17 *Egypt. J. Appl. Agric. Res. (NRC)*, **Vol. 1, No.2, pp. 237- 252 (2008)**

The Effect of Cover Crops on Soil Salinity, Yield and Quality of Balady Mandarin Trees in Sandy Soil

R. A. Abdel-Aziz*, S. B. Elharouny*, Agnieszka Grinn-Gofron**

**Citrus Research Department, Horticulture Research Institute, Cairo, Egypt and ** Department of Plant Taxonomy and Phytogeography, University of Szczecin, Poland.*

THE FIELD research was performed in 11-year-old organic Balady mandarin orchard (*Citrus reticulate*) budded on sour orange planted 5 by 5 meters at El-kssassin Research Station, Ismailia Govornorate, Egypt. It served to evaluate the effect of cover crops including 100% Egyptian clover (*Trifolium alexandrinum* L.) (T1), 100% of barley (*Hordeum vulgare* L.) (T2), and a mixture of 1:1 of clover and barley (T3) in comparison with a fallow as a control, on soil salinity, organic matter, vegetative tree growth, yield and fruit quality. Factorial plot design was used for the studies.

The results have shown significant increase in soil organic matter, tree canopy, fruit set, and fruit yield as well as decrease in soil electrical conductivity and soil pH compared to a control set when T1, T2 and T3 were applied. The highest soil salinity reduction was observed in T1 and T3. Generally, the 1:1 mixture of clover and barley is recommended as a cover crop to improve mandarin fruit yield and quality.

Keywords: Balady mandarin, Cover crop, Fruit quality, Organic matter, Soil salinity, Vegetative growth

Citrus cultivation represents the most important fruit crop in Egypt in terms of history, surface, local consumption and exportation (Sheta *et al.,* 2002). Mandarin orchards face serious problems in the newly reclaimed sandy soils. For example, citrus is salt-sensitive (Maas, 1993). Its response to salinity depends on several factors: These include rootstock - scion combinations, irrigation system, soil type and climate. Changing one or more of these factors could produce entirely different results. Similar to most other plants, salinity reduces citrus trees growth, yield and causes physiological disorders and finally leads to soil desertification (Maas, 1993 and Zekri, 1993a).

In addition, agriculture polices at national and European level have been supporting sustainable agriculture production systems (*i.e.* organic farming) able to guarantee the "environmental quality" increase by preserving air, water and soil quality.

The application of organic agriculture techniques, *e.g.* cover crops, may be considered as a preventive approach. Advantages of using cover crops include the ability to adjust pH of soil, reduce salts from soil, and provide a source of available organic nutrients as well as organic matter to the trees once the cover crop biomass is incorporated into soil (McCloskey *et al.*, 1997).

Moreover, regardless of how healthy or alive soil is, cover crops can play a vital role in ensuring that soil provides a strong foundation for farming system. While, the most common reasons for including cover crops in a farming system may relate to the current season, the continued practice of cover cropping becomes an investment in building healthy soil over the long term. Cover crops improve soil in a number of ways. Protection against soil loss from erosion is perhaps the most obvious soil benefit of cover crops, but providing organic matter is a more long-term and equally important goal. Cover crops contribute indirectly to overall soil health by catching nutrients before they can leach out of the soil profile or by adding nitrogen to the soil.Their roots can even help unlock some nutrients, converting them to more available forms. Cover crops provide habitat or a food source for some important soil organisms, break up compacted layers in the soil and help dry out wet soils (Sustainable Agriculture Network, 1998).

The present investigation was carried out to evaluate the effect of cultivating cover crops both legumes and non legume on the performance of irrigated mandarin trees planted in saline soil.

Material and Methods

Twenty four mandarin trees grafted on sour orange organically grown in the On-years were selected in two consecutive seasons 2004/2007 at El-kssassin Research Station, Ismailia Governorate, Egypt. They grew in sandy soil at 5 by 5 m. The trees were almost similar in vigor and received the normal practices for pruning, organic fertilization etc. The fertilization program was about 1.70 kg rock-phosphate /tree/year added on the soil surface close to the root system around the tree canopy in December. In addition, animal manure extraction was applied manually under tree canopy 30 liters/tree/ month from December to November.

Drip irrigation system was used to irrigate the experimental trees daily during spring, summer and autumn whereas it was done every two days during winter. One more drip irrigation line was set in the area between mandarin trees to irrigate the cover crops. Trees received 7616 m^3 ha^{-1} $year^{-1}$.

Experimental design

Four treatments in a randomized complete block design with three replicates per each one was established, *i.e.* growing 100% *Trifolium alexandrinum* L. cover crop, 100% *Hordeum vulgare* cover crop, 1:1 mixture of *Trifolium* *alexandrinum* L. and *Hordeum vulgare* between tree rows. The fallow served as a control treatment. Each replicate was represented by two trees.

Data were statistically analysed using the (SAS, V8, USA). The data were tested using the general Linear Model. Multiple comparisons of means of the tested treatments were performed according to the Duncan test (Snedecor & Cochran, 1972).

Experimental site preparation

The area between tree rows was ploughed then the seed bed was prepared. Fine animal manure and compost, 1:1 (14.4 ton ha-1), were mixed with the soil. Seeds were then sown in December 2004 and 2006 with a rate of 25 -30 kg ha^{-1} for the Trifolium alexandrinum L. and 35- 40 kg ha-1 for Hordeum vulgare (the common rate in Egypt). Cover crops were incorporated when reached full bloom.

Soil analysis

Soil samples were collected three times per each season: i) before cultivating cover crops in December, 2004 & 2006, ii) before incorporating cover crops in April 2005 & 2007 iii) after incorporating the cover crops into the soil (May, 2005 & 2007). Soil samples were taken horizontally at a distance of 200 cm from tree trunk and vertically at a depth of (0-50 cm) from soil surface using an auger. Soil pH was determined in a soil saturation extract (5g of soil + 50 ml of H_2O using a glass electrode pH- meter (Crison basic 20, xxx, SA, Alella, Barcelona, Spain at 18 °C) as described by Rhoades (1982). The level of total soluble salts (EC dsm^{-1}) was determined in soil extracts (1:2.5) of samples taken in December 2004 & 2006, April 2005 & 2007 and May 2005 & 2007 from the same site and at the same depth using electric conductivity meter (XS cond510, xxx) to obtain EC values in dsm-1 at 20°C. Soil moisture percentage was determined in samples taken from the same site in April each season. The samples were dried at 105 °C till constant weight, then the soil moisture percentage was calculated as follows: [(soil fresh weight – soil dry weight)/ soil dry weight x 100].

