

Organic Fertilization, Cover Crops and Plastic Mulching Effects on Soil Temperature and Moisture, Vegetative Growth, Yield and Fruit Quality of "Anna" Apple Trees

Aly, M. A.¹, Nagwa, A. Abd El-Megeed² and Afaf, M. A. Yousif²

ABSTRACT

Apple orchard cv. Anna/MM106 rootstock planted in 2003 at 4 x 3 m at Al- Nubaria , Behira governorate, were treated during 2009 and 2010 seasons in the inter-row spaces by: 1) check – plots, CP (Control); 2) black polyethylene film, BPF (from the tree trunk to the tree canopy, 0.12 mm thick applied from February to October each season); 3) white polyethylene film, WPF (from the tree trunk to the tree canopy, 0.12 mm thick applied from February to October each season); 4) mulching with Alfalfa straw, MAS; 5) mulching with Rice straw, MRS and 6) compost of organic matter, COM (15m3/Fed.) applied once at December. Trees were planted in a sandy loam with a pH of 7.6 and irrigation was drip system. Results indicated that, all plastic mulch coverings treatments (BPF and WPF) and applied compost of organic matter (COM) showed an increment in soil temperature and soil moisture content in both seasons as compared with control treatment. Moreover, plastic films around the trees gave the highest increment in shoot length, number of leaves/shoot and leaf area followed by mulching with alfalfa or rice coverings soil treatments as compared with check plot treatment, while the compost organic matter treatment gave the lowest value in both experimental seasons. Also, all mulching treatments with plastic films, covering crops, as well as, compost organic matter caused an increased fruit weight (g), tree yield (Kg), fruit length, fruit diameter and fruit firmness as compared with check plot treatment in both seasons. Fruit color percentages had greater light intensity at all polyethylene films applications than light reflected from the other covering crops, compost organic matter and untreated trees. The same trend was found for anthocyanin contents in fruits at both seasons. Concerning the TSS % and acidity %, results showed that mulching treatments either with polyethylene or cover crops decreased the two parameters comparing with control treatment in both seasons, while the reverse was true for starch and total sugar contents. Moreover, the applied treatments increased significantly leaf and fruit N, P, K, Fe, Zn and Mn contents as compared with the control treatment in both seasons.

INTRODUCTION

Mulching systems, including cover crops and living mulches, offer the potential for adequate weed control along with benefits for water conservation and soil fertility. Mulching with organic materials is highly

beneficial in many orchard crops. It precludes weed growth, lowers soil temperature in the root zone, conserves water, reduces soil erosion and increases microbial activity within the mulch and soil, increases humus, organic matter, water percolation and soil nutrition. Mulches may increase disease pressure by maintaining increased humidity within a tree microclimate, e.g., mulches increase the incidence and severity of root rot of citrus trees (Granatstein, 2002).

Cover crops may have substantial effects on several components of agro- ecosystems. They are used for several purposes such as to enhance the natural control of arthropod pests, to suppress weeds and as an alternative to nitrogen fertilizers (Hamm *et al.*, 2002 and Mika *et al.*, 2007). The cultivation of the surface soil to keep it free of vegetation and wet to capture solar heat, which is released at night, warming the orchard. This practice induces organic matter breakdown and negatively affects soil structure, aggregate stability and favors soil compaction among other physical and chemical soil properties (Cambardella and Elliott, 1993 and Balesdent *et al.*, 2000).

Research on cover crops, to a large extent, has been confined to their effects on succeeding cereal crops (Hanna *et al.*, 1995 and Sainju and Singh, 1997). The reduction of soil temperature has other aspects that need consideration. Growth in the spring could be delayed, and transient micronutrient deficiencies do occur under cold soil temperatures. Mulches inhibit the release (as well as the absorption) of radiant energy, which could be important on cold nights. Thus, mulches should be applied to cold- sensitive crops only after the danger of late frost has passed.

