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Effect of Some Mulching Treatments on Water use Efficiency, Yield and Mineral Composition of "Le-Conte" Pear Trees

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Abstract

The present work was conducted at El-Kanater Horticultural Research Station during 2009 and 2010 seasons to study the effect of different mulching methods: black polyethylene plastic, rice straw and hand hoeing on water use efficiency, yield and mineral composition of "Le-Conte" pear trees budded on *P. communis* L. rootstock. Data obtained revealed that all investigated mulching treatments exhibited a positive effect and a significant increase in measured characters as compared to un-mulched treatments in both seasons. Mulching treatments were more effective in increasing water use efficiency, yield diminishing and kc values as compared to un-mulched treatments. Plastic mulch was more effective in this respect where as it improving water use efficiency as compared to other treatments. Moreover, all investigated fruiting parameters (fruit set %, fruit drop %, tree yield either as kg or as No. of fruits per tree, or as ton/fed and yield increment % as compared to the control) were significantly increased as a result of using mulching treatments in comparison with the control. It is quite clear that, leaf N, P and K contents were increased by using both black polyethylene plastic sheet and rice straw mulching treatments in most cases as compared with control . In general, it could be concluded that, both mulching treatments either with black polyethylene plastic sheet or with rice straw were most effective.

Keywords: "Le-Conte" pear, *P. communis* L., plastic mulch, fruiting parameters, polyethylene plastic sheet.

Introduction

Irrigation is an important indicator of crop yield, because it is associated with many factors of plant environment, which influence growth and development. Availability of adequate amount of moisture at critical stages of plant growth not only optimizes the metabolic process in plant cells but also increase the effectiveness of the mineral nutrients applied to the crop**.** Consequently any degree of water stress may produce deleterious effects on growth and yield of the crop **(Saif *et al.*, 2003)**. Surface irrigation method is most widely used all over the world **(Mustafa *et al.*, 2003)**.

In this method, the major proportion of irrigation water is lost by surface evaporation, deep percolation and other loses, resulting in lower irrigation efficiencies. Moreover, there is a tendency of farmer's to apply excess water when it is available **(Jain *et al.*, 2000)**. As the world become increasingly dependent on the production of irrigated lands, irrigated agriculture faces serious challenges that threatmens its suitability. It is prudent to make efficient use of water and bring more area under achieved by introducing advanced methods of irrigation and improved water management practice **(Zaman *et al.*, 2001)**.

Among the water management practices for increasing water use efficiency (WUE) one of them is mulching. Any material spread on the surface of soil to protect it from solar radiation or evaporation is called mulch. Different types of materials like wheat straw, rice straw, plastic film, grass, wood, sand etc. are used as mulches. They moderate soil temperature and increase water infiltration during intensive rain **(Gajri *et al.*, 1994; Khurshid *et al.*, 2006)**.

Evaporation from the soil surface may account for as much as 50% of the total moisture lost from the soil during the growing season for soybean and corn **(Shaw, 1959)**. In this context, mulching with plant residues and synthetic materials is a well-established technique for increasing the profitability of many horticultural crops **(Duranti and Cuocolo, 1989; Gimenez et al., 2002)**. Such effects are mainly contributed to the capacity of mulch to conserve soil moisture **(Vavrina and Roka, 2000).** The information concerning woodchip mulch is ambiguous too. Woodchip mulch advanced the growth and increased the yield of young apple trees **(Treder *et al.*, 2004).** The opposite effect of woodchip mulch was determined on the yield of some strawberry cultivars **(Kikas, 2000).** Also, mulching improved vegetative growth and distribution of roots and their absorption of nutrients (**Verma *et al*., 2005**). Thus, several researches were done in this respect by many investigators **Helail (1993)** on pear trees**, Pande *et al*., (2005), Singh *et al*., (2005), Mikhael (2007) and Mikhael and Mady (2007)** on apple trees.

Materials and methods

The present investigation has been carried out at El-Kanater Horticultural Research Station, Kalyubia Governorate, Egypt. The experiment has been extended for two consecutive seasons of 2009 and 2010 on fruitful pear trees of "Le-Conte" cultivar.