Soil organic matter content was analyzed according to method of Wakley and Black (Jackson, 1967). Mechanical analysis was performed randomly on three samples taken at the first sampling dates, according to the description reported by Chapman and Pratt (1961). Physical and chemical properties of soil are shown in Tables 1 and 2.

TABLE 1. Main physical properties of the soil under experimental trees

Depth (cm)	Particle size distribution %		
	Sand	Silt	Clay
0-50	86.54	3.5	9.95

Soil classification according to Stoops (1998).

TABLE 2. Main chemical constituents in the paste extract of the soil.

EC	pH	N	P	K	Ca^{++} Mg^{++}	Na^{+}	Cl^{-}	SO_4	HCO_3
ds m^{-1}	ppm				Meq/l				
280	8.04	1.3	0.70	0.30	15.33	13.43	9.3	14.58	4.53

Vegetative growth attributes of mandarin trees

At the beginning and at the end of each experimental seasons, tree height (m) and tree canopy volume (m^3) were calculated according to the equation: Canopy volume (m^3) =[0.5236 x height x diameter square] as stated by Turell (1965). The yearly increments in tree height and tree canopy volume were calculated. Ten shoots of the current spring flush, randomly distributed around the tree canopy, were tagged. Leaves number of the tagged shoots was counted and the leaf area (cm^2) was determined using leaf area meter apparatus (model CI- 203, USA). The number of flowers on each tagged shoot was counted. Later on, the numbers of set fruitlets were counted on the same tagged shoots. Fruit set percentage was calculated as follows: number of set fruitlets/ number of flowers x 100). The percentage of fruit drop was calculated according to the following equation: Fruit drop (%) = number of dropped fruits/ number of set fruitlets x 100. Fruit weight (g) and the number of fruit/tree were determined and the yield/fed/ton was calculated. TSS, acidity, TSS/acid ratio and vitamin C were determined in the fruit juice.

Leaf chemical constituents

Samples were taken in (August) of mature leaves from the middle locations of non fruiting shoots of the previous spring flush. Then, dried at 70 °C and were finely grounded and digested in a mixture of perchloric: sulphuric acid (1:3 v/v). The following determinations were carried out: total nitrogen (%) using Kjeldahl method (Naguib, 1969), phosphorus (%) by ascorbic acid method (Watanabe and Olsen, 1965), potassium using the photometric method outlined by Brown and Lilliand, (1946).

Total carbohydrates were determined colorimetrically (at 490 mμ), using phenol sulphuric acid method given by Smith *et al.* (1956). The concentration of sugar was obtained from glucose standard curve.

Results and Discussion

Tree vegetative parameters

Tree height and canopy

The increments in tree canopy volume, generally, ranged from 0.002 to $0.052 m^3$ according to the tested treatment.

Statistical analysis shows that the effect of cover crops was significant Fig. 1. The highest value occurred for *T. alexandrinum* L. However, there was no significant differences between *T. alexandrinum* L. alone and 1:1 mixture of *T. alexandrinum* L. and *Hordeum vulgare*. The least values were obtained from the fallow treatment. This could be due to the amount of nitrogen added by the *T. alexandrinum* L. which influences tree vegetative growth (Esteban, 2001). Moreover, it is noticed that the tree canopy rate increased as the soil salinity decreased. These data are confirmed by Adnan (2004).

The same trend was noticed with the tree height rate (Fig. 1).

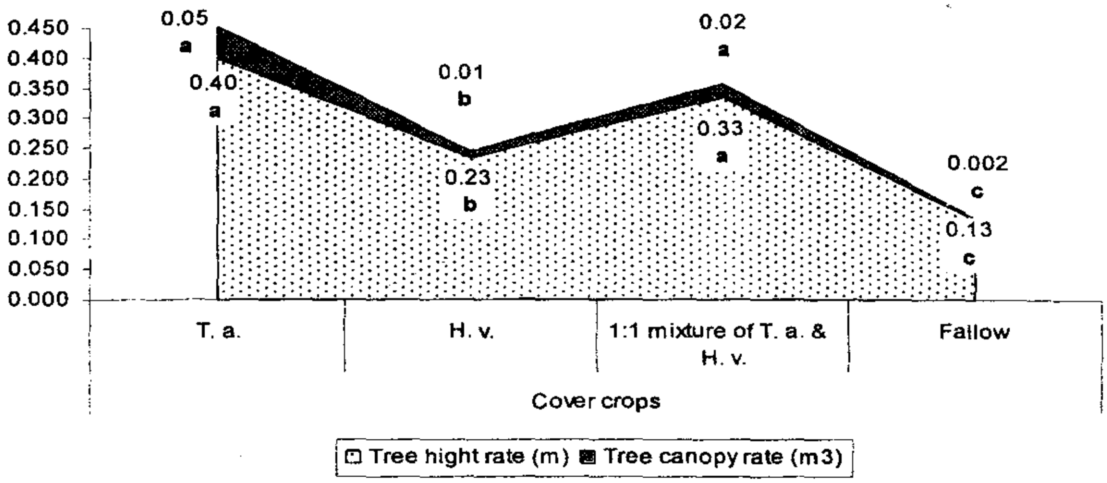

Fig. 1. Effect of cover crops on mandarin tree height rate (m) and tree canopy rate (m^3) Means followed by the same letter are not significantly different at P =0.05 (Duncan test).

Leaf number/shoot and leaf area (cm^2)

The average leaf number /shoot is presented in Fig. 2. The effect of cover crops had significant differences on the leaf number/shoot in both experimental seasons. The highest values were obtained from the *T. alexandrinum* L. and 1:1 mixture of *T. alexandrinum* L. and *Hordeum vulgare* cover crop, whereas the least value has resulted from the control sample. However, there were no differences between the *T. alexandrinum* L. and *Hordeum vulgare*.