Organic fruit production (OFP) has been steadily increasing in recent years due to the excellent returns for growers. The most important fruit crops are pears and apples. Growers considering switching from conventional to organic production can face challenges with soil fertility management one of the most relevant (Granatstein, 2002). Organic and integrated apple management systems offer alternative practices that address environmental concerns (National Research Council, 1989). Organic management practices exclude chemical pesticide and fertilizer inputs and use naturally

¹Fac. of Agric., Saba Bacha, Plant Prod. Dep. Alex. Univ.

²Hort. Res. Inst., Agric. Res. Center, Giza, Egypt

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derived products as defined by organic certification programs. Although studies have found that alternative management practices may improve soil quality as compared to conventional management practices (Reganold *et al.*, 1987, 2001, and Swezey *et al.*, 1998).

Our studies were conducted to determine the effects of various mulches, organic fertilization and cover crops on soil temperature and moisture, vegetative growth, yield components, leaf and fruit mineral contents, tree growth of drip-fertigated "Anna" apple trees.

MATERIALS AND METHODS

Studies were conducted during 2009 and 2010 seasons in a private farm on 6 years old 'Anna' apple cultivar on MM/106 as a rootstock grown at Al-Nubaria, Behira governorate. The trees in this experiment were planted at 3 X 4m spacing. Specific details concerning the soil analysis and plastic cover sheets are presented in Tables (1 and 2). Soil samples were, randomly, taken from two depths (0-30 cm and 30-60 cm) prior to initiating of the experiment and analyzed for physical and chemical properties. A randomized complete block experimental design was used in this trial using five trees for each treatment. The orchard was fertilized with organic manure at a rate of 10 m³/feddan in December year by year. Ammonium sulphate was added at the rate of 2.5 Kg/tree in three equal doses; the first in early March before blooming, the second in May after fruit set and the third in June. Superphosphate was used at the rate of 1.5 Kg/tree in February. Potassium sulphate was also added at the rate of 2.0 Kg/tree in two equal doses; March and May. Thirty 'Anna' apple trees nearly uniform as possible in growth vigor and productivity were chosen for this study. The trees were subjected to fertigation system used in the practical field. Trees were trained to the central leader system. Other cultural practices were applied in a manner consistent with those of commercial 'Anna' apple orchards.

Table 1. The physical and chemical properties of the sandy soil of the experimental site before starting the experiment

Soil Depth (cm)	Texture	pH	E.C. ds/m	O.M (%)	Soluble cations (meq/L)			Soluble Anions (meq/L)		
					Ca ⁺⁺	Mg ⁺⁺	K ⁺	HCO ₃	Cl ⁻	SO ₄
0-30	Sandy	7.48	2.01	0.25	18.60	10.89	1.00	6.30	31.26	8.00
30-60	loam	7.59	2.12	0.29	19.11	11.21	1.31	6.39	33.31	8.90

Table 2. Characteristics of the cover sheet plastic

Treatments	Covering characteristics
Soil White Plastic	Polyethylene, color white, thickness 0.120 mm
Soil black plastic	Polyethylene, color black, thickness 0.120 mm

Treatments included:

- 1- Black polyethylene film, BPF (From the tree trunk to the tree canopy, 0.12 mm thick applied from February to October each season).
- 2- White polyethylene film, WPF (From the tree trunk to the tree canopy, 0.12 mm thick applied from February to October each season).
- 3- Mulching with Alfalfa straw, MAS.
- 4- Mulching with Rice straw, MRS.
- 5- Compost of organic matter, COM (15m³/Fed.) applied once at December.
- 6- Check – plots, CP (Control).

For practical reasons, mulch plots were 1.5 m. The straw was applied each September, using one bales of alfalfa and rice straw per plot (15m²); while the compost organic fertilization was applied once only at the beginning of the trial in 2009 and 2010. Each mulch was approximately 10 cm deep. Apple yield and trunk diameter 30 cm above the ground were recorded annually. Soil temperatures and soil moisture contents were monitored every month through the growing season (from late December to late May and then average of minimum and maximum were calculated).