The selected trees were about 23-years-old, budded on "*Pyrus communis* L.) rootstock, grown in clay loamy soil and planted at 5 meters space in a square system. Trees were carefully selected as being healthy and approximately uniform in their vigour, shape and size and received regularly the same horticultural practices usually done in this region.

The field capacity, the permanent wilting point, the available water and bulk density were determined as well as Physical soil analysis as shown in Table 1. Meteorological data for the Agricultural Research Station are shown in Table 2.

Irrigation started after trees received the winter irrigation on March i.e., starting from bud swelling stage. Irrigation was done when moisture reached the relevant level to determine available soil water retained in the soil. Soil moisture was determined grave metrically on oven dry basis of soil samples taken to a depth of 15 cm. up to 60 cm. water consumption use was calculated as the differences of soil moisture content in soil samples taken prior to 48 h. after irrigation.

Irrigation treatments used in this study were as follows:

Irrigation water was done when 25 % of available soil moisture is depleted.

Soil Mulching treatments:-

1- No cultivated trees (control).
2- Weed cutting: it was practiced two times during each season at 45 days intervals after winter hoeing, i.e., the 1st week of April and the 3rd week of May).
3- Black polyethylene plastic sheet used to cover soil surface under the trees. The polyethylene plastic sheet was 25 micron. The mulch was applied on the 1st week of April on the soil up to the end of the July during both seasons.
4- Rice straw mulch 30 cm thick was spread out on the soil surface to cover the soil completely of the same time of plastic sheets treatment.

Table 1. Physical properties of the orchard soil.

Parameter		**Value**
Particle size distribution (%):		
Clay	%	30.4
Silt	%	34.5
Fine sand	%	34.1
Coarse sand	%	1.0
Texture class		Clay loam

Water parameters and bulk density

Depth	**Field capacity (FC)**	**Wilting Point (WP)**	**Available water (AW)**	**Bulk density (BD) Mg/m^3**
	% by weight	**% by weight**	**% by weight**	
0-15	37.8	19.8	18.0	1.23
15-30	35.4	17.5	17.9	1.20
30-45	32.9	16.1	16.8	1.26
45-60	31.8	16.8	15.0	1.53

FC: moisture at 33 kPa moisture tension.
WP: moisture at 1.5 MPa moisture tension.
AW = FC-WP

Table 2. Meteorological data in 2009 and 2010 seasons.

Season	**2009**							**2010**						
Month	**T.max**	**T.min.**	**W.S**	**R.H.**	**S.S**	**S.R**	**R.F**	**T.max**	**T.min.**	**W.S**	**R.H.**	**S.S**	**S.R**	**R.F**
Feb.	22.9	9.8	2.3	54	11.1	354	0.0	25.0	11.5	1.5	57.7	11.0	354	6.1
Mar.	24.1	13.0	2.6	56	11.8	441	0.0	27.1	13.9	1.9	60	11.8	441	0.0
Apr.	29.3	14.8	2.8	55	12.8	519	0.0	29.6	16.0	1.8	52.3	12.8	519	0.0
May	31.0	18.4	2.8	51	13.5	585	0.0	33.9	19.2	1.7	49.0	13.5	585	0.0
Jun.	37.4	22.1	4.8	49	14.0	627	0.0	37.0	22.7	1.6	51.3	13.9	627	0.0
Jul.	37.2	24.1	5.1	59	13.8	613	0.0	36.3	23.9	1.8	67.0	13.8	613	0.0
Aug.	35.7	23.3	4.5	60	13.1	577	0.0	38.3	25.3	1.8	60.7	13.1	577	0.0
Sep.	35.4	22.5	4.6	58	12.2	512	0.0	35.8	23.5	2.1	59.0	12.2	512	0.0
Oct.	32.8	20.3	4.7	63	11.5	417	0.0	33.8	21.5	1.9	59.0	11.3	417	0.0

Where: T.max. , T.min.= maximum and minimum temperatures °C; W.S = wind speed (m/ sec); R.H.= relative humidity (%); S.S= actual sun shine (hour); S.R= solar radiation (cal/ cm^2/ day). RF = rainfall (mm / month).
[Data were obtained from the agrometeorological Unit at SWERI, ARC]

1. Calculation of water consumptive use (CU):

Water consumpitive use was calculated for each irrigation using the following formula (**Vites, 1965**).