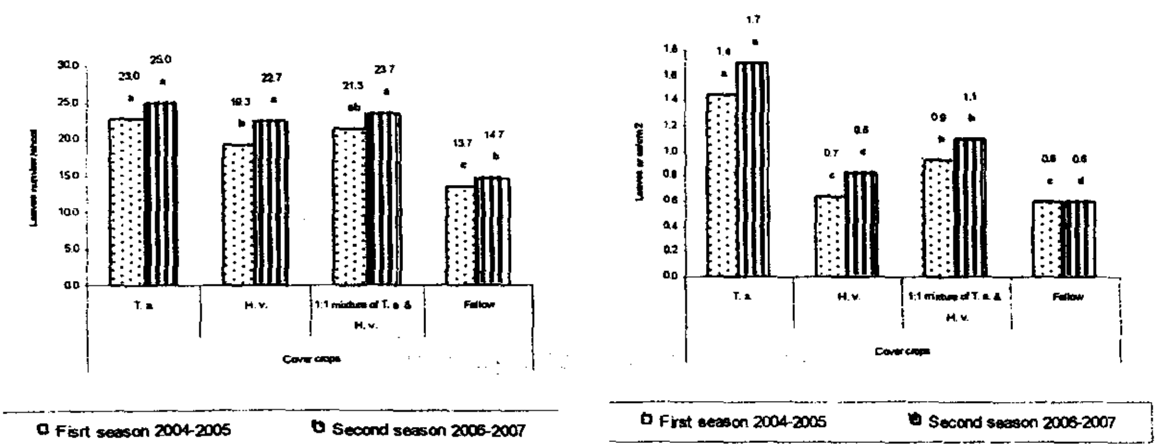

Fig. 2. Effect of cover crops on number of mandarin tree leaves per shoot and area (cm^2) Means followed by the same letter are not significantly different at P = 0.05 (Duncan test).

The leaf area generally ranged from (0.6 to 1.7 cm^2) according to the tested treatments. The effect of the cover crops was statistically significant in both studied seasons (Fig. 2). The best leaf area occurred by *T. alexandrium* followed by the 1:1 mixture of *T. alexandrinum* L. and *Hordeum vulgare*. The least values resulted by the fallow treatment.

Leaf mineral contents

The effect of cultivated cover crops on leaf NPK contents was shown in Fig 3. Statistical analysis showed significant differences in the first season for leaf N and P contents while it was insignificant for leaf K content. Moreover, all the treatments gave significant differences in the second season. However, The 1:1 mixture of *T. alexandrinum* L. and *Hordeum vulgare* gave the highest leaf P and K contents while the *T. alexandrinum* L. gave the highest value of leaf N content.

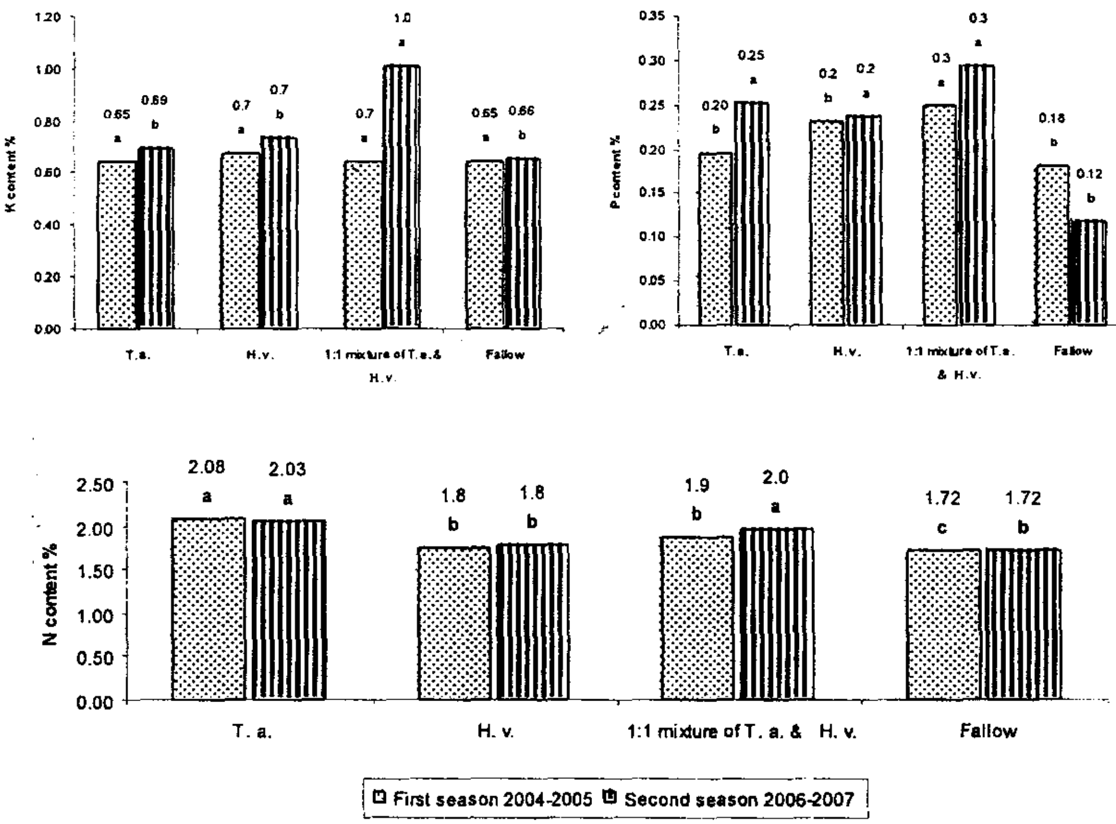

Fig. 3. Effect of cover crops on leaf mineral contents of mandarin tree Means followed by the same letter are not significantly different at P =0.05 (Duncan test).

In view of the obtained results, the obtained data could be due to the organic matter that added to the soil via cover crops. These organic matters feed microorganisms in the soil that, in the process of eating and living and dying, recycle the nutrients embedded in the organic matter. The microbes slowly release not only nitrogen, phosphorous and potassium but also a host of other nutrients and produce substances that combine with minerals in the soil and make them more available to plants in ratios difficult to replicate with synthetic fertilizers (Deborah, 2006).

Leaf carbohydrate content

Data presented in Fig. 4 showed that there was no significant difference between the tested cover crop treatments. However, the control treatment has the lowest carbohydrate contents. The differences started to show significant difference in the second season. The highest value resulted from the use of 1:1 mixture of *T. alexandrinum* L. and *Hordeum vulgare.* These results can be due to the availability of plant nutrition .

