Citrus is suggested to be one of the most important fruit crops all over the world, especially in warm temperate regions, occupied the third position between fruit crops in the world after grapes and apples. Sweet oranges the main grown citrus species in world, Valencia orange cv, ranks the first position between different Sweet oranges kinds all over the world. Salinity of soil and irrigation water regimes and drought conditions are considered to be serious and major problems that faces Valencia orange growers in the dry regions, also, alkaline soils and mal-nutrition reduced citrus production. Generally, natural compounds (Magnetite and humate)can be used as soil improvement products with a superior "residual effect" in the soil and cheaper in compared to other chemical substances which practically used in agricultural systems. Application will help in a lowering cost and give safety product for crops users and increasing benefits as time function than other chemical applications. The main benefit for these materials in soil systems has been substantiated; increases nutrient availability, increased soil pH, increase cation exchange capacity (CEC).

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Valencia ornage trees

Abobatta

Waleed Abobatta

Growth and fruiting of Valencia orange trees

Improving growth and fruiting of Valencia orange trees under salinity condition by Magnetic iron and humate compounds

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Effect of humates compounds and magnetic iron on growth and fruiting of Valencia orange trees (*Citrus sinensis* L.)

Waleed Fouad Rizk Abobatta

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*First of all, thanks to "**ALLAH**" who gave me the patience, power, knowledge and helped me to finish this work without his guidance; this work would have never been accomplished.*

.

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1. *INTRODUCTION*

Citrus is suggested to be one of the most important fruit crops all over the world, especially in warm temperate regions, occupied the third position between fruit crops in the world after grapes and apples.

Moreover, citrus is a major fruit crop cultivated in Egypt as its acreage, production and exportation potentialities are concerned. It is the largest horticultural industry, during the last few years, and harvested area increased rapidly from year to year , reached 483296 feddan in 2011 from the total fruit crop area, which estimated to be 1388153 feddans, the fruiting acreage of citrus occupies 395731 feddan produced 3730685 tons with average of 9.5 tons/ fed. (According to Ministry of Agriculture and Land Reclamation **(Annual report 2011).**

Extension of the cultivated area is due to: I) fit environmental conditions. II) increasing demands of local consumption and III) its highly economic value as a main source for exportation to the European countries and the Gulf countries. Which is expected to boom in the future, such extension in area encourage establishing more studies towards finding out an appropriate management for improving the production and fruit quality.

Sweet oranges the main grown citrus species in Egypt. Valencia orange cv, ranks the second position after Navel orange cv, since it's cultivated area reached 84734 fed. Which represents about 17.5% of the total citrus area. This area produced 904911 metric tons fruits according to 2011 statistics.

Salinity of soil and irrigation water regimes and drought conditions are considered to be a serious and major problems that faces Valencia orange growers in the newly reclaimed regions, whereas, alkaline soils and mal-nutrition reduced citrus production.

Generally, natural Magnetite and humate compounds can be used as soil improvement products with a superior "residual effect" in the soil and cheaper in compared to other chemical substances which practically used in agricultural systems. Application will help in a lowering cost and give safety product for crops users and increasing benefits as time function than other chemical applications.

In addition, natural soil improvement materials are readily available in the local market, whereas, it comes from the weathering of rocks (minning product and organic manures).

Moreover, Magnetite may be play an important role in cation uptake capacity and has a positive effect on immobile plant nutrient uptake (**Esitken and Turan, 2003**), and Magnetic field could be substitution of chemical additives, which can reduce toxins in raw materials and these raise the food safety.

Organic Compost applications to the soil- plant system are diversedue to:

(i) Several organic molecules (e.g. polysaccharides and humic acids) improve soil texture through their effect on aggregation of soil particles.

(ii) Enhanced soil micro organisms, through their activity.

(iii) Enhanced nutrient cycling and weathering of soil minerals.

(iv) Composts contain considerable amount of nutrients that can supplement plant nutrition.

(v) Compost may suppress soil burn plant pathogens, mainly through the activity of antagonistic micro organisms.

(vi) Composts may exert direct enzymatic or hormonal effects on plant roots, inducing growth promotion.

Addition of humic fraction to Fe-deficient plants led to partial disappearance of leaf chlorosis symptoms with a significant increase in chlorophyll and leaf Fe content, humic acids compound fertilizer decreased the NO_3- N content in the fruits; increased vit. C and soluble sugar content **Pinton *et al*., (1998)**.

Citrus growers apply these materials (natural organic fertilizer forms like animal manures or seed meals) for perceived or real improvements in soil physical, chemical, and biological properties, but the main benefit appears to be increases nutrient availability **Perg *et al*., (2001); Obreza and Ozores-Hampton (2000)** .

Abramets and Rovdan (2001) noticed that the impact of humic compounds of peat, saprobe and preparations based on both these materials on mass transport in the soil-plants systems relating to the protection of soils and water from heavy metal pollution.

The need for these humic products in soil systems has been substantiated; many immobilizing materials increased soil pH, humic acid resulted in an increase cation exchange capacity (CEC), and decrease in metal mobility **Oste *et al.,* (2002)**.

In some cases, the addition of alkaline materials simultaneously increased the dissolved organic matter (D O M) concentration in the soil solution, resulting in increasing leaching of metal –D O M complex.

The main target of this study was implement growth and fruiting of Valencia orange trees under salinity stress by natural materials (Magnetite and Humate) under the newly reclaimed soils.

II. REVIEW OF LITERATURES

The previous studies dealing with the effect of magnetite and humic acid on some vegetative growth characters, nutritional status of the trees, yield as well as some physical and chemical characteristics of the fruits in citrus and another evergreen fruit crops are outlined under the following main topics:-

1. Effect of magnetite (Iron Ore)

Vegetative growth:

Early studies, **Savostin (1930)** reported that, a 100% increase in the rate of elongation of wheat seedlings are reached under the influence of magnetic field. **Kato** (**1988**) concluded that, *zea maiz* roots seem to be much more susceptible to the magnetic field than shoot. **Eid, *et al*., (1991)** indicated that, the magnetic iron application increased the production of dry matter on garlic. **Smith, *et al.,* (1993)** found that using different fields combination, one could separately alter the root mass, leaf size and stems thickness of *Raphanus Sativus*.

Yokatani, *et al*., (2001) showed that, magnetic fields have a highly stimulating effect on cell multiplication growth and development of *Avena* seedlings. **Abd El-Al, (2003)**, found that adding magnetic iron to eggplant plantation resulted in higher number of leaves and shoots per plant as well as dry weight compared with the untreated plants.

Esitken, (2003) indicated that, magnetic field applications increased plant growth of strawberry in terms of number of leaves, fresh and dry root weight compared with the control. **De Souza, *et al*., (2005)** illustrated that**,** the tomato plants derived from treated seeds with magnetic fields showed significantly greater leaf area per plant, leaf, stem and fruits dry weight and in general the total dry matter of the treated plants than the controls.

In addition, **Milewski, (2006)** found that, addition of magnetite to the soil promoted petunia plant growth and gave healthy plants able to resist the bugs attack, in general all plants were two to five times their normal size and growth rate. **Soltani, *et al.,* (2006)** reported that, ocimum seeds germinated more rapidly when subjected to a magnetic field, also increased the seed germination percentage, the length of radical and primary stem were also significantly higher than untreated seeds, while lateral root initiation and growth rate were significantly different in a magnetic field.

Turker, *et al*., (2007) mentioned that, static magnetic field increased leaf area and stem length in maize plants. **Al-Hefny, *et al*., (2008)** on cauliflowers concluded that, the most effective magnetite treatment for enhancing the stem length, leaf number and cauliflowers dry weight was 150 to 200 kg/ fed as compared with other levels.

Abdel Rahman, *et al*., (2009) reported that, natural elements compound (NEC) (including magnetite) significantly improved vegetative growth of Navel orange trees (spring shoots), also they found that treatments of natural elements compound significantly improved Volkamer lemon seedlings growth parameters (stem height, stem diameter and number of leaves) compared to the another treatments. **Ameen and Kassim (2009)** on gerbera plants found that, magnetized saline irrigation water increased leaf area.

Eman, *et al*., (2010) indicated that, applied of 1000 g magnetite at December induced the highest values of vegetative growth of Le-Conte pear trees (shoot length, diameter, number of leaves and leaf area).

Ismail, *et al.,* (2010) studied the effect of magnetite, metal compound fertilizer and biocide in controlling nematode, growth and yield of grapevine they showed that, the lower rates of magnetite were significantly increased shoot growth, number of leaves and dry matter % of Superior cv as compared to the other treatments.

Hozayn and Abdul Qados (2010[a]) showed that, the irrigation of chick pea plant with magnetized water significantly increased all growth parameters i.e. plant height, fresh and dry weight (g/plant) and percentage of water contents (%).

Ahmed, *et al.,* (2011) on Roselle plants illustrated that, number of branches per plant, stem diameter; leaves fresh and dry weight as well as branches had the highest values when compost or magnetic iron was added to the soil compared to the control.

Ibrahim, (2011) reported that, soil application of natural elements compound (including magnetite) significantly improved shoot length, number of leaves per shoot and leaf area of Navel orange trees.

Taha *et al*., (2011) showed that, the application of magnetite improved growth of pepper plant under salt condition.

Rezaiiasl *et al.,* (2012) indicated that, magnetic field gaved better growth rate and increased length of main stem of cucumber seedling.

Shehata, *et al*., (2012) study the influence of organic (including magnetite and humic acid) and inorganic fertilizers on cucumber, they found that, the vegetative growth; plant length, number of internodes on the main stem, number of branches per plant and number of leaves per plant were significantly affected by all applied fertilizers compared with the control.

Elzaawely, *et al.,* (2013) noticed that, magnetic field treatments increased sweet pepper seedling height, number of branch per plant, number of leaves per plant and leaf area.

Leaf chemical composition:

Mericle *et al*., (1964) revealed that, metals such as Iron and Cobalt are present in low concentrations as trace elements. They are generally considered as partially mobile physiologically. The presence of a magnetic field may affect a normal tendency of Iron and Cobalt accumulates in the meristems, thereby producing the altered growth rate pattern exhibited by the root in magnetic fields.

Abd El- Al, (2003) indicated that, application of magnetite for Eggplant at the time of cultivation resulted in the higher values of nitrogen, phosphorus, potassium and iron in plant compared with untreated plants. **Turker, *et al*., (2007)** reported that, static magnetic field increased chlorophyll concentration in Sunflower plants. **Al- Hefny, *et al*., (2008)** on cauliflower plants found that gradually increments in nitrogen, phosphorus, potassium and iron concentrations in leaves with increasing magnetite levels, whereas the percentage of sodium, chloride and sulpher were decreased with the increasing of the magnetite levels.

Dhawi and Al-Khayri (2008) studied proline accumulation in response to magnetic fields in date palm and found that, static magnetic field increased proline concentration significantly compared with the control.

Abdel Rahman, *et al*., (2009) mentioned that, natural elements compound (NEC) application on Navel orange trees significantly increase leaf macro and micro elements content such as (nitrogen, phosphorus, potassium, calcium, magnesium, iron, zinc, manganese, and copper).

Ameen and Kassim (2009) study the influence of irrigation with magnetized saline water on gerbera plants, they showed that, magnetized saline irrigation water increased leaves content of chlorine while decreased leaves chlorophyll, sodium and calcium contents.

