

Physiological studies on fertilization of mango trees grow'n in sinai

Eid Mohamed Ahmed Zaen El-Deen

This study was conducted in two successive seasons (2003 and 2004) on Sukkary mango trees cultivar grown in an private orchard at wade El-tequnologia region in Sinai east Suez canal , Ismailia Governorate to the study response of mango trees to three organic manure sources (poultry manure , sheep dung and compost), olive oil waste water at 25 or 50 L. tree and inoculation the soil with mixed (N-fixation and phosphate dissolving bacteria) on growth, nutritional status, yield and fruit quality of mango trees. One hundred and forty four trees Sukkary mango cultivar (seven years old) nearly uniform in shape, size of growth and planted on a sandy soil at 7 + 7 meters distances and irrigated through drip irrigation system were selected. All trees under investigation were subjected to the same agricultural care usually done in the orchard . The experiment was involved three factors in split split plot completely randomized block design . The main plots were organic fertilizers , sub plots were olive oil waste water and sub sub plots were biofertilization . 1-The first factor involved the three organic fertilizers in addition to the check treatment :-a-Poultry manure (10 m3/feddan) added to soil in the end of December. b-Sheep dung (10 m3/feddan) added to soil in the end of December. c-Compost-agriculture waste (50 kg/tree) added to soil in the end of December 2-The second factor was two levels of olive oil waste water oliveoil waste water at 25 or 50 L/tree added to soil in the end of December and the control treatment . 3-The third factor consisted from biofertilization treatment (one liter from Azotobacter, one liter from Azospirillum and one liter from phosphate dissolving bacteria (PDB)) were mixed, dissolved in 140 liter water and added at 2 liter tree in the first of February and unbiofertilization treatment. The following measurements were recorded :-

VI-1-Vegitative growth :-The vegetative growth parameters as (shoot length, number of leaves per shoot, leaf length, leaf width, leaf shape index and leaf area). VI-2-Nutritional status :-Macro elements (N, P, K, Ca, Mg%) and microelements Fe, Mn and Zn as ppm) as indicator to nutritional status of Sukkary mango trees. VI-4-Flowering measurements and yield indicators :-Yield indicators of Sukkary mango trees grown in Sinai i.e., (sex ratio % , malformed panicle, fruit set %, fruit DROP percentage , yield as number and weight of fruits per tree). VI-5- Fruit quality :-VI-5-1-Physical properties :-Fruit physical properties of Sukkary mango trees grown in Sinai i.e., (fruit weight (gm), fruit volume (cm³) , fruit length (cm) , fruit diameter (cm) and fruit shape index). IV-5-2-Fruit chemical properties :-Fruit chemical properties of Sukkary mango as (total soluble solid (TSS) % , total acidity % , TSS acidity ratio, vitamin C (mg/100ml juice) , total sugars % , reducing sugars % and non reducing sugars %). IV-6-Soil chemical properties :- Soil chemical properties at the end of experiment in Sinai i.e., (EC, mmhos cm , pH, organic carbon , organic matter , total nitrogen and ON ratio). IV-7-Soil microbial content:-Total bacterial counts , counts of Azotobacter , Azospirillum and phosphate dissolving bacteria (PDB). The obtained results in both seasons could be summarized as follows :-VI-1-Vegitative growth :-1- Generally organic manure sources (poultry manure, sheep dung and compost) increased all vegetative growth parameters. However, poultry manure treatment surpassed the other two treatments number of leaves per shoot followed by compost, but compost treatment surpassed the other two treatments in shoot length, leaf length, leaf width, leaf shape31)1/11,A XI/AND CONCL VS/ON -205-index and leaf area followed by poultry manure and sheep dung gave the lowest increase in all vegetative growth parameters during both seasons. 2-Single use of olive oil waste water at 25 or 50 L.1tree enhanced all vegetative growth