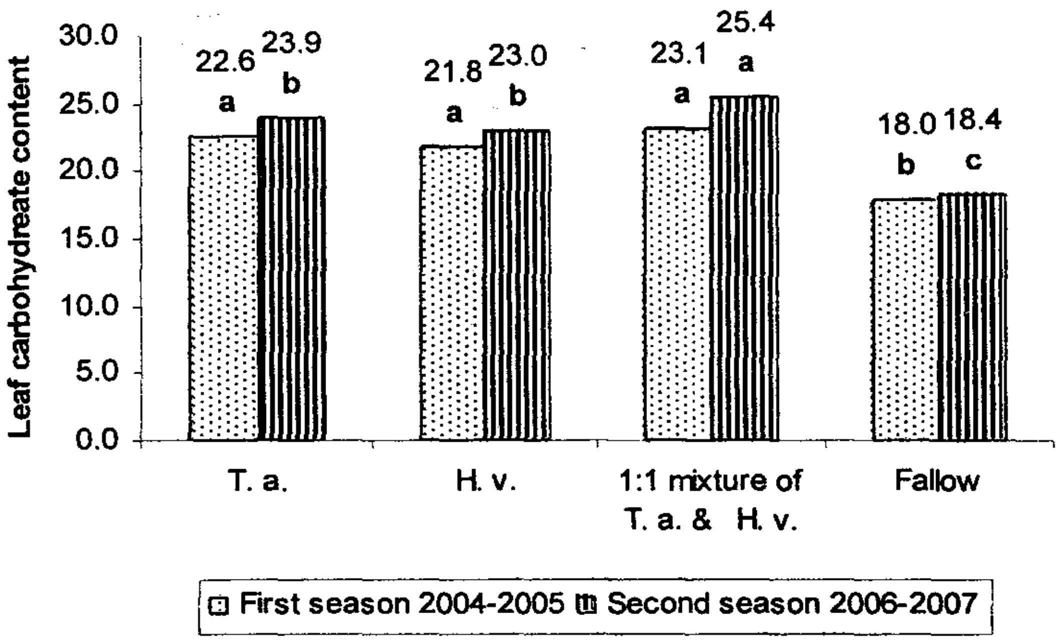

Fig. 4. Effect of cover crop on leaves carbohydrate contents of the mandarin trees Means followed by the same letter are not significantly different at P =0.05 (Duncan test).

Fruit set and Fruit parameters

Fruit set percentage

The effect of tested cover crops was significant in both seasons on the fruit set percentage. The highest value resulted from the use of 1:1 mixture of *T. alexandrinum* L. and *Hordeum vulgare* while there was no significant difference between the *T. alexandrinum* L. and *Hordeum vulgare* alone. The lowest fruit set value was attained by the control treatment (Fig. 5).

In general, cover crops have the advantages not only to increase water-holding capacity but also to modify the microclimate under the tree canopy. These advantages reduce tree stress which can positively affect the fruit set percentage (Pehrson, 1989, Robert *et al.*, 2001 and Dong & Shu, 2004). They mentioned that cover crops reduce tree stress factors *i.e.* water stress and high temperature improve the fruit set percentage in citrus and apple orchards.

The obtained results of fruit set were confirmed by Lin (1998) on Satsuma varities, Gonzalez- Altozano and Castel (1999) on Clementina de Nules; Ebrahiem and Mohamed (2000) on Balday mandarin trees and Abd El Aziz, (2004) on Valencia orange.

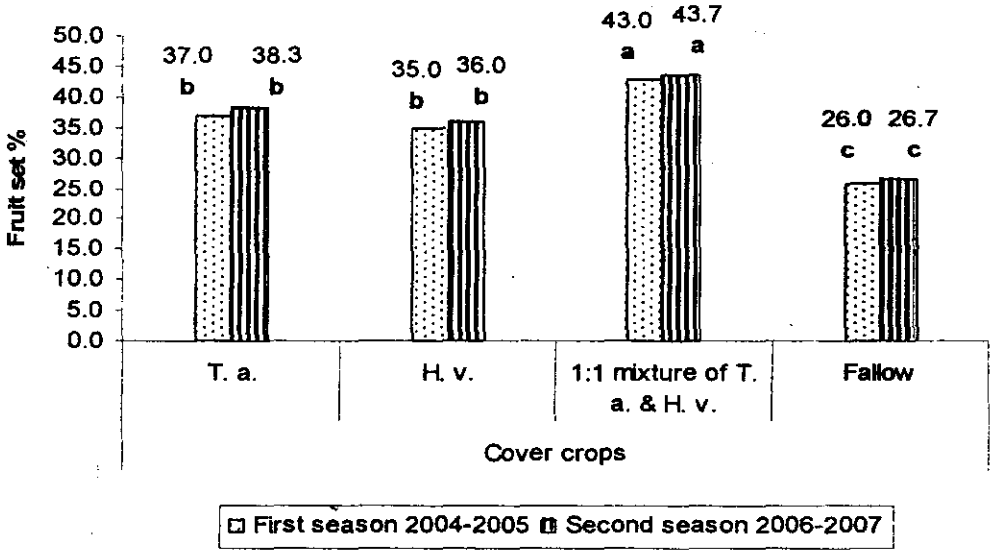

Fig. 5. Effect of cover crop on the fruit set percentage of the mandarin trees Means followed by the same letter are not significantly different at P =0.05 (Duncan test).

Fruit number/tree

Data represented in Table 3 cleared that the highest fruit number per tree obtained from the use of 1:1 mixture of *T. alexandrinum* L. and *Hordeum vulgare* followed by both the *T. alexandrinum* L. and *Hordeum vulgare* as individually cover crops without significant difference between them in the two consecutive seasons. However, the lowest fruit number has resulted by the control treatments in both analyzed seasons. However, the reduction in fruit number/tree, in the second season, ranged from 14 % to 25% in the second season. This could be due to the natural thinning that happened in the first season.

Yield/fed/ton

The same trend was found in the case of yield/fed/ton (Table 3). The yield/fed/tone ranged from (12.6 to 18.6 ton) in the first season and from (1.2 to 8.0 ton) in the second season. All the tested cover crops have promoted the yield/fed/ton in the first season. The highest value was obtained by cultivating both the *T. alexandrinum* L. and *Hordeum vulgare* without any significant difference between them in the second season, while the lowest values were noted from the fallow treatment in the first and second seasons.