Soil temperature was measured in the center of planted row at a depth of 10 cm using thermisters (model 107B, Campbell Scientific, Edmonton, AB) attached to results loggers. Soil moisture content was determined on dry weight basis (θ_w) as the following equation

$$(\theta_w) \% = \frac{\text{wet soil weight} - \text{dry soil weight}}{\text{dry soil weight}} \times 100$$

Leaf samples were collected for nutrient analyses in May and fruit samples were taken for nutrient analyses at harvest time.

Leaf area was examined by portable area meter LI .COR model LI-3000 A. Initial and final shoot length was determined. Also, mean number of leaves per shoot was noticed. For determining N, P, K, Fe, Zn and Mn in the fruits and leaves, at harvest time, samples of fruits were washed with tap water and rinsed with distilled water, the fruits were separated and cut into small pieces using a clean knife and each part was mixed well. Also, 30 leaves were collected from each tree from the third leaf on shoots. Leaf samples were washed with tap water, then with distilled water and oven dried at 70°C for 72 hours to a constant weight (fruit and leaf samples). The dried samples of fruits and leaves were ground and digested with sulphoric acid and hydrogen peroxide according to (Evenhuis and Dewaard, 1980). Suitable aliquots were taken for the determination of mineral elements in leaf and fruit samples. Nitrogen and phosphorus were determined calorimetrically according to Evenhuis (1976) and Murphy and Riley (1962), respectively. Potassium was determined by Flame photometer, while Fe, Zn and Mn by Perkin Elmer atomic absorption Spectrophotometer. The concentrations of N, P and K were expressed as percent, while those of Fe, Zn and Mn were expressed as parts per million, on dry weight basis.

The mature fruits of each tree were harvested and weighed at late of June in both seasons for physical and chemical analysis. Samples of 10 fruits were taken from each tree for physical and chemical analysis. Yield, weight, diameter and length of fruits were recorded. Fruit firmness was determined according to Magness and Taylor (1925) pressure tester using a 5/16 plunger, two readings were taken on the flesh of each fruit after peeling. Fruit color was visually ranked on a scale from 1 to 5, with 1=20% red progressive, 2=40%, 3=60%, 4=80% and 5=100% red color. Also, anthocyanin content was determined at the stage of coloration (mg/100g fresh weight) according to Rabino *et al.* (1977). From these ten fruits, two fruits were used for measuring total soluble solids (TSS) using hand refractometer, acidity and starch content using A.O.A.C. (1980). Total sugars content was determined according to the procedures outlined by Malik and Singh (1980). The starch content was determined in 0.1gm of the residue by hydrolysis with concentrated HCl for 3 hours under reflux condenser (A.O.A.C., 1980). The total reducing power was determined according to Malik and Singh (1980) and the factor 0.9 was used to calculate the starch (Woodman, 1941). The obtained results throughout the two studied growing seasons were statistically analyzed using the analysis of variance (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Results in Tables (3 and 4) show the average soil temperature and moisture of apple orchard under study as affected by different mulch coverings and organic fertilization during 2009 and 2010 seasons.

Soil temperature: Results concerning the effects of different mulch coverings on mean of soil temperature in both studied seasons indicated that black polyethylene film (BPF) increased mean of soil temperatures in the first season by 2.60°C and 2.01°C in the second season, as compared with check plot treatment (CP), followed by white polyethylene film (WPF) which increased mean of soil temperatures in the first season on average by 0.96°C and 0.64°C in the second season as compared with check plot treatment (CP). Generally, all plastic mulch covering treatments and applied compost of organic matter (COM) showed an increment in mean of soil temperatures in both seasons as compared with control treatment (Table 3). No significant differences were noticed between mulching alfalfa straw (MAS) and mulching rice straw (MRS) on one hand, and between (BPF) and (WPF), on the other. Truax and Gagnon (1993) improved soil structure and water infiltration of apple orchard by cover crops as a mulching. Moreover, Nathan *et al.* (2002) found in apple orchards that cover crops as mulching reduced surface soil temperature and water evaporation, improved weed control, and increased soil productivity. All treatments significantly increased the mean of soil temperatures comparing with check plot, while no differences were reported between plastic mulch coverings treatments and mulching with cover straw treatments in both seasons. These results also seemed to be in line with those obtained by Bowen *et al.* (2004). They showed that the polyethylene mulch increased soil temperatures by 2°C. Also, Mika *et al.* (2007) found that in 'Pinova' apple trees irradiation within a canopy was reduced by leaf shading to 26% at 0.5 m, 31% at 1.0 m, 42% at 1.5 m and 48% at 2.0 m above the ground as compared to solar irradiation above the tree. Moreover, reflective mulch increased reflected light intensity 8 times at 0.5 m, 4 times at 1.0 m, 2 times at 1.5 m and by 10% at 2.0 m when compared to bare soil. Moreover, Fawzia (2008) on pear noticed that, mulching trees around the trunk with black plastic tended to increase soil temperature more than white plastic.