parameters compared with untreated trees and using it at 25L. ree was better than at 50L1tree during both seasons of study .3-Inoculate trees with biofertilization gave the highest values of all vegetative growth parameters compared with uninoculated trees .4-Fertilization mango trees with organic manure and inoculation with biofertilization gave better results than single organic fertilization in both seasons . In addition , compost + biofertilization gave the highest values in all vegetative growth parameters except number of leaves per shoot which increased with poultry manure + biofertilization5-Use olive oil waste water at 25 or 50 L. ree and organic manure had positive result than single organic manure . Besides, using olive oil waste water at 25 L. rcc and organic manure was better than using it at 50 LAtree with organic manure and compost + olive oil waste water at 25 L. ree surpassed on other combination in all vegetative growth parameters except number of leaves per shoot which increased with poultry manure + olive oil waste water at 25LAtree .6-Using biofertilization with olive oil waste water at 25 L.1tree gave the highest values compared with use olive oil waste water at 50 L. tee in all vegetative growth parameters during both seasons of study.7- Generally, biofertilization with all combination of organic manure and olive oil waste water improved :all vegetative growth parameters. Using olive oil waste water at 25 or 50 L. ree with organic manure and biofertilization was better than using organic manure with biofertilization without olive oil waste water in all vegetative growth . Besides, using olive oil waste water at 25 L. ree with organic manure and biolertilization was better than using it at 50 [Arco with organic manure and biofertilization . Compost + olive oil waste water at 25L. ree + biofertilization surpassed all other combinations on all vegetative growth parameters except number of leaves per shoot which increased . with poultry manure + olive oil waste water at 2512,tree + biofertilizationV1-2-Nutritional status :-1-Organic manure source (poultry manure, sheep dung and compost) increased all macro and micro elements. However, compost treatment surpassed all other treatments on all macro elements followed by poultry manure. However, the highest values of leaf nitrogen and potassium content were obtained from poultry manure followed by compost treatment. Sheep dung gave the lowest increase in all macro elements followed by control during both seasons. In addition , poultry manure treatment surpassed on other treatments on all micro elements.2-Use olive oil waste water at 25 or 50 L. ree enhanced all macro and micro elements compared with untreated trees and using it at 25L. ree was better than at 50L ree in both seasons except the highest values of leaf magnesium content.3-Inoculate trees with biofertilization gave the highest values of all macro and micro elements compared with uninoculatedtrees .4-Fertilization mango trees with organic manure and inoculation with biofertilization gave better results than organic fertilization only during both seasons. In addition, compost + biofertilization gave the highest values in all macro elements except leaf nitrogen and potassium content were obtained from poultry manure + biofertilization. Moreover, poultry manure + biofertilization gave the highest values in all micro elements .5-Using olive oil waste water at 25 or 50 L. ree with organic manure had positive result than organic manure only . Besides, using olive oil waste water at 25 L. ree with organic manure was better than using it at 50 L. ree with organic manure in all macro and micro elements except leaf magnesium content was increased by using olive oil waste water at 50 L. ree + organic manure and compost + olive oil waste water at 25 L. ree surpassed on other combination in all macro elements. The highest values of leaf nitrogen and potassium content were obtained from poultry manure + olive oil waste water at 25L. ree but, the highest values of leaf magnesium content was obtained from compost + olive oil waste water at 50 LAtree 6-Using biofertilization with olive oil waste water at 25 L. ree were better than single use of olive oil waste water or with 50 L. ree in all macro and micro elements except the highest values of leaf magnesium content was obtained from using olive oil waste water at 50 L. ree in both seasons.7- Generally, biofertilization improved all macro elements with all combination of organic manure and olive oil waste water and using olive oil waste water at 25 or 50 L. ree with organic manure and biofertilization better than using organic manure with biofertilization without olive oil waste water. Besides, using olive oil waste water at 25 L. ree with organic manure and biofertilization was better than using it at 50 L. ree with organic manure and biofertilization in all macro and micro elements except leaf magnesium content increased by use olive oil waste water at 50 L ree + organic manure + biofertilization. Compost + olive oil waste water at 25L. ree + biofertilization surpassed all other combinations in all macro elements except the highest values of

leaf nitrogen and potassium content were obtained from poultry manure + olive oil waste water at 25L. ree + biofertilization, but the highest values of leaf magnesium content was obtained from compost + olive oil waste water at 50 L. ree + biofertilization.

VI-3- Leaf chlorophyll content :Use organic manure source ,olive oil waste water and biofertilization as single or with different combinations failed to show any distinctive effect on total chlorophyll of Sukkary mango trees during 2003 and 2004 seasons, but organic manure, olive oil waste water at 25 or 50 L. ree or biofertilization was better than untreated trees (control).