TABLE 3. The effect of cover crops on the yield components and fruit chemical compositions.

Treatments	Yield components		Fruit chemical compositions			
	Fruit umber /tree	Yield/ $*ha^{-1}$	TSS %	Acidity %	TSS/acid ratio	Vit. C. (mg/100 ml juice)
	First season (2004/2005)					
T. a	440.0 b	15.7 b	9.7 b	1.5 a	7.0 a	26.0 a
H.v.	470.0 b	16.4 ab	11.4 a	1.4 a	8.5 a	25.0 a
1:1 *T. a.* & *H.v.*	523.3 a	18.6 a	11.7 a	1.5 a	7.7 a	27.9 a
Fallow	306.7 c	12.6 c	11.2 a	1.47 a	7.7 a	24.0 a
LSD 5%	32.46	1.08	0.90	NS	NS	NS
	Second season (2006/2007)					
T. a	355.0 b	19.0 a	10.7 a	1.5 a	7.2 a	27.3 a
H.v.	351.7 b	15.2 b	11.7 a	1.3 a	9.3 a	26.0 ab
1:1 *T. a.* & *H. v.*	393.3 a	18.8 a	11.9 a	1.3 a	9.0 a	28.7 a
Fallow	263.3 c	7.6 c	11.2 a	1.4 a	8.8 a	24.0 c
LSD 5%	25.74	1.04	NS	NS	NS	3.14

* Hectare = ha = 2.38 fed.

Fruit chemical compositions

Fruit TSS, acidity and TSS acid ratio

The effect of the cultivation of cover crops on fruit TSS was statistically significant in the first season and insignificant in the second. It could be stated that in the first year the soil water holding capacity was lower than in the second year. The TSS generally ranged from (9.7 to 11.7) in the first season and from (10.7 to 11.9) in the second season. The highest values were obtained by using a 1:1 mixture of *T. alexandrinum* L. and *Hordeum vulgare*. The lowest values have resulted from the use of 100% *T. alexandrinum* L. (Tab. 3). Data in hand could be interpreted in the light of the fact that cover crops increase the availability of irrigation water as a result of increasing water holding capacity (Mark *et al.*, 2006).

Data shown in Table 3 clarified no significant difference in fruit acidity and TSS acid ratio both in the first and second seasons.

Fruit vit. C content

In the first season the differences between the tested treatments was insignificant and were significant in the second. The highest values were resulted from the use of 1:1 mixture of *T. alexandrinum* L. and *H. vulgare* followed by the use of 100% *T. alexandrinum* L. and 100% *H. vulgare* while the lowest value was obtained from the control treatment (Tab. 3). Results of the first season could be discussed by the fact that the trees absorbed an abundance of nitrogen added as a result of incorporating cover crops into the soil while in the second season the accumulation impact of cover crops on soil organic matter was clear which increased the availability of the macro and micro nutrients to be absorbed. Therefore, a plant will decrease protein production and increase carbohydrate production when it absorbs low of nitrogen and because vitamin C is made from carbohydrates, the synthesis of vitamin C is increased (Worthington, 2001).

Soil parameters

Soil organic matter

Data presented in Fig. 6 refer to the evolution of soil organic matter (SOM) content during the first, second and third sampling dates (December 2004 & 2006, April 2005 & 2007 and May 2005 & 2007). No significant changes in SOM content were observed for the tested cover crops in the first sampling dates (December 2004) whereas significant differences were observed in the second and third sampling dates (April 2005 and May 2005) in the first season. The effect of the tested cover crops was significant with all the three sampling dates in the second season.

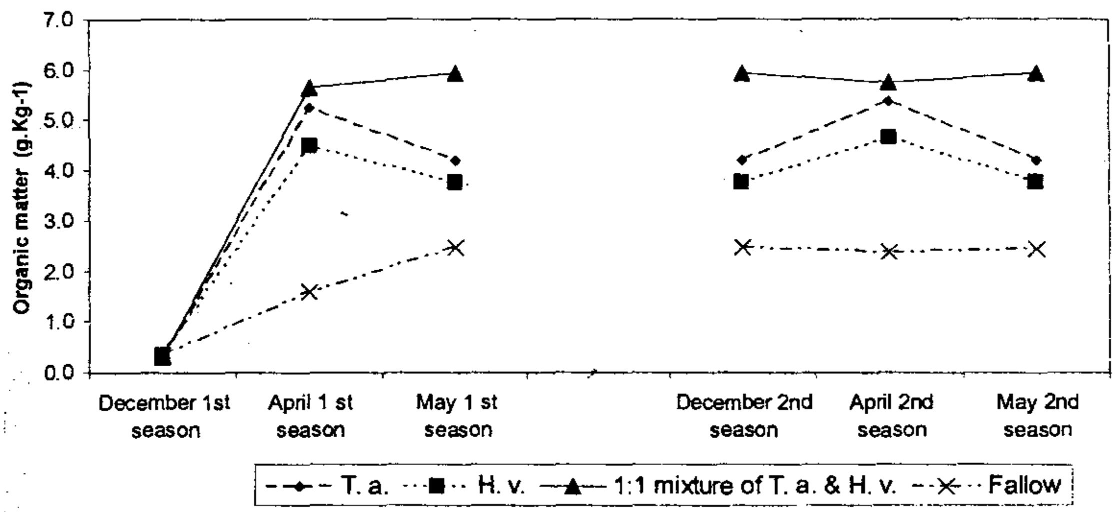

Fig. 6. Effect of cover crops on soil organic matter evolution (g.Kg^{1}) .

However, for the 1:1 mixture of *T. alexandrinum* L. and *H. vulgare* the best results were noted in all the sampling dates (December 2004/2006, April 2005/2007 and May 2005/2007).

Indeed, in that trial, both the tested cover crops showed high increases in soil organic matter and characterized by an important production of biomass closely to soil surface. Incorporating of the legumes biomass increased organic matter in the soil. The same results were noted by Mahler (1989) and Al-Bitar (2004).

Soil Electrical Conductivity

Under the conditions of this investigation, the level of soil electrical conductivity was considered high (> 2.34 dsm^{-1}), intermediate (2.34-1.56 dsm^{-1}) and low (< 1.56 dsm^{-1}) in the soil extract (Magistad and Christiansen, 1984). However, the soil electrical conductivity has reduced with the time (Fig.7).The lowest values were obtained in the last measuring date (May 2007).