Soil moisture: As for effects of different mulch coverings during 2009 and 2010 seasons on mean soil moisture results illustrated in Table (4) revealed that, all plastic mulch films, cover crop straws and compost of organic matter treatments caused an increase in the mean

of maximum and minimum soil moistures in both seasons of the study. It was noticed that (BPF) treatment

Table 3. Effects of different mulch coverings on mean of soil temperature °C during 2009 and 2010 seasons

Treatments	2009			2010		
	Max.	Min.	Mean	Max.	Min.	Mean
BPF	24.95	16.13	20.90a	24.34	16.46	20.50a
WPF	23.02	15.46	19.24a	23.12	15.82	19.47a
MAS	22.98	15.32	19.15b	23.11	15.74	19.43b
MRS	22.54	14.95	18.79b	22.98	15.65	19.32b
COM	21.98	14.65	18.30c	22.01	14.98	18.49c
CP (Control)	20.16	14.43	17.30d	20.89	14.77	17.83d

Table 4. Effects of different mulch coverings on mean of soil Moisture% during 2009 and 2010 seasons

Treatments	2009			2010		
	Max.	Min.	Mean	Max.	Min.	Mean
BPF	74.35	54.35	64.35a	78.32	53.24	65.78a
WPF	76.35	55.21	65.48a	76.34	55.24	65.79a
MAS	72.32	52.69	62.51b	74.25	52.34	63.29b
MRS	69.54	50.32	59.93b	71.34	51.24	61.29b
COM	66.32	47.54	56.93c	69.35	49.21	59.28c
CP (Control)	63.32	45.12	54.22d	66.32	42.31	54.32d

gave the highest values of soil moisture followed by (WPF) treatments, while the (COM) and (CP) treatments gave the lowest values in both seasons. All treatments significantly increased the mean of soil moistures comparing with check plot, while no differences were reported between plastic mulch coverings treatments and mulching with cover straw treatments in both seasons. Truax and Gagnon (1993); Marsh *et al.* (1996), Nathan *et al.* (2002) and Lindhard *et al.* (2007) on apple found that mulching with cover crops improved soil structure and water infiltration, also showed that apple trees planted in soil covered by black plastic had high soil moisture content. Several recent trials in humid regions have identified beneficial effects of mulching on apple tree performance, soil moisture content and biological activity in orchard soils (Nielsen *et al.*, 2008).

As for the effects of different mulch coverings and organic fertilization on some morphological parameters of "Anna" apple trees during 2009 and 2010 seasons, results are presented in Table (5).

Shoot length: Regarding the percentages of increment in shoot length as affected by different treatments, results revealed that, mulching with plastic films around the trees gave the highest increment in shoot length, followed by mulching with alfalfa or rice coverings soil treatments as compared to check plot treatment, while the compost organic matter treatment gave the lowest value in both experimental seasons. All treatments significantly increased shoot length comparing with check plot, while no differences were reported between

plastic mulch coverings treatments and mulching with cover straw treatments in both seasons. No significant difference was found between two mulching with plastic films on one hand, and between mulching with two covering crops on the other. The increment of shoot length comparing to check plot may be due to stimulated root growth caused by increased soil temperature and moisture given under mulching coverings with plastic films leading to early top growth (Jones *et al.*, 1978). Furthermore, Lindhard *et al.* (2007) revealed that, mulch application most consistently affected tree growth, as indicated in a long term field trial where cumulative yield after 5 crop years was increased by surface application of shredded paper, alfalfa and bio-solid mulches. Also, on young apple trees planted in soil covered by black plastic, Mika *et al.* (2007) noticed that the trees had the most vigorous growth and the trees in permanent grass sod had the lowest growth.