VI-4-Flowering measurements and yield indicators :-1- Organic manure sources (poultry manure , sheep dung and compost) increased sex ratio %, fruit set %, number of fruits per tree and weight of fruits (kg ree), but decreased fruit DROP and failed to gave any distinctive effect on malformed panicles percentage . However, compost treatment gave the highest sex ratio, fruit set , number and weight of fruits per tree and the lowest fruit DROP followed by poultry manure during both seasons.

2-Use olive oil waste water at 25 or 50 L. ree increased sex ratio, fruit set, number and weight of fruits per tree, but decreased fruit DROP and failed to gave any distinctive effect on malformed paniclepercentage compared with untreatedtrees and using it at 25L....1tree was better than at 50L ree in both seasons.

3-Inoculate trees with biofertilization gave the highest values of sex ratio , fruit set and number and weight of fruits per tree, but decreased fruit DROP and failed to gave any distinctiveeffect on malformed paniclepercentage compared with uninoculated trees .

4-Fertilization mango trees with organic manure add to inoculation with biofertilization gave better results than single organic fertilization in both seasons . In addition to, compost + biofertilization gave the highest values of sex ratio , fruit set, number and weight of fruits per tree, but decreased fruit DROPand failed to gave any distinctive effect on malformed panicle percentage .

5-Use olive oil waste water at 25 or 50 L. ree with organic manure had positive result than single organic manure. Besides, using olive oil waste water at 25 LAtree with organic manure was better than using it at 50 L. ree with organic manure and compost + olive oil waste water at 25 L. ree surpassed on the combination in increased sex ratio , fruit set %, number and weight of fruits per tree , but decreased fruit DROP and failed to gave any distinctive effect on malformed panicle percentage .

6-Use biofertilization with olive oil waste water at 25 L. ree were better than single use of olive oil waste water or with 50 L. ree in increased sex ratio , fruit set %, number and weight of fruits per tree, but decreased fruit DROP and failed to gave any distinctive effect on malformed panicle percentage in bothseasons .

7-Biofertilization with all combinations of organic manure and olive oil waste water and using olive oil waste water at 25 or 50 L. ree with organic manure and biofertilization was better than using organic manure with biofertilization without olive oil waste water. Besides, using olive oil waste water at 25 L. ree with organic manure and biofertilization was better than using it at 50 L. ree with organic manure and biofertilization .

Compost + olive oil waste water at 25L. ree + biofertilization surpassed on other combination in increased sex ratio , fruit set %, number and weight of fruits per tree, but decreased fruit DROP and failed to gave any distinctive effect on malformed panicle percentage .

VI-5- Fruit quality :-VI-5-1-Physical properties :-1- Organic manure sources (poultry manure, sheep dung and compost) increased fruit weight (gm) and fruit volume (cm)³ but failed to gave any distinctive effect on fruit length (cm), fruit diameter (cm) and fruit shape index) . However, compost treatment gave the highest fruit weight (gm) and fruit volume (cm)³) followed by poultry manure during both seasons of study.

2-Use olive oil waste water only at 25 or 50 L. ree increased (fruit weight (gm) and fruit volume (cm)³) but failed to gave any distinctive effect on (fruit length (cm) , fruit diameter (cm) and fruit shape index) and using it at 25L1tree was better than at 50L1tree in both seasons.

3-Inoculate trees with biofertilization increased (fruit weight (gm) and fruit volume (cm³)), but failed to gave any distinctive effect on (fruit length (cm) , fruit diameter (cm) and fruit shape index) compared with uninoculated trees.

4-Fertilization mango trees with organic manure add to inoculation with biofertilization gave better results than single organic fertilization during both seasons. In addition, compost + biofertilization gave the highest values of increased (fruit weight (gm) and fruit volume (cm³)) .

