at the beginning of vegetation (Wi), the irrigation water requirements (I) and the effective precipitation during the vegetation period (P). The incomes of water from precipitation (P) was taken from the Hydrometeorological Service of the Republic of Macedonia. The effective rainfall was calculated on the basis of total incomes (reduction from 30 to 50 %, depending on the period of vegetation) [17]. Irrigation water requirements (I) for all treatments were calculated according to results in table 1. All treatments have received same quantity of irrigation water during the growing period. Also, as a result of controlled irrigation practice, surface runoff (RO) and deep percolation (DP) were excluded from this estimation. The subsurface water and water transported upward by capillary rise (CR) didn't have influence on water income in the root zone, and they were ignored. The difference between the water content relevant to MSM (momentary soil moisture) and PWP (permanent wilting point) at the end of vegetation is the active soil moisture at the end of the vegetation period (We). The potential evapotranspiration (ETP) was determined by the equation: $ETP = (P + I + Wi) – We$. Conservated water in the soil is calculated on the basis of the difference between evapotranspiration in the control threatment and evapotranspiration in examined threatments.

The soil temperature was measured in the period May-September by digital thermometer, once a month in the afternoon, in three places by treatment on three depths: at the soil surface, at a depth of 3 cm and 10 cm. Only average values are presented here.

The growth of the trees was estimated through measurement of the trunk diameter at a height of 30 cm above the soil surface by caliper at the beginning and the end of the experimental years. The trunk cross-sectional area (TCSA) was calculated from those measurements. The bearing of the trees was computed at the harvest data through the number of the fruits, yield per tree and estimated yield per unit area (ha). The yield efficiency was calculated as kg/cm^2 TCSA. The fruit quality was determined based on average fruit weight and classifying as the extra class of fruit (diameter > 60 mm) and lower classes (diameter < 60 mm).

The statistical analysis of the results was conducted by analysis of variance (ANOVA) and significance of differences between means of treatments was calculated by LSD test. Results were expressed at the $P < 0.05$ level of significance. Statistical program SPSS version 11.0 was used.

RESULTS AND DISCUSION

Ecological conditions

Soil is the physical medium in which the trees are anchorage, which makes it an important factor for their existence, growth, productivity and quality of the fruits. To achieve optimal yield, the pear trees needs sufficient amounts of nutrients and water throughout the vegetation. For pear orchards, the most suitable are deep, structural, drained, carbonless, light soils, with a humus content of at least 2 % and pH 5.5–7 [19].

The soil type of the experimental field was Fluvisol with average field capacity at 60 cm depth of 17.3 %, permanent wilting point of 8.3 %, and soil bulk density of 1.52 g/cm^3.

Table 2. Chemical and water - physical properties of the soil (depth of 0–60 cm)

Parameter	Value
Reaction (pH in water)	6.7
$CaCO_3$, (%)	0.0
Organic matter (%)	2.4
Total nitrogen (%)	0.14
Available phosphorus (mg/100 g soil)	61.7
Available potassium (mg/100 g soil)	59.4
Wilting point (soil moisture retention at 15 bars), volume %	8.6
Field capacity (soil moisture retention at 0,33 bars), volume %	17.3
Bulk density, g/cm^3	1.53

Water- physical properties of the soil such as field capacity (soil moisture retention at 0.33 bars), wilting point (soil moisture retention at 15 bars) and bulk density have a crucial role in determining the irrigation regime of the fruit plantations, i.e. for determining the time and the irrigation application rate [20]. The average soil pH at 0 to 60 cm depth was 6.70. The contents of easily accessible P and K are 61.7 mg/100g and 59.4 mg/100 g, respectively (Table 2). This data shows that the chemical properties of the soil can provide favorable conditions for the pear cultivation.

Successful cultivation of pear orchards is closely related to the climate conditions in the region. Pear is a fruit species with specific needs for several climatic elements, especially for the temperature regime, the schedule of precipitation and the relative air humidity. Based on these parameters, the cultivar and cultivation technology are usually determined, with particular reference to the irrigation. From the data in Table 3 it can be concluded that the climate is semi-arid, suitable for pear growing. A strong change in temperature conditions can be noticed. In terms of precipitation, there is a slight increase in quantities, but their intensity and patterns is unfavorable for fruit production. The increase in temperature and the unfavorable precipitation patterns indicate an increased need for irrigation during vegetation and search for opportunities for water conservation in the soil.