$CU = D.Bd. [Q_2 - Q_1] / 100$

Where: CU = Consumptive use (mm.)

D = the depth (in mm) of the irrigated soil under consideration.

Bd = Bulk density (Mg/m^3) of the soil in the relevant soil depth.

Q_2 = Percentage of moisture in soil (w/w) following maximum irrigation (within the relevant soil depth).

Q_1 = Percentage of soil moisture (w/w) before next irrigation (within the relevant depth).

2. Calculation of crop coefficient and evapotranspiration:

2.1. Reference evapotranspiration (ETo):

Reference evapotranspiration (ETo) was calculated using the meteorological data by four formulas as cited by **Doorenbos and Pruitt, (1977) and Allen *et al.*, (1998)** as follows**: -**

***Formula 1: The Penman- Monteith equation:**

For estimating potential evapotranspiration Penman Monteith was applied by using **CROP WAT model (Smith 1991)** as follows**:-**

$ETo= ET_{rad} + ET_{aero}$

Where:

ETo= Reference evapotranspiration of standard crop canopy (mm/day).

ET_{rad} = Radiation term (mm/day).

ETaero = Aerodynamic term (mm / day).

***Formula 2 the Doorenbos- Pruitt equation:**

Doorenbos – Pruitt (1977) adapted the radiation formula of Makkink **1957** to predict potential evapotranspiration as follows:

ETp = bw Rs/L- 0.3

Where: ETp = Daily potential evapotranspiration (mm/day).

b = Adjustment factor based on wind and mean relative humidity.

W = Weighting factor based on temperature and elevation above sea level.

Rs = Daily total incoming solar radiation for the period of consideration ($cal/cm^2/day$).

L = Latent heat of vaporization of water ($cal/ cm^2/ day$)

Factors (b) and (w) could be obtained from the tables cited by (**Doorenbos and Pruitt 1977**).

2.2 Crop coefficient (Kc)

Crop coefficient (Kc) was calculated using the following equation:

Kc = Eta/Eto

Where:

Eta = Actual evapotranspiration.

Eto = Reference evapotranspiration.

Kc = Crop coefficient of crown

The "WATER" model **(Zazueta and Smajstrla, 1984)** was used to calculate potential evapotranspiration by Doorenbos- Pruitt methods. While, "CROPWAT" model **(Smith, 1991)** was used for Penman Monteith .

3. Water use efficiency (WUE):

Water use efficiency (WUE) is used to describe the relationship between production and the amount of water used. It was determined according to the following equation **(Vites 1965)**:

(gk/f) /yield EUW = Total amount of water delivered to the crop (m^3/f)

4. Methods of analysis:

4.1. Soil physical analysis:

Particle size distribution was conducted using the pipette method according to **Piper (1950)**. Soil moisture constant was determined using the pressure membrane apparatus, considering the saturation percent "SP" at 0 kPa tension, field capacity "FC" at 33 kPa (0.33 bar) tension and wilting point "WP" at 1.5 MPa (15- bar) tension. Available water was considered as the difference between FC and WP **(Stackman 1966).**

4.2. Plant analysis:

Leaf N, P and K contents were determined according to methods stated by **Chapman and Pratt (1961)**. Total nutrients were determined in a digest of concentrated sulphuric, perchloric acid mixture; Nitrogen was determined using the Kjeldahl method. P was measured colourimetrically, as described by **Murphy and Riley (1962)** using a spectrophotometer (Spectronic 20). Potassium were measured using Atomic Absorption Spectrophometer "Perkin Elmer 3300".