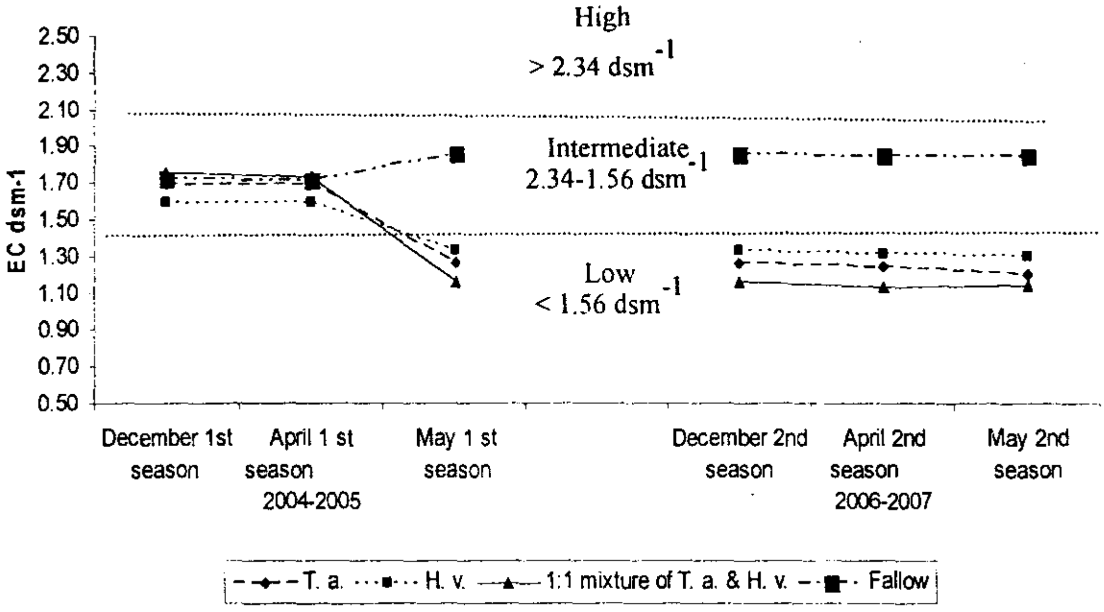

Fig. 7. Effect of cover crops on soil EC evolution (dsm^{-1}).

The reduction in soil salinity levels might be due to the role of legumes cover crops which have the potential to reduce soil salinity level through their deep roots that improve drainage, help to lower the water table level and thus reduce soil salinity (Eilers *et al.*, 1995).

Such effects started to be more evident in the second and third date (April 2005 & 2007 and May 2005 & 2007). Soil salinity level attained the highest values with the fallow treatment, whereas the lowest values were obtained with 1:1 mixture of *T. alexandrinum* L. and *H. vulgare.* The values ranged from (1.59 to 1.73) and from (1.16 to 1.85 dsm^{-1}) and from (1.13 to 1.84) and from (1.14 to 1.84 dsm^{-1}) in the sampling dates of April 2005 and May 2005 in first and second seasons, respectively. The least value resulted from the use of 1:1 mixture of *T. alexandrinum* L. and *H. vulgare* and the heights value resulted from the fallow treatment.

Soil pH

The values of soil pH were higher in the first sampling date (December 2004) in the first season and ranged from 7.9 to 8.1 ppm, the soil classified then as moderately alkaline Fig. 8. These values have reduced in the second and third sampling dates (April 2005 & 2007 and May 2005 & 2007) especially with the cultivated cover crops. The values ranged from 7.0 to 7.8 ppm; 7.0 to 7.6 ppm; 7.0 to 7.8 and from 6.7 to 7.6 ppm in the second and third dates (April 2005 & 2007 and May 2005 & 2007) in the first and second seasons, respectively. These values moved the soil from moderately alkaline class to the neutral one (Marx and Stevens, 1999).

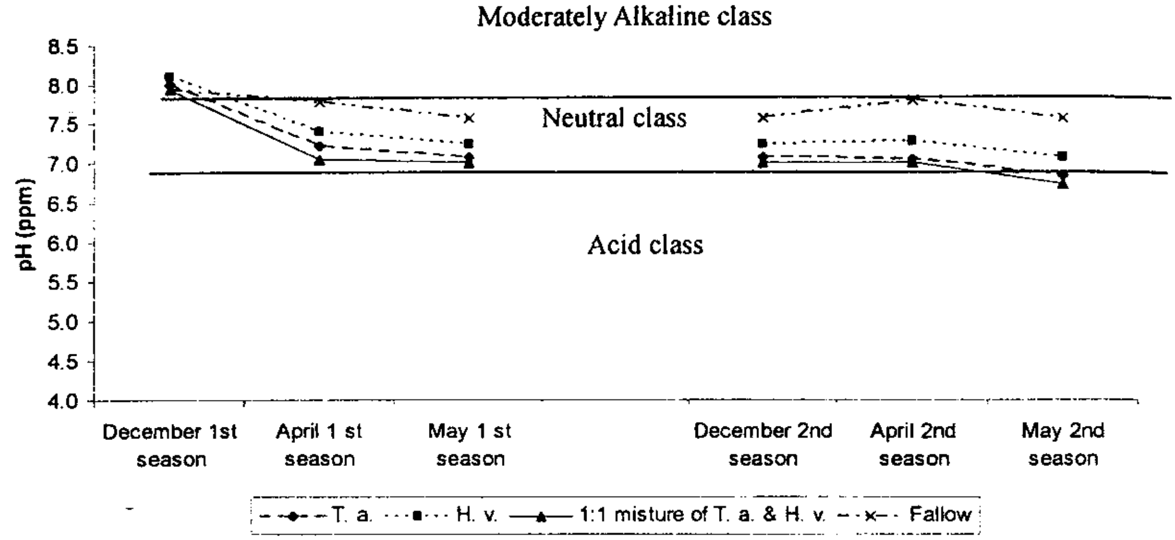

Fig. 8. Effect of cover crops on soil pH evolution (ppm)

The reduction in soil pH contents is probably because of the tested cover crops, which could lower soil pH after decomposing into the soil and releasing organic acids (USDA, 1998).