Leaves number: As for number of leaves/shoot results tabulated in Table (5) demonstrated that, BPF, WPF, MAS, MRS, COM and CP treatments gave 33.00, 34.00, 31.00, 29.00, 25.00 and 23.00 leaves in the first season, while they gave 32.00, 33.00, 29.00, 27.00, 26.00 and 25.00 leaves in the second season, respectively. It was noticed that, mulching trees with white polyethylene films (WPF) increased significantly the No. of leaves/shoot as compared with control treatment in both seasons. Mulching with cover crops either alfalfa or rice reduced the No. of leaves/shoot as compared with mulching with polyethylene films either black or white in both experimental seasons. At the same time,

compost organic matter treatment caused a reduction in the No. of

Table 5. Effects of different mulch coverings on some morphological properties of "Anna" trees during 2009 and 2010 seasons

Treatments	2009			2010		
	% increment in shoot length	No. leaves/shoot	Leaf area (cm ²)	% increment in shoot length	No. leaves/shoot	Leaf area (cm ²)
BPF	27.20a	33.00a	41.23a	26.88a	32.00a	41.89a
WPF	28.02a	34.00a	42.25a	29.98a	33.00a	42.25a
MAS	23.25b	31.00b	40.21b	23.58b	29.00b	40.54b
MRS	21.81b	29.00b	39.98bc	22.92b	27.60b	40.24b
COM	12.25c	25.00c	39.85bc	13.21c	26.00c	39.16c
CP (Control)	0.00	23.00d	39.36c	0.00	24.00d	38.95d

leaves/shoot comparing to mulching with polyethylene films or covering crops treatments in two seasons. All treatments increased significantly number of leaves/shoot comparing with check plot, while no differences were reported between plastic mulch coverings treatments and mulching with cover straw treatments in both seasons. No significant difference was found between two mulching with plastic films on one hand, and between mulching with two covering crops on the other. The same trend was found by Davison (1982) who reported that increasing in the vegetative growth of apple trees was achieved when mulched the trees with black polyethylene around 30% compared with 10% for straw mulching. Also, Neilsen *et al.* (2008) found that all treatments of mulching increased the performance of tree growth.

Leaf area: Regarding the leaf area as affected by different treatments, results revealed that, mulching the trees with plastic films around the trees gave the highest leaf area, followed by mulching with alfalfa or rice coverings soil treatments as compared with check plot treatment, while the compost organic matter treatment gave the lowest value in both experimental seasons. No significant difference was found between two mulching with plastic films on one hand, and between mulching with two covering crops on the other. The increment of leaf area comparing to check plot may be due to stimulated root growth caused by increased soil temperature and moisture given under mulching coverings with plastic films leading to early top growth. Lindhard *et al.* (2007) revealed that, mulch application most consistently affected tree growth, as indicated in a long term field trial where cumulative yield after 5 crop years was increased by surface application of shredded paper, alfalfa and biosolid mulches. Also, on young apple trees planted in soil covered by black plastic,

Mika *et al.* (2007) noticed that the trees had the most vigorous growth and the trees in permanent grass sod had the lowest growth. Also, they found that, the biggest leaf area was found at the horizontal layer between 1.5 and 2.0 m. Leaf area index assessed per canopy cast to the ground was 0.45. Irradiation within 'Jonagored' apple canopy, fruit and leaf distribution was similar to these in 'Pinova'.