Dhawi and Al-Khayri (2009[a]) illustrated that, chlorophyll a, chlorophyll b, carotenoids and total pigments concentration in date palm seedlings significantly increased as static magnetic field intensity increased.

Dhawi and Al-Khayri (2009[b]) concluded that, elementalcomposition of date palm was significantly affected by magnetic field and magnetic resonance imaging (MRI) except phosphorus, in addition, K: Na ratio significantly affected by MRI treatment compared with the control.

Dhawi, *et al*., (2009) on date palm reported that, intensity of static magnetic field and the duration of exposure significantly affected elements composition, the level of calcium, magnesium, iron, manganese and zinc increased, while phosphorus amount decreased.

Maheshwari and Grewal (2009) indicated that, irrigation Celery plants with magnetically water increased phosphorus and calcium concentration of celery shoots, also for snow peas; the magnetically water increased calcium and magnesium concentration.

Eman *et al.,* (2010) on Le Conte Pear trees reported that, application of 1000 g of magnetite/ tree had the highest levels of leaf nitrogen, phosphorus, potassium, calcium and iron as well as total leaf chlorophyll content.

Hozayn and Abdul Qados (2010[a&b]) on chick pea and wheat plants showed that, there were significant increases in photosynthetic pigments (Chl a, Chl b, Chl a+b, carotenoids and total pigment content from irrigated plants with magnetized water compared to control plants.

Ismail, *et al*., (2010) reported that, the highest concentrations of nitrogen, phosphorus, potassium and iron in leaves of superior grape vine were recorded when using magnetic iron ore alone or with biocide.

Mazaherinia, ***et al.,*** **(2010)** study the nano iron oxide particles efficiency on leaves nutrient concentrations in wheat plant and found that, the application of nano iron oxide powder is superior more effective than normal iron oxide in increasing iron concentration of plant significantly, while the application of normal iron oxide increased plant concentration of zinc, copper, and manganese more than nano iron oxide treatment.

Ibrahim, (2011) reported that, soil application of NEC (including magnetite) to Navel orange trees improved leaf content of nitrogen, phosphorus, potassium, calcium, magnesium, iron, zinc, manganes and cupper.

Ghasemnezhad ***et al.,*** **(2012)** showed that, the growth of cucumber seedlings which was treated with alternative currant magnetic field was significantly higher than those of other treatments.

Elzaawely ***et al*****., (2013)** on sweet pepper plants indicated that, magnetic field treatment affected leaf contents of chlorophyll a and b, carotenoids and phosphorus.

On other hand **Ursache-Oprisan,** ***et al*****., (2011)** on sunflower plants found that, magnetite nanoparticles negatively influenced photosynthetic pigment biosynthesis by diminishing chlorophyll content with up to 50 %.

The Total yield:

Abd El-Al, (2003) on Eggplants reported that, application of magnetite recorded heavier total yield of Eggplants compared with no iron addition.

Esitken, (2003) showed that, fruit yield and fruit number per strawberry plant was increased by the magnetic field strength compared with the control.

De Souza, *et al*., (2005) on tomato plants indicated that**,** the fruit numbers per plant, fruit yield/plant and fruit yield/area were significantly influenced by the magnetic treatments than the control plants.

Moreover, Magnetite treatments produced the highest total yield/ fed and curd fresh weight of Cauliflower plants compared to untreated plants **Mansour, (2007), Al-Hefny, *et al.*, (2008)**.

Abdel Rahman, *et al*., (2009) found that, soil application of (NEC) significantly improved Navel orange tree yield through increased fruit-set percentage and reduced the pre-harvest fruit drop.

Maheshwari and Grewal (2009) on celery and snow pea plants reported that, magnetic treatment of recycled water and saline water significant increased yield of Celery plants, also, affect snow pea yield and increase number of pods/plants compared with control treatments.

Eman, *et al., (*2010) reported that, the highest total yield was obtained from Le Conte Pear trees which received 1000 g and 750 g of magnetite.

Hozayn and Abdul Qados (2010[b]) illustrated that, irrigation wheat plants with magnetic water markedly increased all yield components compared to control treatment.

Ismail, *et al.*, (2010) on grapevine indicated that, application of (magnetite, metal compound fertilizer and biocide) increased vine yield in comparison to the control.

Ahmed, *et al.*, (2011) demonstrated that, magnetic iron plus humic acid application on Roselle plants recorded the highest values of seed yield, number of fruits/ plant compared with other treatments.

Ibrahim, (2011) showed that, soil application of natural elements compound (including magnetite) to Navel orange trees increased total yield and tree yield efficiency with respect to the control.

Taha, *et al*., (2011) on *Capiscum annum* grown under salin irrigation water conditions, reported that, the highest dose of magnetite gaved the highest incresesd in yield.

Shehata, *et al*., (2012) on cucumber plants found that, application of (magnetite, compost and humic acid) recorded the highest total yield per feddan and number of fruits per plant compared with control treatment.

Ali *et al*., (2013) on vineyard found that, application of humic aicd, Uni-sal, magnetic iron at highest rate were found to be superior in enhanced vine yield as expressed in weight and number of cluster/ vine in comparison with vines under salinity stress condition.

Mohamed *et al*., (2013) on Valencia orange trees indicated that, the application of biofertilizer plus 750 gm Magnetite treatment was the best combination and was superior for achieving the highest total yield.

physical and chemical characteristics of fruits :

The mature citrus (Citrus spp.) fruit is the end product of a complex set of events that starts with the formation of the reproductive structures, or flowers. The ovary develops into a mature fruit by the processes of cell division, cell differentiation and cell growth. Citrus fruit have a single sigmoid growth curve and are classified as nonclimacteric fruit **(Coombe, 1976).**

Bain (1958) described the three stages of fruit development for 'Valencia' orange (*C. sinensis* L. Osbeck) During stage I, there is slow volume growth, but intense cell division, this period is approximately 9 weeks in duration. Stage II of fruit development is characterised by very rapid fruit growth, and it is due to cell enlargement and cell differentiation. Cell division stops at the beginning of stage II, except for the outer layers of the flavedo and the tips of the juice sacs, during this stage, the rind becomes thinner as the pulp segments undergo rapid growth due to cell enlargement.

Although the rind becomes thinner, the albedo cells continue to enlarge. This is due to the albedo cells enlarging in a tangential direction which results in spongy tissue in which the cell layers are fewer than in the rind at the end of stage I. The same spongy tissue development that develops in the albedo develops in the central axis and in the septum tissue. Most of the increase in size during stage II is due to growth of the pulp segments **(Lowell *et al*., 1989)**

Stage III of fruit development is the maturation period, although volume growth still continues, the rate of growth is much lower than in stage II. Chlorophyll pigments disappear from the flavedo, with the subsequent carotenoid pigment development. Carotenoids increase significantly and are converted into highly colored pigments during and after the loss of chlorophyll.

Abd El Al, (2003) illustrated that, soil application of iron produced largest and heavier fruits of eggplants as compared with control plants.

Esitken, (2003) indicated that, magnetic field applications increased fruit weight of strawberry plants compared with the control.

De Souza, *et al*., (2005) reported that, the magnetic treatments of tomato seeds had a positive effect on mean fruit weight compare to the control plants.

Moreover, **Abdel Rahman, *et al.*, (2009)** and **Ibrahim, (2011)** on Navel orange trees found that, soil application of (NEC) increased fruit peel thickness and firmness, also increase fruit juice, TSS and vitamin C content compared with untreated trees.

Maheshwari and Grewal (2009) reported that, the magnetic treatment significantly increased fresh and dry weight of pods in Snow Pea plants.

Ismail, *et al*., (2010) indicated that, the lower rate of magnetic iron ore was more effective in achieving the best values of berry characteristics (weight, volume, length and diameter) also the lowest value of acidity and the highest value of TSS/ acid ratio of Superior grapevine as compared to the other treatments.

Ghasemnezhad *et al*., (2012) and Rezaiiasl *et al.*, (2012) on cucumber showed that, the number of fruits per plant and the length of main stem were significantly increased by magnetic field.

Elzaawely *et al.*, (2013) on sweet pepper plants, indicated that, fruit fresh and dry weight, number of fruit per plant and vitamin C content increased by magnetic field treatment.

Mohamed, *et al*., (2013) on Valencia orange trees found that, Diatoms, biofertilizers plus magnetite increased fruit dimensions, peel thickness and firmness; also fruits were more lightness and had good rind color.

2- *Effect of humic acid:*

Vegetative growth:

Humic substances have different effects on plants. In this respect, **Vaughan *et al*., (1985)**, showed evidence of stimulation on plant growth by humic substances and consequently increased yield by acting on mechanisms involved in: cell respiration, photosynthesis, protein synthesis, water, and nutrient uptake, enzyme activities.

From other side, humic substances appear to be beneficial in chelating nutrients, preventing their tie up on plant roots and leaves, also, improving conductivity of nutrients into plant tissue, resulting in more efficient utilization of nutrients **(Beames. 1986).**

Potassium humate can be used as organic potash fertilizers enhancing photosynthesis, chlorophyll density and plant root respiration which resulted in greater plant growth and yield had been reported to be due to increasing nutrients uptake such as N, Ca, P, K, Mg, Fe, Zn and Cu.

Webb and Biggs (1988) examined the effect of humate on water stressed citrus trees, they reported that application of humate plus $CaNo_3$ or humate plus micronutrients gaved greater visual improvement than the trees in the other treatments i.e. increased numbers and extent of growth flushes and bark thickness was greater for trees, also cross-sectional stem area of Hamlin/Cleo and Star Ruby/ Swingle increased in all humate treatments.

Chen and Aviad (1990); Chen *et al*., (2004). Stated that, optimal concentrations of humic acid capable to affect and stimulate plant growth have been generally found in the range of 50 - 300 mg L^{-1}, but positive effects have been also seen with lower concentrations.

Tatini ***et al*****., (1991); Fernandez-Escobar,** ***et al*****., (1996); Fernandez-Escobar** ***et al*****. (1999)** mentioned that, under field conditions, foliar application of leonardite extracts (humic substances extracted) stimulated shoot growth of olive trees.

Reynolds, ***et al.,*** **(1995)** reported that humate granules improved growth of `Chardonnay` grapevines, increasing levels of humate granular increased leaf count per vine, leaf area per vine, fresh and dry weight of leaves and petioles.

Alva and Obreza (1998) reported that application of iron humate to nonbearing trees of orange and grapefruit decreased twig dieback rating and increased flush growth, flush color rating, and tree size. **Obatolu, (1999)** showed that humic acid application significantly improved growth of young Coffee Robusta seedlings and have beneficial effect on establishment of coffee.

Zachariakis, ***et al*****., (1999)** reported that grapevine rootstocks grown in the presence of humic substances had increased plant growth, shoot and root dry matter increased significantly as well as in shoot carbohydrate content was observed significant in rootstock plants treated with humic substances.

Guo, ***et al.,*** **(2000)** reported that foliar application of 250-time solution of Komic promoted shoot growth of Red Fuji apple in compared with other treatments.

Atiyeh, ***et al*****., (2002)** found that incorporation of pig manure vermicompost humates into Metro-Mix 360 increased the heights, leaf areas, shoots and roots dry weights and the leaf areas of tomato seedlings grown in these mixtures significantly compared to the control.

Eissa, (2003) reported that application of (Phosphorin + Microbin + potassium humate + Yeast) on Canino apricot trees recorded significant effect on all foliage measurements compared with control.