Table 3. Meteorological condition in Kumanovo region

Period	Temperature, °C			Rainfalls, mm			Annually air
	Annually	IV – X	VI – VIII	Annually	IV – X	VI – VIII	humidity, %
2015	13.4	19.5	23.3	629	389	153	73
2006/15	13.1	19.2	23.8	577	477	189	74
1960/90	11.8	17.5	21.6	542	331	132	74

Water balance and evapotranspiration in experimental orchard

The water balance represents all changes in the water content in a certain volume of soil [18]. In practice, the water balance is used to determine the crop water requirements and the evapotranspiration of agricultural crops during vegetation [17, 21]. The results of the water balance are presented in the table 4. Based on them, the evapotranspiration (ETP) in different ways of maintaining the soil in the row was obtained. From the results obtained in this research, it can be concluded that the active moisture at the end of vegetation in the treatment with black foil is the highest, 1199 m^3/ha, followed by the threatments where the surface is mulched with peat, sawdust, geotextile and straw. The lowest amount of active moisture at the end of the vegetation was found in the control variant, 424 m^3/ha. The highest evapotranspiration during vegetation was noted in the control variant. When we present the ETP data in comparative values, then it can be seen that mulching with black foil shows 18.9 % less evapotranspiration compared to the control treatment, followed by other treatments. These data simultaneously present the water conservation capacity depending on the material used to cover the surface in the row. The treatment with black foil had the highest amount of conserved water, 775 m^3/ha more than the control treatment, followed by peat, sawdust, geotextile and straw, respectively. According that we can concluded that covering the surface in the row can reduce the irrigation for four application rates in the treatment with black foil, two application rates in the treatment with a peat and one in the other treatments, without any consequences at the trees. In other field trial with application of organic mulch materials in pear orchard in Kumanovo region, is noted 12 % higher ETP in control treatment without mulch material in comparison with sawdust mulch treatment and 2 % higher ETP in comparison with grass scraping mulch material [8].

Table 4. Water balance and ETP in pear orchard in m^3/ha

Treatment	Initial active moisture (Wi)	Income from precipitation (P)	Income from irrigation (I)	Total incomes	Active moisture to end of vegetation (We)	ETP (P+I+Wi)-We	Conservation of soil water, m^3/ha
Straw	550	1380	2600	4530	593	3937	169
Sawdust	550	1380	2600	4530	651	3879	227
Peat	550	1380	2600	4530	848	3682	424
Foil	550	1380	2600	4530	1199	3331	775
Geotextile	550	1380	2600	4530	632	3898	208
Control	550	1380	2600	4530	424	4106	0.0

Soil temperature in experimental orchard

The growth of the roots and their absorption power is directly dependent on the soil temperature. Very low and very high temperatures in the soil negatively affect the development of the overall processes in the plant. Evaporation is directly dependent on the soil temperature. At higher temperatures the soil loses moisture faster, which requires more frequent irrigation. On the surface part of the soil in the peat treatment temperature was lower 7.6 °C compared to the control treatment (Figure 1). At a depth of 3 cm, a temperature of 30.8 °C was measured in control treatment, and in peat 25.0 °C, or a difference of 5.8 °C. Black foil and geotextile had the smallest deviations in the measurements compared to the control or the approximate temperature with small differences, which leads to the conclusion that these two variants almost completely transmit heat. In the straw and sawdust treatments there was a decrease in the soil temperature at all measurements at different depths. On average, the mulch and cover material reduces the soil temperature, and on the surface of the soil by 4.88 °C, on the soil layer of 3 cm by 3.68 °C, while the soil layer of 10 cm has a lower temperature by 3.46 °C. The soil temperature depends largely on the way the soil is maintained. In the warm summer months, soil mulched with black foil had the highest temperature, and soils mulched with straw and sawdust had much lower temperatures [13]. The organic mulches kept the soil temperature cooler compared with bare soil, while soil under black plastic had a higher mean temperature than bare soil throughout the season [22]. In spring and sumer months the soil temperatures with straw mulch were lower than under cultivation and geotextile treatments [6].