2- Fruiting parameters:

2-a. Fruit set percentage:

Number of flowers and set fruitless on the tagged branches were counted and recorded in all treatments; fruit set percentage was estimated by the following equation according to **Westwood (1978)**.

$$\text{Fruit set (\%)} = \frac{\text{Number of set fruitless}}{\text{Total number of flowers}} \times 100$$

2-b. - Tree yield (kg or number of fruits/tree and ton/feddan) and yield increment % in relation to the control:

The average yield as kg/tree, number of fruits per tree and ton/feddan for each treatment was recorded at the picking time. Furthermore, yield increment percentage in comparison the control for each treatment was calculated by the following equation according to **Kabeel (1998).**

$$\text{Yield inc. \%} = \frac{\text{Yield/treatment - yield/control}}{\text{Yield / control}} \times 100$$

The experimental treatments are arranged in split plot in complete block randomized design**.**

Results and discussion

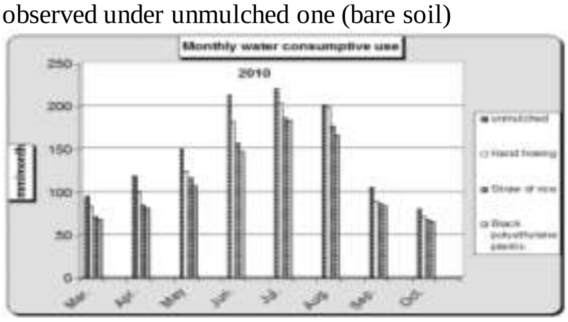
1. Water consumptive use:

1.1. Actual evapotranspiration ETa

The monthly changes in the actual evapotranspiration ETa for pear trees as affected by different mulching treatments during the growing seasons are shown in Table 3 . Data illustrate that the monthly values of ETa under the studied treatments increased in July then decreased of October. The ETa values under soil mulching are lower than the ETa values under un-mulching soil. Plastic mulch treatments recorded the lowest values of ETa followed by rice straw then hand hoeing mulch treatments as compared to the un-mulched treatments. The differences were obtained between un-mulched soil and mulched soil with plastic and rice straw. Plastic, rice straw and hand hoeing mulches reduce ETa by 24.33, 20.23 and 11.1 %, in the first season and 24.83, 21.35 and 12.33% in the second season, respectively as compared with un-mulched soil. These results may be due to the role of mulches in reducing evaporation and keeping soil moisture at root zone to a longer period. In addition, both soil mulching treatments significantly reduced total consumptive use m3/fed, as compared to bare soil in the two seasons of study as shown in Table 3. These results are supported by the observation of **Khalifa (1994), El-Henawy (2006) and Mikhael (2007)**. They mentioned that, monthly and seasonal water consumptive uses of citrus were decreased as affected by different type of mulching.

1.2. Monthly water consumptive use:

Regarding the effect of irrigation and mulching treatments and their interaction on monthly and total water consumptive use CU for le-Conte pear trees, the data of both seasons illustrated in Fig. 1 showed that, monthly values of water consumptive use, mm were gradually increased starting from march and reached the maximum values during June and July, then declined from August to October. These could be attributed to luxuriant growth of "pear trees in this period. This trend was found to be true under all mulching treatments. The data also show that, monthly values of water consumptive used of pear trees under soil mulching with either black P.E. or rice straw were the lowest. Meanwhile, the highest values were observed under unmulched one (bare soil)



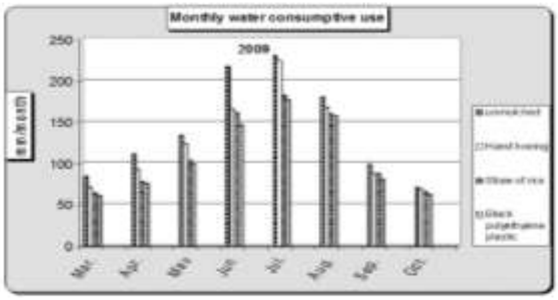


Fig. 1 Monthly ETa mm/month for pear trees as affected by different mulching treatments.

1.3. Reference evapotranspiration ETo

The major parameters required to calculate the ETo are the climatological data, length of growth period of the cultivated crops and surface properties. Data illustrated in Table 3 show the values of reference evapotranspiration ETo which were calculated according to doorenbos - pruitt and Penman-Monteith equations. The ETo values calculated by the different equations reached the maximum in June, July while March reflected the minimum value in both 2009 and 2010 seasons. This trend is due to the variation in sowing data and climate during the two seasons of study. The ETo values calculated by doorenbos - pruitt method were lower than those values obtained by the Penman-Monteith method during the growing months in both seasons.