Rengrudkij and Partida (2003) noticed that, avocado seedlings treated with humic acid had the best results concerning of shoot height and shoot diameter.

Omar and Abdelall (2005) on Superior grapevine noticed that, leaf area was significantly increased with increasing levels of sulphuric acid, humic acid, sulpher and irrigation water treatments.

Shadad, *et al*., (2005) indicates that, bio fertilizers and humate were clearly improved vegetative growth of Canino apricot (leaf area, percentage of leaf dry weight and leaf chlorophyll content) compared to control plants.

El-Seginy, (2006) on young pear and apricot trees, noticed that, all treatment of actosol (soil + foliar) and EM improved all vegetative growth parameters i.e. trunk circumference, number of new shoots, shoot length, shoot diameter, leaf area, tree height and canopy diameter compared with untreated trees.

Norman, *et al*., (2006) noticed that, humic acids extracted from food waste vermicompost as a general pattern increased growth of pepper and marigold plants in response to treatments.

Eissa, *et al*., (2007[a&b]) indicated that humic acid treatments

stimulated shoot length and number of leaves of Le Cont pear, peach and apricot seedlings, also, soil application of humic acid effectively decreased the deleterious effect due to salt accumulation in plant tissues and supported plants to produce longer shoots, higher number of functioning leaves with better expansion.

Ismail, *et al*., (2007) reported that soil application of humic acid (50 ml/L /tree) of Le-Cont pear tree significantly enhanced the growth parameters, also there were gradual increase in shoot length, shoot diameter, number of leaves per shoot and leaf area paralleled to increasing humic acid.

Sayed, *et al.,* (2007) illustrated that, humic acid application on Valencia orange tree significantly increases the values of leaf area, canopy volume and dry weight compared to control.

Abdel Fatah, *et al.* (2008) mentioned that, soil drench application of humic acid to Tifway Bermoda grass hybrid improved growth parameters.

Ferrara, *et al*., (2008) on Italia table grape, found that, the highest increment of shoot length recorded with application of 20mg/L humic acid.

El-Rmah, *et al*., (2009) noticed that, all treatments of mineral fertilizer combined with compost and humic acid gave better effect on trunk and shoot diameter, shoot length and leaf area of young Le-Cont pear trees.

Ghoname, *et al*., (2009) reported that, application of ammonium nitrate with potassium humate had the highest number of branches/plant as well as plant fresh and dry weight of hot pepper.

Katkat, *et al*., (2009) found that, soil application of humus had highest dry weight and mineral elements uptake of wheat plants compared with the control.

Marosz, (2009) studying effect of fulvic and humic organic acids on growth of tree species under salt stress and reported that, humic acids application improved growth of all the Maple species when compared to the control group.

Abdel-Aziz, *et al., (*2010) on Eureka lemon trees found that, there was significant increment in lemon tree canopy volume, average leaf area among treatments of some organic fertilization.

Moreover, humic acid and activate dry yeast treatments on Picual and Aggizy olive trees had highest significant values of leaves dry weight and leaf area per plant compare to other treatments **(Abou Rawash, et *al*., 2010** and **El Sayed 2013).**

El-Bassiony, *et al*., (2010), **El-Hefny, (2010**) and **Hanafy, *et al*., (2010)** showed that, there were gradually and significantly increased of vegetative growth parameters, i.e. plant height, number of leaves and branches as well as fresh and dry weight of whole snap bean and cowpea plants with the rate of humic acid application.

El-Shall, *et al*., (2010) on plum tree reported that, the combined foliar and soil application of humic acid increased tree height, trunk cross-sectional area, shoot number and shoot length and diameter compared to all the other treatments.

Fathy, *et al*., (2010) reported that 15 cm^3 foliar spraying and 75 cm^3 soil addition of humic acid treatment had the highest significant records of shoot length and best values of number of leaves per shoot and leaf area of Canino apricot tree compared to other treatments.

Fayed, (2010) found that (yeast + humic acid) foliar application affected significantly vegetative growth parameters (growth rate of trunk diameter, number of newly formed shoots/twig, new shoot length, number of leaves/shoot and leaf area) of Roghini olive trees.

Ghurbat, (2010) noticed that spraying humic acid with a concentration of 2 g/l caused highest average of cucumber leaf area compared with control treatment

Hassan, *et al*., (2010) reported that humic acid plus 100% mineral nitrogen on young kalamata olive tree gave the highest significant values of leaf number per plant compared with other treatment.

Mehanna, *et al., (*2010) showed that, soil application of humic acid on grapevine rootstock gave the highest plant length and diameter values compared to other treatments and also increased number of leaves per plants and leaf area in the second season compared to other treatments.

Mohammed, *et al*., (2010) illustrated that all vegetative growth parameters of pear trees like (number of leaves / shoot, leaf area, growth rate of trunk diameter, new shoot length and shoot diameter) were significantly affected by application of (compost plus bio-fertilization plus humic acid plus compost tea) compared with other organic treatments.

Rizk-Alla and Tolba (2010) found that, application of (humic acid + Nile Fertil + Mycorrhiza fungi) to Black Monukka grapevines induced the highest values of total leaf area/ vine, shoot diameter compared with other treatments

Salem, *et al*., (2010) on Le-Cont pear tree reported that, all vegetative growth parameters like tree height, tree diameter increment, number of leaves per shoot, leaf area and shoot length and diameter were improved for trees that received humic acid as compared with other treatments.

Abd El-Monem, (2011) found that application of (1% humic acid +0. 5% micro elements) on Coratina olive seedlings significantly increased plant height and recorded the highest value of leaf area while application of (1% humic acid + 0.25% micro elements) gave the highest value of stem diameter.

Aydin, (2011[b]) reported that, humic acid application increased leaf area and leaf water content values of Muskule table grape.

Cavalcante, *et al*., (2011) demonstrated that, humic substances sprayed positively affect aerial part; root system and seedling quality of papaya are improved.

Du *et al.,* (2011) showed that, compound fertilizer with humic acid application increased thickness and fresh weight of leaves, stem growth and enhanced net photosynthetic rate as compared to other treatments.

El-Khateeb, *et al*., (2011) indicated that, mycorrhizal inoculation and humic acid application significantly increased plant growth parameters of *Acacia Saligna* including plant height, stem diameter, leaf area and fresh and dry weight of leaves.

El-Khawaga, (2011) on peach trees found that, using inorganic nitrogen through 50 to 90 % plus 40 to 90 ml humic acid plus 5 to 25 ml *Spirulina platensis* algae / year significantly enhanced the leaf area.

El-Kosary, *et al*., (2011) on Keitt and Ewais mango trees found that, application of microelements and humic acid had the highest number of growth cycle comparing with other treatments.

El-Wakeel and Eid (2011) reported that, mixed nitrogen form with K-humate recorded the highest significant value of plant height increment percentage of nonbearing Navel orange trees.

Hagagg, *et al*., (2011) showed that, application of humic substances to Egazy olive seedlings at rate of 4 cm3/ plant/ month without addition of N P K or with lowest rate of mineral fertilizer gave the best results concerning plant height increment, shoots number per plant, leaves number per plant and the value of stem diameter compared to other treatments.

Khaled and Fawy (2011) on Corn (Hagein, Fardy10), stated that, economical levels of application should be determined and should not exceed 2 g humus/kg in soil and 0.1% in foliar.

Khazaie *et al*., (2011) found that, highest humic acid concentration represented direct impacts on aboveground and leaf biomass and total essential oil yield of hyssop.

Morard, *et al*., (2011) reported that, humic-like substances had positive effects on the fresh weight for all organs of Pelargonium plants.

Yousef, *et al., (2011*) demonstrated that, applied of (humic acid plus amino acids plus macro elements plus trace elements) to olive seedlings recorded the tallest plants and higher values of stem diameter and highest number of branch number per plant and highest number of leaves per seedling

Abd El-Razek *et al.,* (2012) indicated that, humic acid treatments on Florida Prince peach trees increased leaf chlorophyll content, chlorophyll (a), (b) & (a+b) than the control.

Aydin, *et al*., (2012) showed that, the highest leaf area of bean plants was observed with K_2SO_4 salt source with 0.1% humic acid application.

Barakat, *et al*., (2012) illustrated that, application of organic fertilization plus humic acid recorded highest tree canopy volume, higher increment of trunk circumference and highest leaf area of New hall Navel orange trees.

Eisa, *et al*., (2012) reported that, Pre-sowing sugare beet seeds with humic acid significantly stimulated all tested growth characters like shoot fresh weight and root fresh weight and had the maximum averages compare with control treatment.

Gad El-Hak, *et al*., (2012) found that, spraying pea plants with humic acid at 2g/L produced the tallest plants and the highest values of number of branches / plant.

Gawad, *et al*., (2012) on Crimson seedless grapevine reported that, main shoot length and leaf area increased in vines received compost plus biofertilizer and humic acid as compared to control.

Hagagg, ***et al*., (2012)** on Coratina olive reported that, combination between foliar nitrogen application at (50g) and humic acid application produced markedly increasing in plants height, stem diameter, leaves number per plant, higher number of lateral shoots and the highest value of leaf dry weight in comparison with other treatments.

Ishikawa, *et al*., (2012) reported that, application of sulfur-humic on grapevine seedlings improved survival rate under saline-alkaline soil compared with survival rate in the conventional planting.

Khattab, *et al*., (2012) indicated that shoot length and average number of leaves of pomegranate trees significantly increased by increasing the dose of humic acid.

Selim *et al.,* (2012) on potato plants illustrated that, humic acid pplication increased all plant growth parameters and tuber productions..

Shalash, *et al*., (2012) reported that, Humugreen with 2 or 4 ml/ L caused significant effect in vegetative growth features of olive transplants (main stem length, branches number, main stem diameter, number of leaves and leaf area).

Shehata, *et al*., (2012) on cucumber reported that, there were significant increase of leaves number per plant and average number of branches per plant in all treated plants.

Abbas, *et al*., (2013) indicated that humic acid decreases leaf drop percentage, also significantly affected morpho-phsiological and bio-chemical attributes of Kinnow mandarin plants compared with untreated plants.

Ali, *et al.,* (2013) found that application of humic acid; Uni-sal, magnetic iron and inoculation with arbuscular mycorrhuzal on vine plants under salinity conditions were significantly increasing main shoot length, total leaf area/ vine compared to control treatment.

De Santiago, *et al*., (2013) on strawberry in calcareous soils, showed that, humic substances and vivianite (as iron source) increased dry matter, yield in plants when compared with vivianite without HS.

Zhange *et al.,* (2013) on apple trees reported that, humic acid treatment with chemical fertilizer improved one -year-old shoot length, thickness and fresh weight of one hundred leaves and chlorophyll index than that without humic acid treatment.

Leaf chemical composition:

The mineral content of plant parts, in particular leaves is used to identify nutrient deficiencies, excesses or imbalance within a crop. The nutrient status of citrus tree, particularly N, P and K influence crop yields as well as fruit quality (**Moss, 1971: Storey and Treeby, 2000**) and is changed by seasonal changes **(Jones and Parker, 1951)** as well as with the application of nutrients (**Zilkah *et al*., 1996**)

Humic substances appear to be beneficial in chelating nutrients, preventing their tie up on plant roots and improving conductivity of nutrients into plant tissue, resulting in more efficient utilization of nutrients **(Beames. 1986).**

Humic acids were reported to increase the uptake of both macro and micronutrients, such as N, P, K, Fe, and Zn thereby improving the nutritional status of the plant **(Maggioni *et al*., 1987; Mackowiak *et al*., 2001)** Humic acids may also reduce plant uptake of certain toxic metal ions, adsorbing them from the soil solution **(Strickland *et al*., 1979)**

Fortun, *et al*., (1985) on Ryegrass plants illustrated that, humic acid treatment stimulated the development of the photosynthetic structures, the total dry matter, the total content of macronutrients and micronutrients.