Statistical analysis have shown significant differences between the tested treatments in both the second and third sampling dates and the differences in the first sampling date were not significant in the first season. On the other hand, the tested cover crops have shown significant differences in the first, second and third sampling date (December 2006, April 2007 and May 2007) in the second season.

In general, the lowest values resulted from the use of 1:1 mixture of *T. alexandrinum* L. and *H. vulgare.*

Soil moisture

Data showed in Fig 9 cleared significant differences between the tested treatments on the soil moisture content. The highest values were obtained from the 1:1 mixture of *T. alexandrinum* L. and *H. vulgare* and the *T. alexandrinum* L. without significant differences between them, in both the experimental seasons, while the least values resulted from the fallow. These results may as a result of the good impact of the cultivated cover crops to enhance soil organic matter, water holding capacity and soil aggregation.

Conclusion: According to the obtained results we can conclude that, cultivating a mix of clover and barley cover crops between balady mandarin tree rows and then incorporating them when they reach the bloom results in enhancing soil organic matter and reducing the soil pH. The reduction in soil pH increases the availability of macro and micronutrients to be absorbed which is reflected on the tree vigor and fruit quality. On the other hand, cultivating cover crops between mandarin trees can cause a reduction in the fruit number per tree due to the natural thinning that happened as a result of the competitions between the cover crops and the trees. However, the fruit quality parameters were improved. We noticed that the trees yielded a remarkable yield in the off-year. This could be due to the natural thinning that happened in the first season. Based on that notice, we can recommend making more investigations to evaluate the effect of cultivating cover crops between mandarin trees on the alternate bearing.

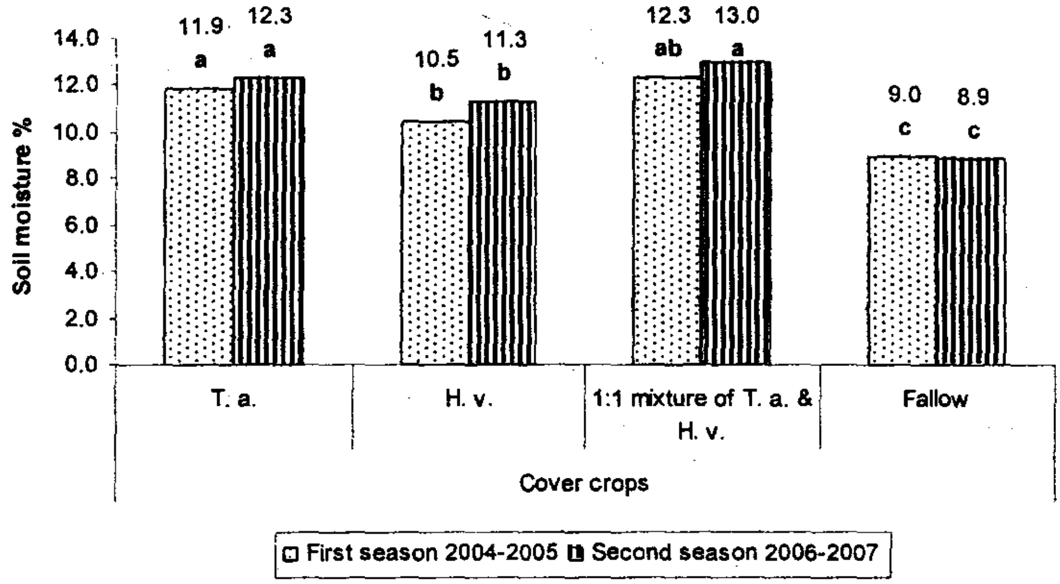

Fig. 9. Effect of cover crops on soil moisture content (%) Means followed by the same letter are not significantly different at P =0.05 (Duncan test)

References

Abd El Aziz, R.A. (2004) Effect of some irrigation treatments on the physiological activities of Balady orange trees. *Ph.D. Thesis,* Hort. Dept. Fac. Agric. El- Zagazig Univ. Egypt.

Adnan, A. (2004) Influence of salinity on citrus: a review paper. *Central European Agriculture Journal* 5 (4), 263-272.

Al-Bitar, L. (2004) Annual self-resseding legumes, a key component of sustainable in Mediterranean organic cropping systems. *Ph.D. Thesis. Universita Degli Studi della* Tuscia- viterbo, Italy.

Brown, J.O. and Lilliland, O. (1946) Rapid determination of potassium and sodium in plant material and soil extracts by flame photometry. *Proc. Amer. Soc. Hort. Sci.,* **48,** 341- 346.

Chapman, H.D. and Pratt, P.F. (1961) *"Methods of Analysis for Soils and Waters".* Univ. of California, Division of Agric. Science.

Deborah, K. R. (2006) Organic fruits and vegetables work harder for their nutrients produce has been losing vitamins and minerals over the past half-century. San Francisco Chronicle page F – 5.

Dong, S. and Shu, H. (2004) Sheep manure improves the nutrient retention capacity of apple orchard soils. *Acta Hort.* (ISHS) **638**,151-155 http://www. actahort. org/books/638/638-19.htm .

Ebrahiem, T.A. and Mohamed, G.A. (2000) Response of Balady mandarin trees growing on sandy soil to application of filter mud and farmyard manure. *Assiut Journal of Agricultural Sciences.* **31** (5), 55-69.

Eilers, R.G., Eilers, W.D., Pettapiece, W.W. and Lelyk, G. (1995) *The Health of Our Soils Toward Sustainable Agriculture in Canada.* L.J. Gregorich (Ed.) pp. 77-86 in Action. The National Land and Water Information Service, Agriculture and Agri-Food Canda. http:// www.agr.gc. ca/nlwis-snite/index-e. cfm?s1= pub & s2= hs_ss & page=14 [online] last consultant date 31 of Aug., 2006.

Esteban, A.H. (2001) Fertilization Programs for Apple Orchards. New Mexico State University is an equal opportunity/affirmative action employer and educator. NMSU and the U.S. Department of Agriculture cooperating. http://cahe.nmsu.edu/pubs/_h/h-319.html [online] last consultant date 5 of July.,2006.

Gonzalez- Altozano, P. and Castel, J.R. (1999) Regulated deficit irrigation in 'Clementina de Nules' citrus trees. I. Yield and fruit quality effects. *J. Hort. Sci. and Biotech.*, **74** (6), 706-713. (CAB Intern. Abst. http:// www. cabsubsets.com).