2. Crop coefficient Kc:

Two different equations were used to assess the extent of closeness of each estimate with the actual values obtained by direct measurement These equations are the Penman - Monteith equation using the CROPWAT model, and Doorenobs - **Pruitt (1977)** equation.

The Doorenbos-Pruitt formula was the closest compared with the Penman - Monteith equation because the ET crop calculated from this formula differed very slightly from the actual ET value. The actual crop coefficient (Kc) was calculated for the different types of mulching is shown in Table (4). The maximum un-mulching values (1.20 and 1.17) were obtained in July while the minimum values (0.55 and.57) were obtained in March with an average of 0.87 and 0.90 over the whole two seasons. The actual (Kc) increased from March to August then declined in September and October in both seasons. The actual minimum (Kc) values were obtained under plastic mulch followed by rice straw then mean while hand hoeing mulching came in the third rank in this respect. On the other as hand control treatment maximized Kc value.

Table 3. Monthly ETo and ETa mm/month for pear trees different treatments according to the studied equations during 2009 and 2010 seasons.

ETo mm/ month			**ETa mm/ month Actual evapotranspiration**			
			2009			
Months	Doorenbos - Pruitt	Penman-Monteith	Black polyethylene plastic	Straw of rice	Hand hoeing	Unmulched
March	109.1	117.8	60.2	64.4	70.5	83.8
April	138.9	153	75.8	77.5	92.8	110.9
May	166.78	182.9	99.1	103.47	123.72	133.36
June	192	228	146.1	161.1	165.9	217.4
July	191.9	229.4	177	181.7	224.6	230.4
August	176.1	204.6	157.5	160.6	167.9	180
September	150.9	183	80.5	87.8	88.1	98.3
October	121.2	139.5	61.7	64.5	68.5	70.6
Seasonal (mm)	1246.9	1438.2	857.9	901.1	1002	1129.8
			2010			
March	117.2	136.4	66.9	70.2	82.3	94.5
April	141.9	168	80.2	83.8	100.1	118.1
May	177.0	207.7	106	115.4	123.7	149.3
June	191.7	219	145.9	155.9	180.9	212.3
July	188.8	220.1	182.4	185.4	202.8	235.3
August	182.3	217	164.8	176.4	197.4	184.8
September	151.5	183	83	85.3	88.6	104.9
October	123.1	161.2	64.9	66.7	70.8	79.8
Seasonal (mm)	1273.4	1512.4	894.1	939.1	1046.6	1179

Table 4. Calculated and theoretical crop coefficient Kc for pear trees under mulched and un-mulched conditions during 2009 and 2010 seasons

	Doorenbos - Pruitt				**Penman- Monteith**			
				2009				
Months	Black polyethylene plastic	Rice straw	Hand hoeing	unmulched	Black polyethylene plastic	Rice straw	Hand hoeing	Unmulched
March	0.55	0.59	0.65	0.77	0.51	0.55	0.60	0.70
April	0.55	0.56	0.67	0.80	0.50	0.51	0.61	0.72
May	0.59	0.62	0.74	0.80	0.54	0.57	0.66	0.73
June	0.76	0.84	0.86	1.13	0.64	0.71	0.85	0.95
July	0.82	0.84	0.87	1.20	0.69	0.70	0.89	1.00
August	1.01	1.03	1.28	1.02	0.87	0.89	0.81	0.88
September	0.53	0.58	0.58	0.65	0.44	0.48	0.48	0.54
October	0.51	0.53	0.57	0.62	0.44	0.48	0.49	0.54
Seasonal (mm)	**0.67**	**0.70**	**0.78**	**0.87**	**0.58**	**0.61**	**0.67**	**0.76**
				2010				
March	0.57	0.60	0.70	0.81	0.49	0.51	0.60	0.69
April	0.57	0.59	0.71	0.83	0.48	0.50	0.60	0.70
May	0.60	0.65	0.70	0.84	0.51	0.56	0.60	0.72
June	0.76	0.81	0.94	1.11	0.67	0.71	0.83	0.97
July	0.87	0.93	1.05	1.17	0.83	0.84	0.92	1.00
August	1.00	1.02	1.11	1.10	0.76	0.81	0.91	0.92
September	0.55	0.56	0.58	0.69	0.45	0.47	0.48	0.57
October	0.53	0.54	0.58	0.65	**0.40**	**0.41**	**0.44**	**0.50**
Seasonal**(mm)**	**0.68**	**0.71**	**0.80**	**0.90**	**0.57**	**0.60**	**0.67**	**0.76**