Potassium humate can be used as organic potash fertilizers. It supplies high levels of soluble potassium in readily available forms. Combined with humic acid, potassium can be rapidly absorbed and incorporated into plant whether via soil or foliar application methods.

Enhancement of plant growth using potassium humate had been reported to be due to increasing nutrients uptake such as N, Ca, P, K, Mg, Fe, Zn and Cu **(Davies and Albrigo 1994; Adani *et al.,* 1998)**

Tatini *et al.,* (1991);Fernandez-Escobar, *et al*., (1996) mentioned that, under field conditions, foliar application of leonardite extracts (humic substances extracted) promoted the accumulation of potassium, magnesium, calcium, boron and iron in leaves of olive in compared with untreated trees.

Reynolds, *et al*., (1995) reported that, increasing the amount of humate granuls increased phosphorus, iron and manganese but decreased potassium in the lamina of `Chardonnay` grapevines.

Wang, *et al*. (1995) on wheat plants reported that, addition of humic acids to soil with phosphorus fertilizer significantly increased the amount of water-soluble phosphate, strongly retarded the formation of occluded phosphate, and increased P uptake by 25%.

Alva and Obreza (1998) reported that, application of iron humate to nonbearing trees of orange and grapefruit increased leaf iron concentration, also increasing the availability of phosphorus to plants.

It has been shown that Fe-deficient cucumber plants, at least in part, could use Fe complexed with HS to reduce Fe (III) before being absorbed by the roots **(Pinton *et al*., 1998; Pinton *et al*., 1999).**

Zachariakis, *et al*., (1999) on grapevine rootstocks grown in the presence of humic substances showed increased in total leaf chlorophyll content and decreased Chla/Chlb ratio, also the root and leaf level of total iron, Manganese and Zinc was increased significantly by the humic substances treatment.

Guo, *et al*., (2000) on Red Fuji apple trees, found that, application of 250-times solution of KOMIC increased chlorophyll content, enhanced photosynthesis in leaves compared with other treatments.

Nardi, *et al*., (2000) showed that, application of low molecular weight (LMW) humic acid on maize seedlings enhanced nitrate transport (89%) and the magnitude of the increase were higher than that induced by GA (73%).

Rengrudki and Partida (2003) found that, leaves of avocado trees treated with humic acid had higher nitrogen level and a slight increase in potassium compared with untreated trees

The highest total chlorophylls content of asparagus was found in plants fertilized with humic acid substance **(Tejada and Gonzalez 2003).**

Garcia-Mina, *et al*., (2004) reported that, humic extract increased iron content significantly in wheat plants grown in the soil of lowest iron availability.

Turkmen, *et al*., (2004) on tomato plants, illustrated that, humic acid not only increased macro-nutrient contents, but also enhanced micro- nutrient contents of plant.

Omar and Abdelall (2005) on Superior grapevine illustrated that, application of sulphuric acid, humic acid, sulpher and irrigation water had significantly increased in potassium level, total carbohydrates and total free amino acids were increased proportionally with the increasing applied amount of humic acid, while chlorine and sodium in the leaves and roots significantly decreased, meanwhile, higher content of proline recorded from control plants.

Shadad, *et al*., (2005) reported that, applied bio fertilizers and humate on Canino apricot had significantly higher nitrogen content and improved leaf chlorophyll content than the control treatment.

Virgine and Singaram (2005) indicated that, soil application of humic acid with recommended dose of fertilizers to tomato plants recorded the highest available N, P, K, Fe and Zn.

El-Seginy, (2006) illustrated that, actosol (soil + foliar) treatments on young pear and apricot trees had the higher leaf nitrogen, potassium, iron, manganese and zinc content, also, all treatments had significantly positive effect on leaf carbohydrate content and leaf chlorophyll reading values, meanwhile, treatments decreased leaf sodium content values compared to the control.

Fallahi, *et al., (*2006) on 'Early Spur Rome' apple trees reported that, tree receiving humic substances (Agriplus) combined with high nitrogen rate enhanced leaf nitrogen.

Saleh, *et al*., (2006) observed that, there is a gradually increment of nitrogen percentage in the leaf of Thompson seedless grapevine with increasing humic acid, where treatments of (100 % mineral nitrogen plus 2% humic acid gave the highest value of potassium content.

Sanchez-Sanchez, *et al*., (2006) on grapevine cv ' Italia' they found that, humic substances increased the foliar levels of phosphorus and iron, meanwhile decreased sodium leaf content when used humic acid as a chelate to improve the uptake of iron by plants.

Cerdán, *et al*., (2007) reported that, application of commercial humic substance increased leaf phosphorus and iron in lemon trees.

Eissa, *et al., (*2007[a]) found that, soil application of humic acid to peach and apricot seedlings exhibited a remarkable increment in the percentage of nitrogen, phosphorus and potassium leaf contents than untreated trees, also had higher chlorophyll content and successfully minimized sodium, chlorine and proline leaf content

Eissa, *et al*., (2007[b]) on pear seedlings showed that, humic acid treatments improved nutritional status and gave the highest leaf contents of nitrogen, phosphorus and potassium, also, stimulated pear plants to have more leaf chlorophyll content, and effectively reduced sodium and chlorine leaf content, and significantly reduced proline leaf content to the normal concentration as compared with the control

Perez-lopez, *et al*., (2007) reported that, organic farming of Clemenules mandarin had a significant effect on the mineral leaf content (Potassium, calcium, magnesium and iron, copper, manganese and zinc).

Sayed, *et al.*, (2007) on Valencia orange trees indicated that, application of humic acid increased leaf meniral contents (N, P, K, Mg, Ca, Fe, Zn and Mn) and increased the values of chlorophyll A &B as compared with the untreated trees.

Abd El-Monem, *et al.,* (2008) on Thomson seedless grapevines found that, application of humic acid with biofertilizers significantly affected nitrogen percentage in the leaf content.

Abdel Fatah, *et al.* (2008) mentioned that, soil drench application of humic acid to Tifway Bermodagrass hybrid improved (N, P and K) leaf contents.

Ferrara, *et al.,* (2008) on grape found that, application of humic acid increased increase chlorophyll and nitrogen leaf contents.

El- Mohamedy and Ahmed (2009) showed that, combination between humic acid and biofertilizers (phosphorien) improved leaves mineral content (N, P and K) of mandarin in compared with untreated trees.

Marosz, (2009) indicated that, organic fertilizers (fulvic and humic organic acids) improved concentration of chlorophyll in leaves of maple spp. trees under salt stress.

Selim, *et al*., (2009 and 2012) on potato plants reported that, application of humic substances had a high significant effect on the examined biochemical indictors like, starch content and total soluble solids and this application associated with the decrease of nutrients leaching, also manifested the highest mineral nutrient contents in potato leaves comparing with other treatment.

Abdel-Aziz*, et al., (*2010) on Eureka lemon trees found that, humic acid treatment had the highest leaf nitrogen, phosphorus and potassium content compared with other treatments.

Abou Rawash, *et al*., (2010) illustrated that, humic acid treatment on Picual olive young trees caused higher significant values of leaf nitrogen, calcium and zinc content and dry weight per plant respectively compare to other treatments.

Demirkiran and Cengiz (2010) on pistachio found that, humic acid application significantly increased phosphorus and decreased sodium, zinc and copper leaf content.

El-Shall, *et al.*, (2010) on plum tree reported that, foliar application of humic acid increased nitrogen content than other treatments, while a combined application of humic acid to soil and foliage produced the highest phosphorus, potassium and leaf content and induced the highest micro-nutrient in leaves.

El- Hefny, (2010) on cowpea plants revealed that, humic acid application increased N, P, K, K/ Na and Ca/ Na leaf contents and decreased Na, Ca and Cl leaf contents, also, carbohydrate content were significantly increased in cowpea seeds by increment the level of humic acid application, meanwhile, the reduction of proline seed content of cowpea were statistically by increasing the level of humic acid.

Fayed, (2010) on Roghini olive trees found that, foliar application of (yeast + humic extract) recorded the highest leaf content of nitrogen, iron, zinc and manganese content of leaves, also gave the highest results of leaf pigments (chlorophyll a and b).

Ferrara and Brunetti (2010) studied the effect of times of application of humic acid on grape cv 'Italia' they found that, humic acid increase chlorophyll content in the leaves.

Ghurbat, (2010) reported that, spraying humic acid at 2g/ L on cucumber plants gave the highest average of leaves chlorophyll content compared with control treatment.

Hanafy, *et al.*, (2010) revealed that, addition of humic acid significantly increased chlorophyll a, total chlorophylls and carotenoids concentrations in leaves of snap bean plants comparing with control plants.

Hassan, *et al*., (2010) reported that, humic acid plus 100% mineral nitrogen on young kalamata olive tree had the highest significant values of N, P, Ca and Mn leaf content compared with other treatment.

Mehanna, *et al., (*2010) on grapevine rootstocks indicated that, humic acid treatment significantly increased potassium content and leaf total chlorophyll contents, while, treatment of (Uni-Sal and humic acid) gave the lowest chloride and sodium values in different plant organs compared to other treatments.

Mohammed, *et al*., (2010) on Le-Conte pear trees showed that, application of (compost plus bio-fertilization plus humic acid plus compost tea) had the highest leaf nutrient contents i.e.nitrogen, potassium, calcium, magnesium, zinc, iron and manganes also significantly increased total leaves carbohydrates and leaf pigments compared with other organic treatments, while all organic fertilization treatments decreased leaf proline concentration compared with the chemical fertilizer treatment.

Rizk-Alla and Tolba (2010) reported that, application of (humic acid + Nile Fertil + Mycorrhiza fungi) on Black Monukka grapevines gave the higher percentage of total nitrogen, phosphorus, potassium and total chlorophyll of the leaves, also increased significantly total carbohydrate content in the canes of Black Monukka grapevines as compared to control.

Abd El-Monem, *et al.,* (2011) on Coratina olive seedlings found that, application of (1% humic acid + 0.5% micro elements) increased nitrogen, potassium content in the leaves and gave highest content of iron and zinc, as for phosphorus percentage treatment of (1% humic acid + 0.25% micro elements) gave the highest P value, regarding manganese content in the leaves treatment (0.5% humic acid + 0.25% micro elements) gave the highest value.

Aydin, (2011[b]) reported that, humic acid application to Muskule table grape recorded sufficient levels of nitrogen, phosphorus, iron, manganese and cupper in leaves blade content compare to the control treatment.

Cavalcante, *et al*., (2011) demonstrated that, there is a gradually increment of leaf chlorophyll of papaya seedlings with increasing humic acid doses until 15 ml/m^2 dose.

El-Khawaga, (2011) on peach trees illustrated that, using inorganic nitrogen through 50 to 90 % plus 40 to 90 ml humic acid plus 5 to 25 ml *Spirulina platensis* algae / year significantly improving leaf mineral content of nitrogen, phosphorus and potassium comparing with using completely inorganic nitrogen.