Fruit physical properties: As for the effects of different treatments on some physical properties of fruits, results illustrated in Table (6) showed that, all mulching treatments with plastic films, covering crops, as well as, compost organic matter caused an increasing in mean fruit weight (g), Wt. fruits/tree (Kg), fruit length (cm), fruit diameter (cm) and fruit firmness (lb/inch²) as compared with check plot treatment in both seasons. It was noticed that, mulching trees with white polyethylene films (WPF) significantly increased the fruit physical properties as compared with control treatment in both seasons. Mulching with cover crops either alfalfa or rice reduced the fruit physical properties as compared with mulching with polyethylene films either black or white in both experimental seasons. At the same time, compost organic matter treatment caused a reduction in the fruit physical properties comparing mulching with polyethylene films or covering crops treatments in two seasons. The same results were confirmed by El-Seginy (2000) on Le-Conte pear who found that mulching treatments increased fruit physical properties as compared with control. Also, Reganold (2006) found that the organic apples were either firmer fruits or always as firm as the conventional and integrated apples, while Mika *et al.* (2007) found that, no significant influence of mulching on mean fruit weight and fruit firmness. They all suggested that, the higher moisture and temperature and better nutrient

availability by reduction of leaching offered by mulching may have been the reasons for the increasing in fruit physical properties.

Table 6. Effects of different mulch coverings on yield and some physical fruit properties of "Anna" trees during 2009 and 2010 seasons

Treatments	2009					2010				
	Fruit weight (g)	Wt. fruits/tree (Kg)	Fruit length (cm)	Fruit diameter (cm)	Fruit firmness (lb/inch ²)	Fruit weight (g)	Wt. fruits/tree (Kg)	Fruit length (cm)	Fruit diameter (cm)	Fruit firmness (lb/inch ²)
BPF	131.32b	43.25b	6.99b	6.89b	16.35b	131.25b	45.25b	7.12b	7.12b	17.98a
WPF	135.02a	45.23a	7.12a	7.02a	17.78a	136.21a	47.54a	7.25a	7.22a	17.99a
MAS	129.12c	41.87c	6.67c	6.70c	15.99c	129.52c	44.89c	7.00c	7.01c	17.36b
MRS	126.23c	40.27c	6.54c	6.66c	15.89c	128.87c	39.35d	6.96c	6.99c	16.38bc
COM	123.25d	38.89d	6.45c	6.56d	15.64d	125.56d	39.24d	6.54d	6.44d	16.92bc
CP (Control)	115.36e	34.26e	6.15d	6.21e	15.27e	118.21e	37.24e	6.24e	6.35e	16.87c

Fruit chemical characteristics: Effects of different mulch coverings on some chemical fruit properties of "Anna" trees during 2009 and 2010 seasons are presented in Table (7). Fruit color percentages had greater light intensity at all polyethylene films applications than light reflected from the other covering crops, compost organic matter and untreated trees. In both experimental seasons, results showed that, the spectral distribution of the reflected light from the BPF and WPF treatments was more significant than other remained treatments. Also, results mentioned that light reflected from the films either mulching with polyethylene or covering crops was different in quantity. It was noticed that, the increment in the concentrations of fruit color percentages reduced the light intensity in the mulching with cover crops than in mulching with polyethylene films. Also, significant differences were found between polyethylene films treatments and all remainder treatments. The same trend was found for anthocyanin contents in fruits in both seasons. This observation is consistent with previous findings by Andrias and Crisosto (1996) and Tarara (2000) which reported that, the quality of reflected light from the film was not different from direct sunlight, but it was reduced in intensity, also reflection of solar radiation by film modified the orchard microclimate. Moreover, Mika *et al.* (2007) found that reflective mulching improved significantly red blush on 'Jonagored' apples, and in the next season there was no effect because on mulched and control trees all apples had 100% of red skin.

As for the effects of different mulch coverings on some chemical fruit properties of "Anna" trees during 2009 and 2010 seasons, results in Table (7) concerning the TSS % and acidity % results showed that mulching treatments either with polyethylene or covering crops decreased the two parameters comparing with control

treatment in both seasons, while the reverse was true for starch % and total sugar %. Statistical analysis revealed that, mulching with white plastic films around the trunk of trees significantly increased all chemical fruit properties of "Anna" trees during 2009 and 2010 seasons comparing with control. These results disagree with those reported by El-Seginy (2000), while they agree with those obtained by Lindhard *et al.* (2007).