3. Water use efficiency

Water use efficiencies (WUE) calculated for the different studied treatments are shown in Figure 2 In general, the values of water use efficiency (WUE) increased with the applying of mulch treatments. The highest increase in (WUE) was obtained under plastic mulch followed in descending order by rice straw mulch then hand hoeing as compared to un-mulch treatments in both seasons. Average values of (WUE) were (3.32 - 3.11), (3.06 – 2.90), (2.46 –

2.90) and (1.74 -1.63) kg/m^3 for plastic mulch, rice straw mulch, hand hoeing and un-mulch in both seasons, respectively.

This may be due to yield increment under mulching treatments as a result of increasing water availability and decreasing both the weed and water evapotranspiration. Plastic sheet, rice straw and hand hoeing mulching generally led to increas (WUE) by 48.6 %, 44.5 % and 29.4 % over the un-mulched treatment, respectively in both seasons. Significant differences in (WUE) among treatments were obtained. These results are in agreement with those obtained by **El-Henawy (2006)** who reported that, WUE values under soil mulching were higher than under bare soil.

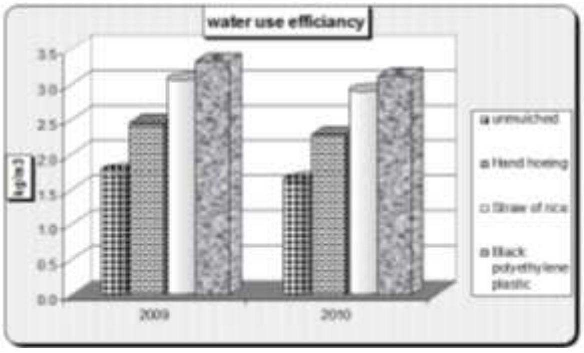


Figure 2: Effect of mulching treatments on water use efficiency (WUE) Kg/m3 of pear trees.

4. Yield measurements (number of fruit/tree and either kg/tree or ton/fed.):

With respect to the effect of some mulching treatments on fruit set and same yield parameters of "Le-Conte" pear trees, data obtained during both the 1st and 2nd seasons of study and tabulated in Table 5, it was quite clear that, trees which were treated with both black polyethylene plastic and straw of rice had significantly the highest values of all abovementioned yield measurements i.e., number of fruits/tree, kg/tree yield as and ton/fed. On the other hand, the least values of of the investigated parameters were statistically exhibited and always in concomitant to those untreated pear trees (control). In addition, the other treatments were in between as compared to as the aforesaid two extents. Such trend was true during both 2009 and 2010 seasons of study.

5. Leaf mineral contents:

Regarding leaf N, P and K content , data presented in Table 6 revealed that, leaf N, P and K were significantly increased by using both black polyethylene plastic and straw of rice mulching treatments in most cases as compared with bare soil during both seasons of study. These findings were supported by those obtained by **Neilsen et al. (1986) and Thakur et al. (1997)** on apple trees and **Zeerban (2004)** on grapevines they mentioned that. Soil mulching treatment increased leaf mineral content under polyethylene mulching. These results may be attributed to the mulching effect on improving root growth and its respiration rate due to modifying soil temperature and moisture content, which in turn, created a suitable condition for soil microorganisms. These modifications in soil condition may be responsible for increasing nutrients absorption via roots.

Table 5. Response of some fruiting parameters to the different mulching treatments of "Le-Conte" pear trees during 2009 and 2010 seasons

		2009						
Treatments	Black polyethylene plastic	Rice straw	Hand hoeing	unmulched	Black polyethylene plastic	Rice straw	Hand hoeing	Unmulched
Fruit set %	5.50 AB	5.54 A	5.50 AB	4.67 C	4.30 A	4.25 AB	4.13 B	3.93 C
Number of fruits/tree	430.0 A	428.0 A	414.3A B	390.0 C	436.7 A	430.0A B	415.0B C	393.0 D
Yield/tree (kg.)	69.60 A	68.13 A	59.73 B	47.98 C	70.83 A	68.92A	61.61B	49.29 C
Yield ton/fed	11.90 A	11.58 A	10.35B	8.28 C	11.69 A	11.45A	10.03 B	8.06 C
Yield increment	45.29 A	42.16 A	24.65B	0.00 D	45.29 A	40.03A	25.13B	0.00 D

Table 6. Effect of mulching treatments on leaf macronutrients % of "Le-Conte" pear trees in 2009 and 2010 seasons.