El-Wakeel and Eid (2011) on nonbearing Navel orange trees noticed that, leaf Zn content recorded a higher significant value with application of nitrogen source with K-humate.

Jun-feng, *et al*., (2011) reported that, sprayed Crimson seedless grape with different combination of foliar fertilizers (based on amino acid, humic acid) significantly increased chlorophyll content (SPAD value).

Also **Khaled and Fawy (2011)** on corn plants reported that, foliar application of humic acid increased N, P, K , Fe, Zn, and Mn amounts in plants under salinity condition when compared with other treatment.

El-Khateeb, *et al.,* (2011) on *Acacia saligna* trees, found that, humic acid treatments increased Chlorophyll a and b contents.

Mansour, *et al., (2011)* found that, grapevine leaf potassium content was highly affected by humic acid treatments and this effect was more pronounced and significant for treatments of (50% mineral N + 50%

compost + 1% HA) and (50% mineral nitrogen +50% compost + humic + plus yeast extract).

Morard, *et al*., (2011) reported that humic-like substances improved mineral nutrition of various organs of Pelargonium plants compared with control, there were significant augmentation of copper and zinc contents in various parts of plants, also there was positive effect on flower Mn content, also foliar application of humic-like substances on grapevine increased of nitrogen contents of grapes.

Turan, *et al.,* (2011) on maize plants under soil salinity condition found that, soil application of humus was significantly effective on dry weight and on the uptakes of N, P, Mg, Cu and Mn, meanwhile, application of humic substances and Na Cl to the soil was significant for the Cu uptake.

Yousef, *et al., (* 2011) found that, applied of (humic acid + amino acids + macro elements + trace elements) to olive seedlings increased phosphorus leaf content, while potassium and iron contents in the leaves was slightly increased by (humic acid + macro elements) application the other treatments.

Abd El-Razek *et al*., (2012) on Florida Prince peach trees illustrated that, all humic acid treatments alter significantly N, P and K leafe content than the control.

Ameri and Tehranifar (2012) reported that, fertigated *Fragari ananassa* var: Camarosa plants with 20 ppm humic acid had the highest nitrogen percentage and chlorophyll content.

Asgharzade and Babaeian (2012) showed that, humic acid and acetic acid foliar applications on grape increased potassium, phosphorus and iron concentrations in leaves in comparison to control treatment.

Aydin, *et al*., (2012) on bean plants indicated that, humic acid application at all salt types gave the highest leaf nitrogen and phosphorus contents and decreased leaves proline content.

Barakat, *et al.,* (2012) on New hall Navel orange tree noticed that, the highest leaf nitrogen (%), leaf Phosphorus (%) and leaf potassium (%) was found with organic fertilization plus humic acid application.

Eisa, *et al*., (2012) reported that, Pre-sowing sugar beet seeds treatments with humic acid significantly increased total soluble sugars and decreased proline to minimum concentration compared to control treatment, also humic and Ca-boron treatments significantly increased K concentration in shoot and root and improved Na: K ratio in compared to control. while humic treatment significantly increased almost all measured essential elements such as N, P, K, Ca, Mg, Zn and Mn compared with control.

Gawad, *et al*., (2012) on Crimson seedless grapevine illustrated that, leaf nitrogen, phosphorus and potassium content was significantly affected by application of (compost plus biofertilizer and humic acid) as compared to control.

Sarwar, *et al*., (2012) indicated that, there is a gradually increment of peas plants P, K, Zn and Mn by increasing humic acid doses until 150 kg/hectar.

Selim *et al.,* (2012) found that, application of 120 kg ha^{-1} manifested the highest mineral nutrient contents in potato leaves comparing with other treatments and the control treatment.

Shalash, *et al*., (2012) reported that, Humugreen with 2 or 4 ml/ L caused significant increase in nitrogen and potassium leaf contents of olive transplants.

Abbas, *et al.,* (2013) on Kinnow mandarin illustrated that, humic acid application significantly improved bio-chemical attributes (photosynthetic rate, stomatal conductance and total chlorophyll contents) in compared with untreated trees.

Ali, *et al.,* (2013) on grapevine reported that, total chlorophylls leaf content was positively affected by the application of humic acid, Uni-sal, magnetic iron and inoculation with arbuscular mycorrhuzal compared to the control, also all applied materials significantly reduced proline content in leaves comparing to control.

Moreover, in aggizy olive trees soil applications of yeast plus humic acid succeeded in increasing total chlorophyll, N, k, Fe, Zn and Mn leaf content compared with the untreated trees **(El Sayed 2013**).

The Total yield:

The ultimate goal of the health and vigour management of tree through integrated approaches is to increase the fruit yield and improve quality. It may be achieved through better nutrition management, plant protection and tree growth control to increase flower bud formation, fruiting setting, increase fruit size and yield etc. different interventions to improve yield have been tried by scientists, which are being reviewed as under.

In several studies, humic and folic acids preparations wer reported to increase the uptake of mineral elements, and to increase the yield of crop plants (**Kauser and Malik 1985; Chen *et al.* 2004**).

Great increases of the yields (from 30 up to 70%) were reported for various wine grapes cultivars in California after the applications of two leonardite extracts **(Brownell *et al.,* 1987).**

Webb and Biggs (1988) examined the effect of humate on stressed citrus trees, and reported that, a combination of humate and micronutrients, or humate and CaNO3 increased fruit set and production on 23yr old *Citrus reticulat*a L. `Honey Tangerine` trees.

Xue *et al.*,(1994) observed superior effects of chemical fertilizer augmented with humic acid for several crops including apple trees.

Wang, *et al.* (1995) observed that, adding humic acids to an alkaline soil with P fertilizer to wheat increased yield by 25%.

Alva and Obreza (1998) reported that, application of iron humate increased fruit yield of Hamlin orange trees, also fruit yield of Flame grapefruit had greater response to application of iron humate than that to application of Fe-EDDHA

Li, *et al., (*1999) showed that, liquid fertilizer containing humic acid increased total yield of apple trees.

Zhu Rong, (2000) on pear trees noticed that, yield of pear trees increased when treated trees with humic acid.

Fathi, *et al.*, (2002) on peach trees indicated that, all biostimulants treatments significantly enhancing fruit yield, while (Gibrellic acid + potassium humate) treatments were significantly superior to the other treatments.

Eissa, (2003) on Canino apricot trees found that, biostimulants application (Phosphorin + Microbin + potassium humate + Yeast) consistently increased tree yield compared with control.

Omar and Abdelall (2005) illustrated that, application of sulphuric acid, humic acid, and sulpher and increasing irrigation water significantly increased number of cluster and yield per Superior grapvine of Superior compared with the control.

Omar, (2005) and **Saleh, *et al*., (2006)** on Thompson seedless grapevine illustrated that, application of humic acid with compost increased yield significantly.

Virgine and Singaram (2005) reported that, soil application of humic acid 20 kg/ha^{-1} along with 100 percent recommended dose of fertilizers to tomato plants recorded the highest fruit yield.

Fallahi, *et al*., (2006) found that, applied Agriplus combined with high nitrogen rate gave the higher yield of 'Early Spur Rome' apple trees than control.

Norman, *et al.,* (2006) noticed that, humic acids extracted from food waste vermicomposts increased significantly the numbers of flowers and fruits of peppers plant.

Scheuerell and Mahaffe (2006) stated that, humic acid is a suspension, based on potassium humates, which can be applied as a plant growth stimulant or soil conditioner for enhancing natural resistance against plant diseases and pests which consequently increase the yield of plant

Dantas, *et al*., (2007) studying effect of humic acid and weather conditions on guava trees, they found that, application of humic substances presented high leaf content of total soluble sugars.

Ismail, *et al*., (2007) on Le-Cont pear tree reported that, humic acid application significantly enhanced percentage of fruit set and induced a progressive increment fruit number, fruit yield per tree and fruit yield per feddan while decreased the percentage of burnt spurs.

Sayed, *et al*., (2007) on Valencia orange trees noticed that, application of humic acid increased total yield per trees compared with control.

Abd El-Monem, *et al*., (2008) on Thomson seedless grapevines found that, (50% mineral nitrogen + humic acid + biofertilizers) treatment increased yield (kg) per vine.

Ferrara, *et al.,* (2008) studying effect of humic on Italia table grape and found that, foliar application of humic acid generally caused an increase of total yield per vine.

Improvement of soil organic matter, for example by addition of humate substances, could increase the yields of some field crops **(Ulukan, 2008).**

El-Mohamedy and Ahmed (2009) on mandarin trees showed that, combination between humic acid and biofertilizers (phosphorien) caused highest number of fruit /tree and highest yield as kg / tree compared with untreated trees.

Ghoname, *et al*., (2009) mentioned that, there was an increase in hot pepper fruit yield per plant and per feddan with application of Ammonium nitrate combined with potassium humate compared to the control treatment.

Selim, *et al*., (2009) found that, addition of humic substances to potato grown on sandy soil with the NPK fertilizer tended to increase number of tubers/plant, total tuber yield and its components.

Abdel-Aziz, *et al*., (2010) illustrated that, adding humic acid to Eureka lemon trees gave the highest fruit set values and the highest yield values.

Abu Nuqta and Bat'ha (2010) noticed that, potassium humate increase yield of Helwany grape compared to the control.

El-Bassiony, *et al*., (2010) stated that, green pod yield of snap bean plants (Phaseolus vulgaris, L.) cv. Paulesta grown under sandy soil conditions significantly increased by increasing the spray of humic acid from 0 to 1 up to 2 g/l.

El-Shall, *et al*., (2010) studying influence of humic acid on plum tree and found that, the combined foliar and soil application of humic acid gave highest yield.

El-Hefny, (2010) found that, total yield of cowpea were gradually increased with increasing the level of humic acid application, also the highest total yield per feddan were resulted from cowpea plant irrigated by low water salinity with application of high level of humic acid.

Fathy, *et al*., (2010) on Canino apricot tree reported that, application of 15 cm3 foliar spraying and 75 cm3 soil addition of humic acid had the highest significant values of fruit set percentage, percentage of retained fruit per tree, number of fruit per tree and fruit yield per tree.

Fayed, (2010) observed that, treatment of (yeast plus humic) on olive trees had the highest results of initial and final fruit set than the other treatments, while (compost tea and sprayed with yeast plus humic acid) treatment, gave the highest yield than the other treatments.

Ghurbat, (2010) reported that, spraying humic acid at 2g/ L on cucumber plants caused significant increase in fruit number /plant and total yield compared with untreated plants.

Hanafy, *et al*., (2010) revealed that, addition of humic acid significantly increased total pod yield, number of pods/plant, pods weight/plant, average pod weight as well as pod diameter of snap bean plants under calcareous soil conditions comparing with control plants.

Mohammed, *et al*., (2010) studying influence of some organic and biofertilizers rates on Le–Conte pear trees and indicated that, fruit set percentage and yield per tree (kg) was significantly improved by adding organic fertilizer and stimulators compared with other treatments.

Rizk-alla and Tolba (2010) reported that, application of (humic acid + Nile Fertil + Mycorrhiza fungi) on Black Monukka grapevines gave the highest yield/ vine as compared to control.

Said-Al Ahl and Hussein (2010) studying effect of water stress and humate on oregano plants them found that, the irrigation applied at 90% available soil moister using fresh water irrigation, combined with potassium humate gave the best result of herb fresh yield (g/ plant) in all cuts.