5-Use olive oil waste water at 25 or 50 L. ree plus organic manure had positive result than use organic manure only . Besides, use olive oil waste water at 25 L. ree with organic manure was better than using it at 50 L. ree with organic manure. Compost + olive oil waste water at 25 LAtree surpassed on other combinations in increased (fruit weight (gm) and fruit volume (cm³)) but failed to

gave any distinctive effect on (fruit length (cm) , fruit diameter (cm) and fruit shape index).6-Use biofertilization with olive oil waste water at 25 L. tree were better than olive oil waste water at 50 L. tree in increased (fruit weight (gm) and fruit volume (cm³)), but failed to gave any distinctive effect on (fruit length (cm) , fruit diameter (cm) and fruit shape index).7- Biofertilization with all combinations of organic manure and olive oil waste water at 25 or 50 L. tree was better than using organic manure with biofertilization without olive oil waste water. Besides, using olive oil waste water at 25 L. tree with organic manure and biofertilization was better than using it at 50 L. tree with organic manure and biofertilization . Compost + olive oil waste water at 25L. tree + biofertilization surpassed on other combination in increased (fruit weight (gm) and fruit volume (cm³)) but failed to gave any distinctive effect on (fruit length (cm) , fruit diameter (cm) and fruit shape index)

.IV-5-2-Fruit chemical properties :-1-Organic manure sources (poultry manure, sheep dung and compost) increased (total soluble solid (TSS) %, TSS acidity ratio, vitamin C (mg/100ml juice) ,total sugars % and non reducing sugars %), but decreased total acidity % and reducing sugars %. However , compost treatment gave the highest (total soluble solid (TSS) %, TSS acidity ratio vitamin C (mg/100ml juice) ,total sugars % and non reducing sugars %) and the lowest total acidity % and reducing sugars %) followed by poultry manure during both seasons of study.2-Use olive oil waste water at 25 or 50 L. tree and Inoculate trees with biofertilization increased (total soluble solid (TSS) %, TSS acidity ratio, vitamin C (mg/100ml juice) ,total sugars % and non reducing sugars %) but decreased total acidity % and reducing sugars % compared with untreated YON/I, / KI' _AND CONCLUSION -213-trees and using olive oil waste water at 25L. tree was better than at 50L1tree during both seasons.3-Fertilization mango trees with organic manure alone or add to inoculation with biofertilization gave better results than single organic fertilization in both seasons. In addition, compost + biofertilization gave the highest values of (total soluble solid (TSS) %, TSS acidity ratio, vitamin C (mg/100ml juice) ,total sugars % and non reducing sugars %) but decreased total acidity % and reducing sugars % .4-Use olive oil waste water at 25 or 50 L.1tree alone or with organic manure had positive result than single organic manure . Besides, using olive oil waste water at 25 L. tree with organic manure was better than using it at 50 L. tree with organic manure and compost + olive oil waste water at 25 L. tree surpassed on other combination in increased (total soluble solid (TSS) %, TSS acidity ratio, vitamin C (mg/100ml juice) ,total sugars % and non reducing sugars %) but decreased total acidity % and reducing sugars %.5-Use biofertilization with olive oil waste water at 25 L.1tree) were better than single use of olive oil waste water or with 50 L.1tree in increased (total soluble solid (TSS) %, TSS 1 acidity ratio, vitamin C (mg/100ml juice) ,total sugars % and non reducing sugars %) but decreased total acidity % and reducing sugars % .7- Biofertilization with all combination of organic manure and olive oil waste water at 25 or 50 LATree better than use organic manure with biofertilization without olive oil waste water. Besides, using olive oil waste water at 25 L.1tree with organic manure and biofertilization was better than using it at 50 LATreeSVII.X.IRT AND CONCLUSION -214-with organic manure and biofertilization . Compost + olive oil waste water at 25L. tree + biofertilization surpassed on other combination in increased (total soluble solid (TSS) %, TSS acidity ratio, vitamin C (mg/100ml juice) ,total sugars % and non reducing sugars %), but decreased total acidity % and reducing sugars %.IV-6-Soil chemical properties :-1-Organic manure sources (poultry manure, sheep dung and compost) increased (organic carbon, organic matter, total nitrogen and CN ratio), but decreased electrical conductivity EC, nunhos cm and pH. I however , compost treatment gave the highest (organic carbon , organic matter , total nitrogen and CN ratio)2-Fertilization mango trees with organic manure alone or with added to inoculation with biofertilization gave better results than single organic fertilization. In addition to, (compost + biofertilization) gave the highest values of (organic carbon , organic matter, total nitrogen and CN ratio), but decrease electrical conductivity ECe (mmhos/cm) and pH .3-Use olive oil waste water at 25 or 50 L. tree alone or with organic manure had positive result than single organic manure. Besides, use compost + olive oil waste water at 50 L. tree surpassed the other combination in increased (organic carbon, organic matter, total nitrogen and CN ratio) but decreased electrical conductivity ECe (mmhos/cm) and pH .4-Use biofertilization alone or with olive oil waste water were better than single use of olive oil waste water and using olive oil waste water at 50 L. tree + biofertilization increased (organic carbon , organic matter , total nitrogen and CN ratio).5-