As for the effects of different treatments on leaf and fruit mineral contents, results in Tables (8 and 9) revealed that, all applied treatments, significantly increased leaf and fruit N, P, K, Fe, Zn and Mn as compared with control treatment in both seasons. White plastic film (WPF) resulted high values of different nutrients followed by (BPF), while the control treatment was the least in this regard in both seasons. Statistical analysis showed that mulching with plastic films white or black increased significantly the contents of leaves and fruits from different minerals in the two seasons as compared with control. The same findings were recorded by Frimanslund (1984) and Fawzia (2008) on pear, Neilsen *et al.* (1986), Nathan *et al.* (2002) and Mika *et al.* (2007) on apple. For all species, the nitrogen levels were within or above the normal range. The highest nitrogen levels were found in the trees planted with a red clover. This is because red clover is a legume and can fix nitrogen into the soil. Compost increased leaf nitrogen levels by about 30% into the upper end of the recommended range for apples. Recently, Neilsen *et al.* (2008) reported that, little information was available concerning the effects of mulching in high-density apple orchards in irrigated regions where daily irrigation and fertigation might be expected to reduce potential nutrient and water stresses. Moreover, mulching plays an important role in development of potassium-deficiency.

Table 7. Effects of different mulch coverings on some chemical fruit properties of "Anna" trees during 2009 and 2010 seasons

Treatments	2009						2010					
	Fruit color (%)	TSS (%)	Acidity (%)	Antho-cyanin (mg/100g)	Starch (%)	Total Sugar (%)	Fruit color (%)	TSS (%)	Acidity (%)	Antho-cyanin (mg/100g)	Starch (%)	Total Sugar (%)
BPF	55.65b	11.02b	0.45b	31.32a	3.65a	8.12a	72.25b	11.32b	0.59b	32.01a	3.21a	8.99a
WPF	66.96a	10.99e	0.47b	32.12a	3.69a	8.25a	76.65a	11.99a	0.54b	33.25a	3.33a	9.11a
MAS	32.21c	11.32b	0.48b	29.86b	3.12b	7.99b	41.21c	11.35b	0.59b	31.02b	3.12a	8.78a
MRS	31.35c	11.42b	0.46b	28.54b	2.99bc	7.78b	38.56c	11.11b	0.56b	30.65b	2.99b	7.99b
COM	25.32d	11.33b	0.46b	27.78c	2.65c	7.58c	32.25d	11.54b	0.54b	25.56c	2.84b	7.89b
CP (Control)	21.02e	12.00a	0.58a	21.36d	2.85c	7.37c	28.32e	11.80a	0.62a	22.47d	2.94b	7.86b

Table 8. Effects of different mulch coverings on some leaf mineral contents of "Anna" trees during 2009 and 2010 seasons

Treatments	2009						2010					
	N (%)	P (%)	K (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)	N (%)	P (%)	K (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)
BPF	2.01b	0.32a	1.06a	302b	59b	46a	2.11b	0.31a	1.21b	299a	61a	32a
WPF	2.21a	0.35a	1.12a	301b	65a	52a	2.3a1	0.36a	1.35a	302a	69a	34a
MAS	2.01b	0.33a	1.09a	308c	62a	50a	2.22c	0.34a	1.32a	278b	62a	33a
MRS	1.99b	0.29a	1.02abc	278c	59b	48a	2.09d	0.29b	1.21b	274b	58b	29b
COM	1.98b	0.24b	1.00bc	269d	51c	32b	2.02e	0.25b	1.11c	269c	49b	27b
CP												
(Control)	1.85c	0.20b	0.97c	265d	47c	24c	1.91e	0.22c	1.02c	267c	48b	25b

Table 9. Effects of different mulch coverings on some fruit mineral contents of "Anna" trees during 2009 and 2010 seasons