Salem, *et al*., (2010) illustrated that humic acid treatment and 50% nitrogen dose with P. petulifolia rootstock gave the higher fruit set % and the highest yield of Le Cont pear tree compared with other treatments.

Aydin, (2011[a]) on Horoz Karasi grapevine reported that, application (1/3 cluster reduction + humic acid) had the maximum grape yield.

El-Khawaga, (2011) reported that, the maximum yield of peach tree were presented on trees that fertilized with 50% inorganic nitrogen plus 80 ml humic acid plus 25 ml Spirulina platensis algae/ tree.

El-Kosary, *et al*., (2011) on Keitt and Ewais mango trees they found that, application of spraying microelements and soil supplementation humic acid significantly increased mango tree yield comparing with other treatments.

Jun-feng, *et al*., (2011) reported that, spraying humic acid liquid fertilizer for four times on Crimson seedless grape was most significant, with the yield increment and quality improvement compared with the control

Magdi, *et al.*, (2011) concluded that, bio-fertigation of microbial inoculums and humic substances could be used as a complementary for mineral fertilizers to improve yield and quality of cowpea under sandy soil conditions.

Mansour, ***et al.,*** **(2011)** showed that, treatments of (50% mineral nitrogen +50% compost + 1% humic acid + yeast extract) producing the highest weight of clusters and yield values/ vineyard.

Abd El-Razek ***et al*****., (2012)** on Florida Prince peach trees found that, the highest yield per tree was recorded with humic acid treatments in comparison with untreated trees.

Asgharzade and Babaeian (2012) indicated that, foliar applications of humic acid and acetic acid increased yield of grape in compare to control.

Eisa, ***et al.,*** **(2012)** reported that, Pre-sowing sugar beet seeds treatments with humic acid gave significant increases in yield and its components compared with control.

Gad El-Hak, ***et al*****., (2012)** on peas plants (Pisum sativum L.) noticed that, humic acid foliar application produced higher values of fresh pod weight, fresh seed weight/ pod and green pod yield.

Gawad, ***et al.,*** **(2012)** on Crimson seedless grapevine illustrated that, application of compost plus biofertilizer and humic acid had the highest cluster weight and yield / tree value compared to other treatments.

Ishikawa, ***et al*****., (2012)** on grapevine reported that, application of sulfur-humic stimulate 10% of the grapevine trees to produce fruit by contrast those in the conventional planting had no fruit.

Khattab, ***et al.,*** **(2012)** indicated that, the higher significant average number of fruits and yield /tree of pomegranate resulted by using 9 m3 water level plus 48g humic acid/ tree/ season.

Kotodziej, ***et al*****., (2012)** noticed that, leonardite addition in roseroot plants (*Rhodiola rosea* L.) was the factor that affected yielding and quality parameters of plants.

Sarwar, *et al*., (2012) reported that, there was significant effect of humic acid and phosphorus on green peas yield, the highest peas yield was attained where humic acid was applied at 100 kg per hectare with 50% dose of phosphorus.

Sugier, *et al.*, (2013) found that, leonardite application on arnica (*Arnica montana* L.) had significant increment of number of flowering stems and inflorescences per plant resulting in raw material yields increase along with increasing leonardite dose.

Abbas, *et al*., (2013) reported that, humic acid caused minimum fruit drop of Kinnow mandarin plants as compared to control.

De Santiago*, et al*., (2013) on strawberry, reported that, humic substances and vivianite (as iron source) at 1 g kg–1 increased yield in plants when compared with vivianite without humic substances.

Soil application of 10 g yeast/ tree plus humic acid 60 g/ tree on Eggazy olive had the highest value of total yield/ tree **(El-Sayed2013)**

Hagagg, *et al.*, (2013[a] [&] [b]) found that, the highest yield of Picual olive trees and Kalamata olive trees obtained with all humic treatment which increased tree average yield compared with the control.

Mahmoudi, *et al*., (2013) on Kiwifruit reported that, humic acid application increased the fruit yield compared to the untreated trees.

Physical and chemical characteristics of the fruits:

Fruit quality reflects numerous internal and external attributes, on the basis of which, standards determining minimum levels of palatability and commercial acceptability have been established empirically over the years. In citrus, external features like color, size and peel thickness etc. are the most important parameters to estimate the quality of the fruit while internal characters contributing to fruit quality are quantity and quality of juice, seediness, vitamin C contents, acidity, TSS, TSS/TA. The composition of citrus fruit varies with cultivars, climate, rootstock and cultural practices **(Davies and Albrigo 1994)**.

Humic acids were reported to promote the quantitative properties of fruit, such as yield, fruit weight, width, length and diameter, thereby improving the quantitative status of the plant **(Maggioni *et al*., 1987; Mackowiak *et al*., 2001; Shehata *et al*., 2012).**

Moreover, liquid fertilizer containing humic acid improved fruit quality, increased apple fruit weight, yield and soluble solid content **(Li, *et al*., (1999)** and **Guo, *et al*., (2000).**

The simulative effect of potassium humate in enhancing fruit characteristics may be attributed to some plant hormone-like substances seem to be present in the humic substances, thus exerting a possible stimulating effect on fruit growth **(Pizzeghello, *et al*., 2001)**.Humic substances when added to lemon trees (cv. Fino) raised fruit weight compared to control **Sanchez- Sanchez, *et al*., (2002).**

Generally, fruit quality is characterized by high amounts of yield, fruit weight, width, length and diameter of fruit which have positive effects on the palatability of fruit by consumers **(Thakur and Chandel 2004).**

Biostimulants treatments increased fruit quality i.e. (fruit size, weight, fruit flesh thickness, size, weight, polar and equatorial dimensions and skin color ,total soluble solids and total soluble solids/ acidity ratio) of peach ,apple and Canino apricot compared with control, **Fathi, *et al*., (2002) and Eissa, (2003).**

Omar and Abdelall (2005) found that, application of sulphuric acid, humic acid, sulpher and increasing irrigation water treatments significantly increased number and weight of cluster, berry weight and berry size of Superior grapevine compared with the control plants.

Saleh *et al.*, (2006) noted that, organic fertilizer and humic acid improved fruit quality of treated vines.

Sanchez- Sanchez, *et al.,* (2006) studied the effect of replacement of Fe chelate fertilizer with humic substances on grapevine cv ' Italia', they found that, maximum berry weight when the replacement of chelate with the humic compound about 50%.

Cerdán, *et al.*, (2007) reported that, in lemon trees some fruit quality parameters like vitamin C content and peel thickness were improved with a partial substitution of Fe(o,o-EDDHA) by humic substances.

Ismail, *et al.*, (2007) on Le-Cont pear tree noticed that, humic acid treatment significantly successfully enhanced fruit weight, fruit size, fruit dimension and juice total soluble solids and decreasing number of fruits in one kg.

Sayed, *et al.*, (2007) on Valencia orange trees found that, all humic acid applications improved physical and chemical properties of fruit i.e. fruit weight, fruit size, peel thickness, juice percentage, total soluble solids. Total soluble solids/acidity ratio and vitamin C content except total acidity which was decreased compared to control

Ferrara, *et al.*, (2008) on Italia table grape and illustrated that, spraying humic acid increased significantly berry weight, berry length, berry width, total soluble solids, the Brix/ acidity ratio and acidity reducing significantly, also single bunch weight increased with respect to the control treatment.

El- Mohamedy and Ahmed (2009) on mandarin trees showed that, the heaviest and larger fruits were harvested from trees treated with humic acid and biofertilizers (phosphorien or microbien), also, treatments enhancing fruit quality i.e. total soluble solids, total soluble solids/ acid ratio and juice weight compared with the control.

Ghoname *et al*., (2009) found that, combining ammonium nitrate fertilizer and potassium humate foliar spray gave the highest values of hot pepper fruits number per plant and fruits fresh and dry weight, total carbohydrate contents, ascorbic acid than the other treatments.

Selim, *et al*., (2009) reported that addition of humic substances to potato grown on sandy soil with 75% fertigation treatment caused increase in tuber quality indicators.

Abdel-Aziz, *et al*., (2010) reported that, adding humic acid to Eureka lemon trees increased fruit physical and chemical characteristics fruit weight, juice weight, juice/ fruit weight, rind thickness, TSS, vitamin C and juice acidity.

Abu Nuqta and Bat'ha (2010) illustrated that, potassium humate treatment increase cluster weight and total soluble solids of Helwany grape compared to the control.

El-Shall, *et al*., (2010) on plum trees indicated that, application of of humic acid recorded highest fruit weight, equatorial diameter and fruit firmness also produced fruit more fleshy compared with the control.

Fathy, *et al*., (2010) on Canino apricot trees reported that, humic acid treatments significantly increased fruit firmness, juice soluble solids content and soluble solids content/ acidity ratio also, recorded highest values of polar diameter and equatorial diameter.

Fayed, (2010) illustrated that, the highest values of fruit physical parameters of olive tree were obtained by application of spraying yeast plus humic acid i.e. shape index, fruit weight, fruit flesh oil and carbohydrates content.

Ferrara and Brunetti (2010) on table grape (*Vitis vinifera* L.) cv Italia, reported that, application of humic acid caused a significant increase of berry size, width and weight, total soluble solids (Brix) with respect to the control, and a significant decrease of tartaric acid and a significant increase of the Brix/ TA ratio.

Rizk-alla and Tolba (2010) on Black Monukka grapevines found that, application of (humic acid + Nile Fertil + Mycorrhiza fungi) gave the highest values of cluster weight, increases berry weight, berry size and reduces berry shattering also improved the chemical quality of berry in terms of increasing the total soluble solids, total soluble solids/ acid ratio and anthocyanin content of berry skin and reducing the total acidity compared to the control.

Salem, *et al*., (2010) illustrated that, humic acid treatment on Le Cont pear trees had significant increase in fruit weight, fruit volume, fruit diameter, total soluble solids and fruit length, also, obtained the less acidity values.

Aydin, (2011[a]) on Gök üzüm and Horoz Karasi grapevine reported that, application of (1/3 cluster reduction + humic acid) recorded maximum cluster weight, maximum berry weight increase, maximum °Brix, meanwhile, fruit color (red and blue color intensity values) were statistically significant in Horoz Karasi grapevine.

Du *et al.,* (2011) show that, chemical fertilizer combined with humic acid improves apple fruit firmness and soluble sugar content.

El-Khawaga, (2011) on peach tree found that, using 50% inorganic nitrogen plus 80 ml humic acid plus 25 ml Spirulina platensis algae/ tree significantly improved quality of the fruits in term of increasing fruit weight, total soluble solids% and total reducing sugar% and decreasing total acidity% comparing with using completely inorganic nitrogen.

El-Kosary, *et al*., (2011) on Keitt and Ewais mango trees illustrated that, spraying microelements and soil supplementation humic acid gave significant increasing in fruit weight, fruit size and the highest fruit length, the highest significant increasing in fruit TSS% also increased fruit width.

Jun-feng, *et al.*, (2011) on Crimson seedless grape reported that, spraying vines with different combination of foliar fertilizers (based on amino acid, humic acid) promoted the cluster growth and improved fruit characters i.e. weight per panicle, 100 fruit weight, the berry hardness, soluble solids proportion, vitamin C and sugar/acid ratio, at the same time, the titrable acidity was significantly reduced.