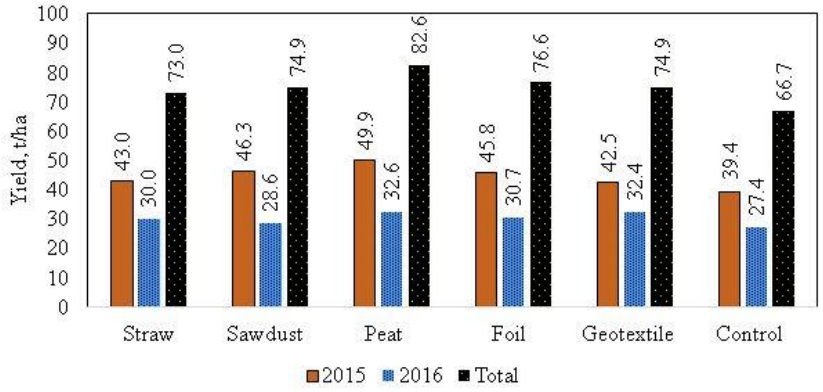

Figure 1. The effect of mulching of the soil temperature

The growth of the tree

The trunk is the most important and integral indicator of the overall activities of the tees [2]. Its growth in a certain period is a significant indicator of the optimal agrotechnical measures applied in the orchards. The activity of the root system and the productivity of the assimilation apparatus is most precisely registered through the dimensions of the trunk. With the increased absorption of water and

nutrients from the soil, the productivity of the asymilates in the crown of the trees increases. All these products contribute to the formation of elements of the xylem and the phloem in the trunk, which eventually affects trunk diameter increase. From the data presented in Table 5, it can be concluded that there is a low growth of the trunk in all treatments in the two experimental years. The weak growth of the trunk is primarily due to the dwarfing rootstock on which the trees are grafted, but also on the fairly high yield of the trees. However, the greatest increment of the trunk for the entire test period was determined in trees where the soil was mulched with a sawdust (4.61 cm^2), and the lowest increment was measured in the trees of the control (3.49 cm^2). The increment of the trunk diameter of the trees of the other treatments is in the range between the growth of the fruits of extreme treatments. There were statistically significant differences among the growth of TCSA in treatment mulched by sawdust and in straw treatments, treatment covered with geotextile and control treatment.

The usage of geotextile or straw mulches over the ground cover had significant advantages in terms of increased soil water and tree growth in apple orchard [7]. The growth trunk diameter at apple trees was different between the applied mulches, however, no positive effects was observed compared to the control. No significant differences were observed in TCSA between differ mulches [11]. The application of straw mulch in apple orchard and had higher efficiency toward the elimination of weeds, the improving growth parameters as well as the yield and the quality of the fruit compared with the clean cultivation [23]. The data given in our study are not fully consistent with previous findings concerning the effects of differ mulches on overall growth parameters. That is because the tree growth depends on many factors among with tree bearing in the propriate growing season.

Table 5. Trunk cross section area (TCSA)

Treatment	TCSA, cm^2			Growth, cm^2		
	2015		End of 2016	2015	2016	Total
	Beginning	End				
Straw	22.80	25.39	26.47	2.55ab	1.09b	3.64b
Sawdust	25.22	28.24	29.84	3.01a	1.60a	4.61a
Peat	21.10	23.61	25.19	2.42ab	1.57a	4.00ab
Foil	22.49	25.24	26.75	2.64ab	1.45ab	4.09ab
Geotextile	22.37	24.90	26.17	2.43ab	1.21ab	3.64b
Control	22.17	24.65	25.81	2.38b	1.11b	3.49b

Values followed by the same letter in a column were not statistically different according to LSD test ($P < 0.05$).

Yield per tree and unit area

The income, the profitability and the economic justification for pear cultivation depends on the yield of the trees. The yield can be shown through several parameters such as: the number of fruit per tree, the yield per tree and unit area, and through relative indicators such as yield per stem size. The yield differs between experimental years (Table 6 and Figure 2), due to damage on the trees caused by late spring frosts in 2016.