Biofertilization with all combination of organic manure and olive oil waste water and use olive oil waste water at 25 or 50 L. tree with organic manure and biofertilization better than using organic manure with biofertilization without olive oil waste water. Besides, using compost + olive oil waste water at 50 L. tree + biofertilization increase (organic carbon , organic matter , total nitrogen and CN ratio). IV-7-Soil microbial content:-1-Organic manure application increased total bacterial counts , counts of Azotobacter , Azospirillum and phosphate dissolving bacteria (PDB) compared with unamended and compost treatment gave the highest values in this respect 2-Use olive oil waste water at 25 or 50 L. tree increased total bacterial counts, counts of Azotobacter, Azospirillum and phosphate dissolving bacteria (PDB) compared with control and application of olive oil waste water at 25 L. tree treatment gave the highest values in this respect 3-Biofertilization increase total bacterial counts, counts of Azotobacter, Azospirillum and phosphate dissolving bacteria (PDB) compared with untreated trees (control) and gave the highest values in this respect .4- Use biofertilization with organic manures increase total bacterial counts, counts of Azotobacter, Azospirillum and phosphate dissolving bacteria (PDB) compared with single organic fertilization and compost with biofertilization treatment gave the highest values in this respect .5-Use olive oil waste water at 25 L. tree with organic manure increased total bacterial counts, counts of Azotobacter, Azospirillum and phosphate dissolving bacteria (PDB) compared with single organic fertilization and the highest values of total bacterial counts, counts of Azotobacter, Azospirillum and phosphate dissolving bacteria (PDB) obtained from compost with olive oil waste water at 25 L tree6-Use biofertilization with olive oil waste water at two levels (25 and 50 L. tree) increased total bacterial counts, counts of Azotobacter, Azospirillum and phosphate dissolving bacteria (PDB) compared with single use of olive oil waste water. Besides, the highest values of total bacterial counts, counts of Azotobacter , Azospirillum and phosphate dissolving bacteria (PDB) obtained from olive oil waste water at 25 L. tree with biofertilization 7-Use biofertilization with all combinations of olive oil waste water at 25 L. tree and organic manure increased total bacterial counts , counts of Azotobacter , Azospirillum and phosphate dissolving bacteria (PDB) compared with using organic manure with olive oil waste water without biofertilization . Besides, the highest values of total bacterial counts, counts of Azotobacter, Azospirillum and phosphate dissolving bacteria (PDB) obtained from compost and olive oil waste water at 25 L. tree with biofertilizationIV-8-The costs and net return by Egyptian pound per feddan : 1- Poultry manure gave net return higher than other organic manure source and olive oil waste water at 25 L. tree gave net return higher than olive oil waste water at 50 L tree but biofertilization gave net return lower than olive oil waste water at 25 L. tree , poultry manure and compost treatments but better than olive oil waste water at 50 L. tree and sheep dung treatments. 2-Using biofertilization with compost gave the highest net return followed by biofertilization + poultry manure .3-Using olive oil waste water at 25 L tree + compost gave the highest net return compared with the lowest net return obtained from using olive oil waste water at 50 L. tree with sheep dung.4-Using biofertilization with olive oil waste water at 25 L tree gave the highest net return compared with using biofertilization with olive oil waste water at 50 L. tree.5-The highest net return obtained from compost + olive oil waste water at 25 L. tree + biofertilization compared with using olive oil waste water at 50 L. tree + sheep dung + biofertilization. Consequently, according to the previous results it is preferable to using compost at 50 kg tree, olive oil waste water at 25 L tree or biofertilizers at (one liter from Azotobacter , one liter from Azospirillum and one liter from phosphate dissolving bacteria (PDB)) were mixed, dissolved in 140 liter water and added at 2 liter tree) as a single use of organic fertilization or single biofertilization on sukkary mango trees under Sinai condition. Biofertilization could be used in combination with compost and olive oil waste water at 25 L. tree to improve sukkary mango yield and help to product clean fruits without pollution.