Adding humic acid and amino acids increase the absorption of nutrients by Corn (Hagein, Fardy10) plants and positively affects the development of fruit quantity **(Khaled and Fawy, 2011).**

Mansour, *et al*., (2011) reported that, application of and (50% mineral nitrogen +50% compost + humic acid + yeast extract) affected total soluble solids of berry vine and improving juice TSS% than the control.

Abd El-Razek *et al*., (2012) noticed that, humic acid treatments improved physical and chemicals parameters of Florida Prince peach fruit (i.e. fruit length, volume, weight, T. S. S., acidity % and T. S. S/ acid ratio) in comparison with the control.

Asgharzade and Babaeian (2012) indicated that, foliar application of humic acid and acetic acid gave the highest effect on cluster length and diameter of grapevine compared to control.

Gawad, *et al*., (2012) reported that, treatment of compost plus biofertilizer and humic acid improved fruit quality expressed by increasing TSS, and decreasing acidity of Crimson seedless .grapevine.

Abbas, *et al*., (2013) on Kinnow mandarin trees indicated that, application of 80 ml humic acid per tree recorded maximum sugar content, higher juice percentage, increased fruit weight, fruit size, improved fruit taste and quality, while decreased reducing sugar and total titrable acidity of fruit juice.

Ali, *et al*., (2013) on vineyard illustrated that, application of humic acid, Uni-sal, magnetic iron and inoculation with arbuscular mycorrhuzal recorded significantly increment in berry weight, size, total soluble solids and total soluble solids/ acid ratio compared to the control

El Sayed (2013) on Aggizy olive trees showed that, treatment of humic acid gave highest significant value of fruit characters i.e. (fruit weight, flush weight, fruit length, and fruit width).

Hagagg *et al*., (2013[a&b]) on Picual and Kalamata olive trees revealed that, most fruit quality parameters were significantly affected by humic acid treatments (i.e. fruit weight, size and shape index, fruit oil percentage) compared with the control.

Mahmoudi *et al*., (2013) on Kiwifruit reported that, humic acid application increased the fruit weight and fruit shape parameters.

Zhang *et al*., (2013) on apple trees, indicated that, humic acid with chemical fertilizer showed the greater positive effects on soluble solids, soluble sugar, and vitamin C content and negative effects on titrable acidity content.

III. MATERIALS AND METHODS

This study was conducted during (2011 / 012 and 2012/ 013) seasons on forty- eight trees, uniform in growth vigors and 5 - year-old of Valencia orange trees (*Citrus sinensis* L.), budded on sour orange rootstock in a private orchard situated at Abu Shalaby - El Salhia region, Sharkia Governorate in sandy-clay loamy soil (Table 1- c) with well drained (water table more than two meters depth).

Trees spacing is 5 x 5 M apart, irrigated from well water source (Table 2) under Drip irrigation system (GR) with two laterals along the row of trees - drippers at 50cm distances and 4L/hour.

The main target of this study was examining the effect of magnetite (magnetic iron) and K-humates (humic acid) doses on vegetative growth, mineral composition, yield and fruit quality of Valencia orange trees under salinity stress. Analysis of the tested soil at two levels (0-30cm and 30-90cm soil depth) and irrigation water used was carried out according to **Wild *et al.*, (1985)** and the obtained data are shown in Tables (1&2).

Table (1) Some chemical and physical analysis of the experimental soil:

a) Chemical soil properties:

Depth	Cations meq /L				Anions meq/L					
	K	**Na**	**Mg**	**Ca**	**Cl**	**SO4**	**HC**	**CO3**	**EC**	**pH**
0-30 cm	0.9	41.3	5.6	8.2	49.5	4.00	3.5	0	5.6	8.3
30-90	0.9	43.6	5.0	9.5	52.5	2.70	3.8	0	5.9	8.5

b) Available nutrient of macro and micro elements mg/K soil:

Depth	Cu	Mn	Zn	Fe	K	P	N
0-30 cm	0.18	1.0	0.30	3.5	131.6	2.1	22.1
30-90 cm	0.19	0.6	0.25	2.4	152.0	2.6	20.6

c) Soil mechanical analysis:

Sample	Soil	Clay	Silt	Fine sand	Rough
0-30 cm	1.51	12.4	19.1	34.49	32.5
30-90 cm	1.55	13.2	17.3	34.15	33.8

Table (2): Water analysis (some chemical characters of the experimental water):

					Cations meq /L				Anions meq/L		
p H	**E C**	**Mn**	**Zn**	**Fe**	**Na**	**Mg**	**Ca**	**K**	**Cl**	**SO_4**	**HCO3**
7.60	**3.12**	**0.45**	**.0.04**	**0.08**	**12.90**	**3.00**	**4.50**	**0.2**	**16.00**	**1.90**	**2.10**

1 – <u>Experimental treatments</u>:

The present experiment included the following sixteen treatments as a soil application of:

1- Magnetite at 250 gm / tree M1.

2- Magnetite at 500 gm / tree M2.

3- Magnetite at 1000 gm / tree M3.

4- Humates at 25 gm / tree H1.

5- Humates at 50 gm / tree H2.

6- Humates at 100 gm / tree H3.

7- Magnetite at 250 gm + humates at 25 gm / tree M1+H1.

8- Magnetite at 250 gm + humates at 50 gm / tree M1+H2.

9- Magnetite at 250 gm + humates at 100 gm / tree M1+H3.

10- Magnetite at 500 gm + humates at 25 gm / tree M2+H1.

11- Magnetite at 500 gm + humates at 50 gm / tree M2+H2.

12- Magnetite at 500 gm + humates at 100 gm / tree M2+H3.

13- Magnetite at 1000 gm + humates at 25 gm / tree M3+H1.

14- Magnetite at 1000 gm + humates at 50 gm / tree M3+H2.

15- Magnetite at 1000 gm + humates at 100 gm / tree M3+H3.

16- Control (as the Owner management).

The used magnetite (Magnetic iron), contained 8.8%FeO, 26.7%Fe_2O_3, 2.6%MgO, 4.3%SiO_2 and 0.3%CaO, obtained from "El-Ahram Company for mining and natural fertilizers", Giza, Egypt. The magnetite (magnetic iron) and humic acid (K-humates) Fertilizers at the previous amount was added once on the first week of January of both seasons, each treatment was replicated three times (one tree per each).

The chosen trees yearly received fertigation program that recommended by the Egyptian Ministry of Agriculture; including: 40kgm farmyard manure (0.3 % N, 1.2 % K_2O and 0.45 % P_2O_5), 600gm N as ammonium nitrate (33.5 %N), 200gm P as phosphoric acid (85 % P_2O_5) and 500gm K as potassium sulphate (48 % K_2O) per tree. Foliar applications of micro-elements were applied as chelated compounds of (Fe, Zn and Mn) two times / season (February and July). Agricultural practices such as irrigation, hoeing, pruning as well as pest and fungi management was done as citrus orchard practices.

2– Experimental design:

A complete randomized block design with three replicates was followed for statistical analysis of the present investigation.

3- Measurements of vegetative characters:

Methodology as has been reported in this experiment for different investigated characteristics in response to various treatments was carried out as follows:

Spring shoot length and number of leaves :

Sixteen new shoots from spring growth cycle were chosen on four labeled branches on the four main directions for measuring shoot length (cm) and number of leaves per shoot at last week of May.

Leaf area (cm^2):

Twenty mature leaves from spring growth cycle were taken from the middle parts of the shoot (at September) to determine the leaf area, according to **Ahmed and Morsy (1999)**. Leaf area was calculated as follows: Leaf area (cm^2) = 0.46 (maximum length of leaf x maximum width of leaf) + 1.81.

Tree canopy volume (m^3):

Tree size, expressed as canopy volume, was calculated by the formula: 0.5238 x tree height x diameter square, According to **Turrell, (1946).**

4- Chemical composition of the leaves :

To determine of N, P, K, Mg, Ca, as a percentage and Zn, Fe, Mn, B, Na and Cl as p. p. m content in the leaves. Fifty mature leaves (about six months in age) from non- fruiting shoots of the spring shoots (at the 1st week of Sept.) were taken (according to **Summer, 1985).** The leaves were cleaned with a piece of clothes, fresh weight was recorded, washed with tape water, then rainsed with distilled water and Oven 70°C was used for drying samples which weighed, blended and digested using H_2SO_4 and H_2O_2 (according to **Wilde *et al.*, 1985)**.

In the digested solutions N ,P , K ,Mg , Ca ,Zn , Fe , Mn , B , Na and Cl at dry weight basis were determined according to the following procedures that outlined by **(Piper , 1950 and Wilde *et al.*, 1985).**

- Total nitrogen(N): was determined by using the micro- Kjeldahl method as described by **(Piper , 1950)**

- Phosphorus (P): was determined colorimetric using Carl – Zeiss spectrophotometer at the wave length of 660 mu after 1/2 h. of preparation, (**Troug and Meyar 1939)**.

- Potassium (K): was determined by using Flame photometer, according to the method of **Wilde *et al.*, (1985).**

- Magnesium (Mg) and Calcium (Ca) were determined by using atomic absorption according to the procedure of **Wilde *et al.*, (1985).**

- Micronutrients: Zn, Fe, Mn, B, Na and Cl were determined by using atomic absorption according to the procedure of **Peach and Tracey (1968).**

Total carbohydrates :

Were determined according to the method of **Dubois *et al.,* (1956)** as follows:

A known weight (0.1 gm) of sample was dried placed in a test tube, then 1N HCl acid (10 ml.) was added. The tube was sealed and placed for 6 hours in an oven at 100 C. The solution was then filtered and the filtrate was clarified by the leading and deluding method using lead acetate solution (137 gm/L.) and the excess of lead salt was precipitated using potassium oxalate solution. The extract was measured into a measuring flask (50 ml.).The combined filtrate was completed to the mark with distilled water. The data was expressed as gm/100 gm D.W. and calculated according to the following equation:

$$\text{Total carbohydrates (gm / 100gm)} = \frac{C\ (mg/ml) \times V}{1000 \times W} \times 100$$

whereas, C = Concentration

V = volume of carbohydrate

extract W = sample weight

Proline leaf content:

Proline was determined according to **Bates *et al*., (1973).** Approximately 0.5g of dry plant material was homogenized in 10 ml of3% aqueous sulfosalicyclic acid and filtered through Whatman's No. 2 filter paper. Two ml of filtrate was mixed with 2 ml acid-ninhydrin and 2 ml of glacial acetic acid in a test tube. The mixture was placed in a water bath for 1 hr at 100 ^{o}C. The reaction mixture was extracted with 4 ml toluene and the chromophore containing toluene was aspirated, cooled to room temperature, and the absorbance was measured at 520 mm with a Bausch and Lomb Spectrometer 710. Appropriate proline standard were included for calculation of proline in the sample.

Relative water content:

Twenty desks from twenty fresh leaves were taken for each replicate and immediately weighed to obtain a leaf fresh weight. Disks were putted in Petri dish full with distilled water overnight under dark conditions, so that, leaves will become fully hydrated and weighed to determined saturated weight according to **Morgan (1984)**.

$$\text{Relative Water content} = \frac{\textbf{(Fresh w. – Dry w.)}}{\textbf{(Turged w. – Dry w)}} \times \mathbf{100}$$

Specific leaves weight (Sp. L.W.):

Twenty mature leaves(spring growth cycle) at the old part of the shoots were taken from to determine the leaf area, then, dried in the electrical oven at 70 ^{o}C till a constant dry weight .Specific leaves weight was calculated as follows:

$$\textbf{Specific leaves weight} = \frac{\textbf{leaves dry weight}}{\textbf{leaves area}}$$

Determination of photosynthetic Pigments in leaves:

Chlorophyll a, Chlorophyll b and carotenoids were extracted from fresh leaves by grinding in a mortar with 85 % aqueous acetone. Extract solution was filtered through funnel no. G4, then the filtrated was made up to a known volume with acetone 85 % conc.