	2009				2010			
Treatments	**Black polyethylene plastic**	**Rice straw**	**Hand hoeing**	**unmulched**	**Black polyethylene plastic**	**Rice straw**	**Hand hoeing**	**unmulched**
N %	2.35 A	2.27 AB	2.17 BC	2.13 C	2.47 A	2.40 A	2.19 B	2.15 B
P %	0.25 B	0.27 A	0.23 C	0.22 C	0.27 B	0.29 A	0.23 C	0.23 C
K %	1.70 A	1.58 A	1.38 B	1.37 B	1.58 A	1.61 A	1.44 B	1.43 B

Conclusion

Mulched treatments were more effective in reducing water evaporation, increasing water use efficiency and pear trees yield compared to un-mulched treatments. Plastic mulch was more effective in reducing evapotranspiration and improving water use efficiency as compared to rice straw mulch. Although, plastic mulch is superior to rice straw mulch, it adds costs to the farmers. Applying rice straw mulch would lower these costs and increases the environment benefit compared to plastic mulch. It is suggested that increasing the applied rate of rice straw can raise its performance in reducing evaporation. The results also concluded that the (Kc) values were lower under mulching compared to un-mulching. It is preferred to use Doorenbos-Pruitt equation to predict the evapotranspiration of pear trees under the studied region.

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تأثير بعض معاملات التغطية علي كفاءة استخدام المياه والمحصول والمحتوي الكيماوي لاشجار الكمثري صنف ليكونت

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أجريت هذه الدراسة بالمزرعة البحثية بمحطة بحوث البساتين بالقناطر الخيرية خلال موسمى الدراسة 2009، 2010 بهدف دراسة الطرق المختلفة لتغطية التربة على النحو التالى: التغطية الأولى بالبلاستيك (بولى إيثلين الأسود) والأخرى بقش الأرز وأيضا العزيق اليدوى مرتين خلال التجربة هذا بالإضافة إلى معاملة المقارنة (ترك الأرض دون إجراء أية معاملات عليها) وتأثير هذه المعاملات المختلفة على كفاءة استخدام المياه والمحصول والمحتوي الكيماوي لأشجار الكمثرى المطعومة على أصل (الكميونس).

وقد اوضحت النتائج المتحصل عليها أن كل معاملات التغطية المختبرة أظهرت تأثيراً إيجابياً ومعنوياً فى زيادة كل ا لقياسات تحت الدراسة. وكانت معاملات التغطية أكثر فعالية في زيادة كفاءة استخدام المياه مقارنة مع الكنترول بدون معاملة .وكان البلاستيك أكثر فعالية في تحسين كفاءة استخدام المياه بالمقارنة مع المعاملات الأخرى و قيم معامل المحصول.kc كانت أقل تحت التغطيه مقارنة مع ترك الأرض دون إجراء أية معاملات عليها .

كذلك أشارت النتائج إلى أن قياسات الإثمار المختبرة (عقد الثمار – نسبة التساقط – المحصول سواء كجم أو عدد للشجرة أو طن للفدان أو الزيادة المئوية لمحصول المعاملات مقارنة بمعاملة المقارنة (الكنترول) قد تحسنت وزدادت معنوياً نتيجة لاستخدام معاملات مقاومة الحشائش مقارنة بمعاملة المقارنة (الكنترول). كذلك أشارت النتائج الي ان النتروجين والفوسفور والبوتاسيوم زاد بشكل ملحوظ في أوراق الكمثري في معاملات التغطية بالمقارنة بالكنترول. وعموماً فإنه يمكن القول أن كلا من معاملتى التغطية سواء بالبلاستيك (بولى ايثلين أسود) أو بقش الأرز كانتا أكثر فاعلية .