Jackson, M.I. (1967) *"Soil Chemical Analysis"*. Perentice Hall of India Private Limit. New Delhi.

Lin, Q.X. (1998) The cultural techniques for high quality, high production and high return of growing satsuma varieties. *South China Fruits*, **27**(3),14-15.

Maas, E. V. (1993) Salinity and citriculture. *Tree-Physiology* **12** (2), 195-216.

Magistad, O.C. and Cheristiansen, J.E. (1984) *Saline soils, their nature and management irrigation and drainage engineer.* U.S. Regional Salinity Laboratory, Riverside, Culifornia, Sept. Circular No. 707.

Mahler, R.L. (1989) Evaluation of the green manure potential of Austrian winter pea in northern Idaho. *Agron. J.* **81**,258-264.

Mark G., Richard, S., Jeff, M. Steven, T. K., Calvin, F. , Tim, H. William, H. and Louise, J. (2006) Soil fertility management for organic crops. Division of agriculture and natural resources. University of California. http//anrcatalog.ucdavis.edu. publication 7249

Marx, E.S. and Stevens, R.G. (1999) Soil test interpretation guide. Orgigon State University Extension Service. http://extension. oregonstate. edu/ catalog/ pdf/ ec/ ec 1478.pdf [on line] last consultant date 28 of Aug., 2006.

McCloskey, W.B., Wright, G.C. and Taylor, K.C. (1997) Managing Vegetation on the Orchard Floor in Flood Irrigated Arizona Citrus Groves. [In: Wright, G.C. (Ed.). Citrus Research Report. *College of Agriculture Series* P-109 , 91-103].

Naguib, M.L. (1969) Colorimetric determination of nitrogen components of plant tissues. *Bull. Fac. Agric. Sci., Cairo Univ.*, **43**,1.

Pehrson, J.E. (1989) Groundcovers and orchard temperatures. *Citrography* **75**,14. http://www. plantmanagementnetwork.org/pub/php/research/ covercrop/ [online] last consultant date 20 of Aug.,2006.

Rhoades, J.D. (1982) " *Soluble Salts". In: Methods of Soil analysis.* Part 2, A. I. (ed.), Agronomy Monograph No. 9.

Robert, E., Rouse, R.M., Muchovej, J. and Jeffrey, M. (2001) Guide To Using Perennial Peanut As A Cover Crop In Citrus. a Fact sheet HS-805, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of **Florida. http://edis.ifas.ufl.edu/** CH180 [online] last consultant date 15 of Aug., 2006.

Sheta, I., Eidsalem, S. and Fahmy, H. (2002) Improvement of the citrus sector by setting up common conservation strategies for the free exchange of healthy citrus plant genetic resources. http://ressources.ciheam.org/om/pdf/b33/02001705.pdf# search= %22 citrus %2C Egypt %2C %20 varieties%22 [online] last consultant date 22 of Aug., 2006.

Smith, F., Gilles, M.A., Hamilton, J.K. and Gedees, P.A. (1956) Colorimetric methods for determination of sugar and related substances. *Anal.*, **28,** 350.

Snedecor, G.W. and Cochran, W.G. (1972) "*Statistical Methods*". 6th ed. lowa State Univ., Amess. lowa. USA.

Stoops, G. (1998) Key to the ISSS "Handbook for Soil Thin Section Description". Natuurwet. *Tijdschr.* **78** ,193-203.

Sustainable Agriculture Network (1998) "*Managing cover crop profitability*". 2nd ed. Handbook series Book 3, USA. ISBN 1-888626-04-6.

Turell, F.M. (1965) Comparative noctumal thermal budgets of large and small citrus trees. *Ecology.* **46,** 25-34.

USDA (1998) "*Managing Cover Crops Profitably*". 3$^{rd.}$ ed. Handbook Series Book 9 Sustainable Agriculture Network. 10300 Baltimore Ave., Bldg. 046 Beltsville, MD 20705 www.sare.org.

Watanabe, F.S. and Olsen, S.R. (1965) Test of an ascorbic acid method for determining phosphorus in water and NaHCO3 extracts from soil. *Soil Sci. Soc. Am. Proc.* **29,** 677-678.

Worthington, V. (2001) Nutritional Quality of Organic Versus Conventional Fruits, Vegetables and Grains. *The Journal of Alternative and Complementary Medicine*, **7,** (2).

Zekri, M. (1993a) Salinity and calcium effects on emergence, growth and mineral composition of seedling of eight citrus rootstocks. *Journal of Horticultural Science*, **68** (1), 53-62.

(*Received* 20/4/2008;
accepted 8/10/2008)

تاثير محاصيل التغطية على ملوحة التربة ، المحصول و الجودة لاشجار اليوسفى البلدى فى الاراضى الرملية

رضا عبد الله عبد العزيز* ، سامح بهجت الحارونى* وأجنيشكا جرين جوفرون**
* قسم بحوث الموالح – معهد بحوث البساتين – القاهرة- مصر
و ** قسم تقسيم النبات – جامعة شتتشن- بولندا

أجريت هذه التجربة على أشجار يوسفى بلدى عضوى عمر ١١عام مزروعة على مسافات ٥*٥م بمحطة بحوث القصاصين بمحافظة الاسماعيلية بغرض تقييم تاثير محاصيل التغطية و هى البرسيم المصرى ١٠٠٪ - الشعير ١٠٠٪ و كذلك مخلوط من كلا النوعين بنسبة ١:١ بالاضافة الى معاملة المقارنة (بدون استخدام محصول تغطية) على ملوحة التربة – المادة العضوية للتربة – النمو الخضرى للأشجار و كذلك المحصول الناتج و جودة الثمار و ذلك فى تجربة عاملية

وأظهرت النتائج أن إستخدام معاملات التغطية السابقة أدى إلى زيادة معنوية فى محتوى التربة من المادة العضوية – المجموع الخضرى – عقد الثمار – المحصول وكذلك نقص الـ pH ودرجة التوصيل الكهربى للتربة مقارنة بمعاملة الكنترول. وكان أعلى نقص فى ملوحة التربة قد تحصل عليه من استخدام البرسيم المصرى و مخلوط من البرسيم المصرى مع الشعير بنسبة ١:١.

و بصفة عامة يمكن التوصية باستخدام البرسيم المصرى و الشعير بنسبة ١:١ كمحصول تغطية لتحسين المحصول و جودة ثمار اليوسفى .