The highest total yield for the two experimental years was obtained in the treatment where the soil was mulched with peat (35.5 kg/tree or 82.6 t/ha). The lowest yield per tree was obtained in the control treatment (28.6 kg/tree or 66.7 t/ha). A statistically significant difference compared to the control treatment were determined in the treatments of peat mulching and foil covering. In the period of full bearing of the pear tree, in the Skopje region, determined an average annual yield of 14.3 kg/fruit or 23.7 t/ha [24].

Table 6. The yield per tree

Treatment	Yield per tree, kg		
	2015	2016	Total
Straw	17.9ab	12.5ab	30.4b
Sawdust	19.3ab	11.9b	31.2ab
Peat	20.8a	13.6a	34.4a
Foil	19.1ab	12.8ab	31.9a
Geotextile	17.7ab	13.5a	31.2ab
Control	16.5b	11.4b	27.9b

Values followed by the same letter in a column were not statistically different according to LSD test ($P < 0.05$)

The yield per tree does not differ greatly compared to current results, but there considerably

larger difference in the yield per unit area. This is primarily due to the difference in the number of trees per unit area (2400 versus 1666). At the cultivar Bartlet, on generative rootstock obtained average yield of 31.6 t/ha [25]. Compared to our results, the yields was lower, which is primarily due to the large difference in the intensity of the experimental plantations. The mulch treatments had not significant differences in TCSA at the trees. Similarly, the overall yield, total number of fruits, fruit firmness and total soluble solids content were not significantly affected by the use of different mulches. No statistically significant differences were observed between sizes among the fruit collected from trees grown under various mulches, but sawdust contributed to the significant increase of the fruit diameter [11]. The various way of floor management (clean cultivation, herbicides, straw mulching, mowing) under canopy, in plum orchard, had no statistically significant differences on the tree growth, but the cumulative yield for six year had been the greatest at the spraying with herbicides treatment, and the yield had been the lowest at the mulching treatment [6].

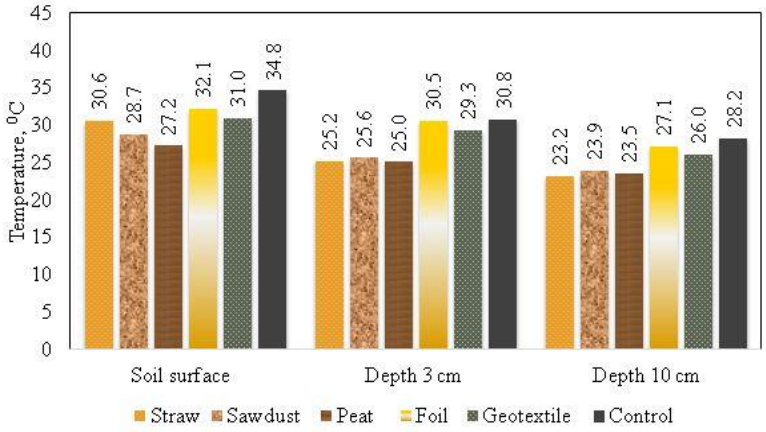

Figure 2. Yield per unit area

Yield efficiency is an important indicator of trees bearing. From the data given in table 7, it can be concluded that the average yield according to this parameter is greatest in trees where the soil is mulched with peat (0.73 kg/cm^2), while the lowest yields was obtained in sawdust and control treatments, 0.56 and 0.57 kg/cm^2 , respectively. According to literature data, dwarfing trees give more fruits when this parameter is taken into consideration. In our case, the trees of the variants with sawdust are most developed, but also with the smallest yield compared to other variants.

Table 7. Yield efficiency, kg/ cm^2 TCSA

Treatment	Yield, kg/ cm^2 TCSA		
	2015	2016	Average
Straw	0.75	0.47	0.61
Sawdust	0.72	0.40	0.56
Peat	0.93	0.54	0.73
Foil	0.78	0.48	0.63
Geotextile	0.75	0.52	0.63
Control	0.70	0.44	0.57

The quality of the fruits

The results for the average fruit weight, number and weight of fruits by classes, as well as their percentage participation in certain classes are presented in table 8. It can be concluded that the average weight of fruits in all treatments was within the characteristic of Bartlet cultivar. The average weight of the fruits in treatments did not differ greatly, but still the fruits of the treatment where the soil was mulched with straw reach the highest values (235.0 g), and the fruits of the control treatment had the lowest value (215.0 g). There was no significant difference between the control variant and variant straw in terms of the number of fruits per tree, and the difference in the weight of the fruits can be explained with the fact that by mulching the water content of the soil improves and thus provides better conditions for the development of the trees in the course of vegetation. It was found that there was no statistically significant difference between the control and the other treatments. At the Bartlet cultivar multiyear average weight of the fruits of 241.2 g is determined [26], which is very close to the results of

our trials. The mulcing in the tree rows had significant effects on the trees growth and the yield compared to tillage, but there was no effect on fruit quality parameters in pears [15].