Treatments	2009						2010					
	N (%)	P (%)	K (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)	N (%)	P (%)	K (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)
BPF	1.88a	0.37a	1.11b	72a	30a	48a	1.98a	0.41a	1.19a	92a	31a	42a
WPF	1.89a	0.39a	1.22a	84a	35a	51a	1.94a	0.42a	1.22a	96a	35a	45a
MAS	1.82b	0.38a	1.19a	78b	32a	50a	1.89b	0.36b	1.19a	94a	32a	43a
MRS	1.71b	0.36a	1.02b	77b	27b	44b	1.79b	0.37b	1.15a	89b	26b	39b
COM	1.69c	0.32a	1.02b	76b	27b	40c	1.62c	0.35b	0.99b	87b	27b	36b
CP												
(Control)	1.42d	0.29b	0.95c	76b	18c	38c	1.47d	0.32c	0.89c	81c	22c	34b

CONCLUSION

It can be concluded from the above mentioned results that, plastic mulch coverings treatments and applied compost of organic matter (COM) caused an increment in mean of soil temperatures and moisture content as compared with control treatment. The increment of morphological parameters and fruit physical and chemical properties by using the plastic mulching especially white plastic films comparing to check plot may be due to stimulated root growth caused by increased soil temperature and moisture given under mulching coverings with plastic films leading to early top growth.

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الملخص العربي

تأثير التسميد العضوي، محاصيل التغطية والتغطية بالبلاستيك على درجة حرارة ورطوبة التربة، النمو الخضري، المحصول وجودة الثمار على أشجار التفاح "آنا"

محمود أحمد علي، نجوى أبو المجد عبد المجيد، عفاف محمد علي يوسف

بقش البرسيم أو الأرز بينما معاملة التسميد العضوي أعطت أقل النتائج خلال موسمي الدراسة مقارنة بمعاملة الكونترول. أيضا أوضحت النتائج أن كل المعاملات تحت الدراسة تسببت في زيادة كل من متوسط وزن الثمرة، وزن الثمار/شجرة، طول وقطر الثمرة وصلابة الثمار خلال موسمي الدراسة مقارنة بمعاملة الكونترول. كما أظهرت النتائج أن نسبة تلويث الثمار كانت أعلى ما يمكن مع التغطية بالبلاستيك مقارنة بباقي المعاملات وكذلك الكونترول وقد تحققت نفس النتائج بالنسبة لمحتوى الثمار من الأنتوسيانين خلال موسمي الدراسة. كما أظهرت النتائج أن معاملة التغطية سواء بالبلاستيك أو القش خفضت من قيم الحموضة والمواد الصلبة الذائبة بينما العكس صحيح بالنسبة لمحتوى النشا والسكريات الكلية خلال موسمي الدراسة مقارنة بمعاملة الكونترول. كما أوضحت النتائج أن كل المعاملات تحت الدراسة أدت إلى زيادة معنوية في محتوى الأوراق والثمار من النتروجين، الفوسفور، البوتاسيوم، الحديد، الزنك والمنجنيز خلال موسمي الدراسة مقارنة بمعاملة الكونترول.

تم معاملة أشجار تفاح صنف "آنا" مطعوم على أصل مولنج مورتن ١٠٦ مترعة عام ٢٠٠٣ على مسافات ٤x٣ متر في منطقة النوبارية، محافظة البحيرة. تم تطبيق المعاملات التالية خلال موسمي الدراسة ٢٠٠٩، ٢٠١٠م تغطية التربة تحت محيط الأشجار: (١) معاملة المقارنة، (٢) شرائح بلاستيك أسود من فبراير حتى أكتوبر، (٣) شرائح بلاستيك أبيض من فبراير حتى أكتوبر، (٤) تغطية التربة تحت محيط الأشجار بقش البرسيم، (٥) تغطية التربة تحت محيط الأشجار بقش الأرز، (٦) ٣١٥ سماد عضوي للفدان في ديسمبر مرة واحدة. والأشجار مترعة في تربة رملية طميية ذات درجة حموضة ٧,٦ ونظام الري بالتنقيط.

أشارت النتائج أن معاملات التغطية بالبلاستيك ومعاملة التسميد العضوي أدت إلى زيادة كل من حرارة ورطوبة التربة خلال موسمي الدراسة مقارنة بمعاملة الكونترول. كما أدت معاملات التغطية بالبلاستيك إلى زيادة في طول النموات الخضرية، متوسط عدد الأوراق/فرع والمساحة الورقية تليها معاملة التغطية