In all treatmens there was a very high percentage of extra class fruits. On average, the largest mass of fruits of extra class was in treatment mulching with peat (15.7 kg/ tree). In control treatment the smallest percentage of extra-class fruits and fruits weight was noticed. This is primarily due to less favorable conditions for the development of trees because of poor water availability in the zone of the root system. In other treatments the index of water conservation increases, the conditions for development of the root system were improved, through which higher yield and improved quality characteristics of the fruits were provided.

Table 8. The weight of the fruits and the mass and % of fruits per classes (average 2015–2016)

Treatment	Fruit weight, g	The mass of fruits per tree, per classes, kg		Number of fruits per classes, %	
		Extra class	Lower classes	Extra class	Lower classes
Straw	225.0a	14.1	1.1	85.4	14.6
Sawdust	222.0a	14.3	1.3	83.9	16.1
Peat	221.6a	15.7	1.5	83.5	16.5
Foil	217.5a	14.7	1.2	83.6	16.4
Geotextile	220.6a	14.3	1.3	84.9	15.1
Control	210.0a	12.5	1.4	81.1	18.9

CONCLUSIONS

Mechanical cultivation of the soil in the tree row minimizes weed competition during growing period of the trees. However, it carries several disadvantages for soil structure, low water conservation and high soil temperature, resulting in weak tree growth and lower yield. Mulching with organic matter or soil coverage with synthetic materials improves conservation of moisture and successfully controls the growth of weeds. With the soil conditions improvement activity of the root system is ensured, resulting in better growth and fruiting of the trees. The application of this measure can mitigate the consequences of insufficient rainfall during vegetative period of the trees.The simplest and cheapest way of soil mulching is by straw. Over time the straw rot and should be replaced every year. In this way the organic matter of the soil constantly increases. Lack of straw as mulching material is that it is easy and can be spread by wind, soil remains bare and it occurs weeds. The best mulch material is sawdust from coniferous plants. Its disadvantage is lack of sufficient quantities for mass application. Peat is quite effective as mulch material, but it is very expensive. Geotextile is very effective for covering of the soil, it takes a long time, has a good water permeability of precipitation, do not allow growth of weeds, has good moisture conservation. The only disadvantage is its high cost. The black foil as a covering material has many shortcomings because of can not be recommended for practical usage in the orchards.

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ВЛИЈАНИЕ НА МУЛЧИРАЊЕ НА ПОВРШИНАТА ВО РЕДОТ ВО НАСАД ОД КРУША НА ТЕМПЕРАТУРА И ВЛАЖНОСТ НА ПОЧВАТА, ПОРАСТ И ПРИНОС НА ОВОШКИТЕ

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Во трудот се презентирани резултатите од испитувањата за влијанието на разни видови мулч и покривен материјал на површината во редот во насад од круша врз температурата и влажноста на почвата, порастот, приносот и квалитетот на плодовите кај сортата *вилјамовка* на подлога дуња МА. Експерименталниот насад е посаден на растојание на садење 3.2 × 1.3 m и наводнуван со систем капка по капка. Површината на почвата помеѓу редовите е одржувана со затревување. Во испитувањето беа опфатени следниве видови мулч материјал:

слама, пилевина од четинари, тресет, црна фолија, ткаенина од полиестерски влакна и окопување на почвата како контролна варијанта. Резултатите од испитувањето покажуваат дека материјалот за мулчирање има ефект врз редукција на температурата на почвата во текот на летните месеци, како и врз подобрување на конзервација на влагата во почвата. Со мулчирањето на почвата во редот се подобруваат вегетативниот пораст, приносот и квалитетот на плодовите кај сортата *вилјамовка.*

Клучни зборови: круша; мулч материјали; конзервирање на вода; пораст; принос