The optical density of the filtrate was determined using Carl – Zeiss spectro colorimeter at the wave's length of 662, 644 and 440 mu. Chlorophyll a, Chlorophyll b and carotenoids contents as (mg/l.) were calculated by means of Wettstein's formula **(Wettstein, 1957)**.

Chl.a = 9.784 x E.644 - 0.99 x E.644

Chl.b = 21.426 x E.644 - 4.63 x E.662

Carotenoids = 4.695 x E.440 - 0.266(a +b)

Whereas, E: optical density at the wave length indicated.

5- Flowering behavior:

During spring growth cycle, leafy and woody inflorescences percentage were estimated by counting the number of each type at the 1st week of April, and calculated in relative to the total number ofinflorescences. Also, numbers of flowers for both inflorescences were registered then percentages of flowering in both inflorescences were recorded.

6. Fruit setting:

Initial fruit setting percentage were estimated by counting the number of flowers on the labeled shoots periodically at five days interval starting at the Second week of March in both seasons till setting completed (1st week of April) then, the number of fruitlettes was counted and the percentage of initial fruit setting was calculated by divided the number of fruitlettes by total number of flowers and multiplying the product x 100.

Final fruit setting was calculated by dividing the number of fruits just before harvesting by total number of flowers and multiplying the product x100.

7. Yield and yield efficiency:

Harvesting was achieved during the regular commercial harvesting time prevailing under Sharkia Governorate conditions (mid. of March in both seasons) when TSS/acidity reached at least 8: 1.

Yield per tree expressed in weight (kg) was recorded.

The number of fruits per tree was counted at the harvesting time.

Yield efficiency as kg/ m^3 of canopy volume was calculated:

$$\text{Yield efficiency (kg/ m}^3\text{)} = \frac{\textbf{tree yield}}{\textbf{canopy volume}}$$

8. Fruit quality:

At harvesting date ten fruits were picked at random from constant height and from all directions of each tree, to determine fruit physical and chemical characters as follows:

8. a. Physical parameters:

1- Average fruit weight (gm.).

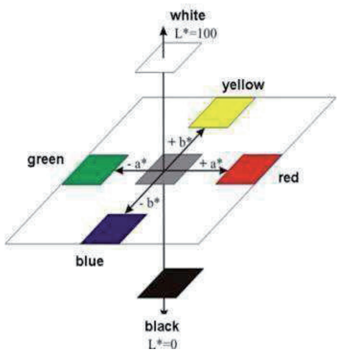
2- Average fruit volume (cc).

3- Fruit shape index values by dividing height by diameter of fruit.

4- Percentage of juice (w/w).

5- Fruit peel thickness (cm).

6-Fruit color as follows:



Three fruits per tree were selected from different side three times as following: at a last week of December, January and mid of March every season. Color densities were determined by using a colorimeter device (CR-400 Minolta Co., Osaka, Japan).

Color intensity values were provided as CIEL* (Commision Internationele de I'E Clairage) a* b* coordinates, which defined the color in a three-dimensional space. However, Hue angel deviating more 90^{o}

represent greener fruit, whereas values nearer to 90^o, represent yellower fruit, while a* and b* were the chromaticity coordinates, (a*) (greenness to redness), (b*) (blueness to yellowness), respectively. L* is an approximate measurement of luminosity, which is the property according to which each color can be considered as equivalent to a member of the gray scale, between black and white, taking values within the range of 0 to 100. Thus, a* takes positive values for reddish colors and negative values for the greenish ones, whereas b* takes positive values for yellowish colors and negative values for the bluish ones and (C*) Chroma were determined at two different spots around the equatorial zone of the fruit using a Minolta colorimeter **(Minolta, 1994)**

8. b. Chemical parameters:

1- Percentage of total soluble solids (TSS) by a handy refractometer.

2- percentage of total acidity (as mg citric acid / 100 ml juice) by titration with 0.1 N Sodium hydroxide using phenolphthalein as an indicator **(A.O.A.C.,1995).**

3-TSS / acid ratio:

The ratio between total soluble solids and acid were calculated.

4- Percentages of total and reducing sugars: according to the volumetric method **Lane and Eynon (1965) (A. O. A. C., 1995).**

5- Vitamin C. content (as mg /100 ml juice) was determined by using 2, 6 dichlorophenol indophenol dye **(A.O.A.C.,1995).**

9 - Statistical analysis:

Obtained data of this study in the two successive seasons (2011-12) and (2012-013), were tabulated and statistically analyzed using randomized complete block design according to **Snedecor and Cochran, 1967**. The differences between various treatment means were compared using Duncan's multiple range test according to **Canteri *et al*., 2001**.

IV. RESULTS AND DISCUSSIONS

In this regard specific effect of two studied factors vis Magnetite (Iron ore); Humic acid (K-humate) and their combinations were evaluated regarding the response of the different measurements of the fruitful trees of the Valencia orange budded on sour orange rootstock which grown in sandy-clay loamy soil and irrigated with saline water from (well water resource) as follows:

1. *Vegetative growth*:

The average shoot length; number of leaves per shoot and average leaf area of spring flushed shoots, as well as the tree canopy volume were the four investigated growth measurements in this concern. Data obtained during both 2011/012 and 2012/013 experimental seasons are presented in **Table (3).**

1.1. Shoot length:

Regarding the effect of Magnetite; K-humate and their combinations, it is quite evident that M_3H_2 treatment was significantly increased shoot length (10.90 cm) in the 1st season (2011/012) and T_{14} (10.50 cm) and T_{15} (10.13cm) in the 2nd season (2012/013) when compared to other treatments. Non significant effect of other treatments on shoot length was recorded during both studied seasons.

These results are in agreement with those obtained by **De Souza** ***et al*****., (2005); Ismail** ***et al*****., (2010); Mora** ***et al*****., (2010) and Abd El-Monem** ***et al*****., (2011),** increased shoot length of different plant species., by magnetite application and the magnetic treatments led to a remarkable increase in plant root and stem length, these initial effects are very positive since they appear to induce an improved capacity for nutrient and water uptake, providing greater physical support to the developing shoot. In spite of the ability of humic substances to increase shoot growth in different plant species cultivated under diver's growth conditions. the mechanism responsible for this effect of humic substances and magnetite is poorly understood, but, It is possible that the shoot promoting effect of humic substances involves a primary effect on root $H^{(+)}$-ATPase activity and nitrate root-shoot distribution that causes changes in the root-shoot distribution of certain cytokines, polyamines and abscisic acid, thus affecting shoot growth .

1.2. Number of leaves:

Concerning the effect of Magnetite; K-humate and their combinations **Table (3)** cleared that, insignificant effect of treatments on number of leaves/shoot in the 1st season (2011/012). Whereas, M_3H_2 treatment was significantly increased number of leaves/shoot (8.33) when compared to M_1, M_2, M_3, H_1, H_2, H_3, M_1H_1, M_1H_2, M_3H_1 and control treatments. Also, control treatment was significantly the lowest number of leaves (4.33) in the 2nd season (2012/013) during this study.

These results are in harmony with those obtained by **Abd El-Al (2003)** magnetite on Eggplant, had higher average leaves number per plant. Adding, **Eissa *et al*., (2007[a])**; **Fathy *et al*., (2010) and Khattab *et al*., (2012)**, humic application gave a positive effect on leaf number of different plant species.

Table (3): Effect of magnetite and K-humate treatments on the Vegetative growth characters of Valencia orange trees in 2011/012 and 2012/013 seasons.

Treat.	Shoot length (cm)		Number of leaves		Leaf area (cm2)		Canopy volume (m3)	
	(2011/2012)	**(2012/2013**	**(2011/2012)**	**(2012/2013**	**(2011/2012**	**(2012/2013**	**(2011/2012)**	**(2012/2013)**
M1	7.33 b	7.53 b	5.33 a	5.00 bcd	15.89 ab	15.72 b	16.33 bcd	21.86 cd
M2	6.67 b	7.47 b	4.00 a	5.33 bcd	16.93 ab	16.62 b	16.52 bcd	22.63 bcd
M3	8.50 ab	7.30 b	6.33 a	5.00 bcd	17.38 ab	17.98 ab	17.18 bcd	24.71 bcd
H1	6.83 b	7.80 b	4.33 a	5.67 bcd	16.91 ab	17.12 ab	16.13 cd	22.55 bcd
H2	7.17 b	7.80 b	5.00 a	5.33 bcd	17.49 ab	17.64 ab	15.85 cd	22.52 bcd
H3	7.83 b	7.90 b	6.00 a	5.00 bcd	17.75 ab	17.85 ab	17.63 bcd	25.27 bcd
M1H1	7.37 b	7.13 b	4.67 a	4.67 cd	16.67 ab	16.18 b	16.80 bcd	23.09 bcd
M1H2	7.97 b	7.70 b	5.67 a	5.67 bcd	16.67 ab	17.03 ab	16.68 bcd	23.82 bcd
M1H3	8.70 ab	8.83 b	6.33 a	7.00 abc	17.85 ab	17.91 ab	17.36 bcd	24.80 bcd
M2H1	7.13 b	7.67 b	4.33 a	6.33 abcd	16.26 ab	17.37 ab	16.70 bcd	23.35 bcd
M2H2	8.00 b	7.97 b	5.67 a	6.67 abcd	16.94 ab	17.39 ab	18.75 abcd	25.50 bcd
M2H3	7.50 b	8.50 b	5.33 a	6.00 abcd	17.93 ab	18.39 ab	19.70 ab	28.26 bc
M3H1	7.17 b	7.73 b	4.67 a	5.33 bcd	16.97 ab	17.49 ab	17.59 bcd	24.46 bcd
M3H2	10.90 a	10.50 a	7.33 a	8.33 a	18.83 ab	19.97 a	20.59 a	33.41 a
M3H3	8.67 ab	10.13 a	6.67 a	7.67 ab	19.16 a	20.01 a	19.07 abc	28.80 b
Control	7.33 b	6.97 b	4.00 a	4.33 d	15.35 b	15.86 b	15.43 d	19.29 d

1.3. Average of leaf area:

With regard to the effect of Magnetite; K-humate and their combinations, data in **Table (3) and Fig (1)** showed that**,** M_3H_3 treatment was significantly the highest increment of leaf area (19.16 cm^2) when compared to other treatments and control in the 1st season (2011/012). While, M_3H_3 and M_3H_2 treatments were significantly increased leaf area (20.01and 19.97cm^2) respectively, in compared to M_1; M_2; M_1H_1 and control treatments and insignificant effect with other treatments in the 2nd season.

These results confirmed with the previous findings by **Chen and Aviad (1990); Smith *et al*., (1993); Sayed *et al*., (2007)** and **Barakat *et al*., (2012)** whom indicated that, humic substances play an important role as a nutrient supplying which increase soil fertility and increase the availability of nutrient elements. In addition, using different magnetic field combination could separately alter the root mass, leaf size and stem.

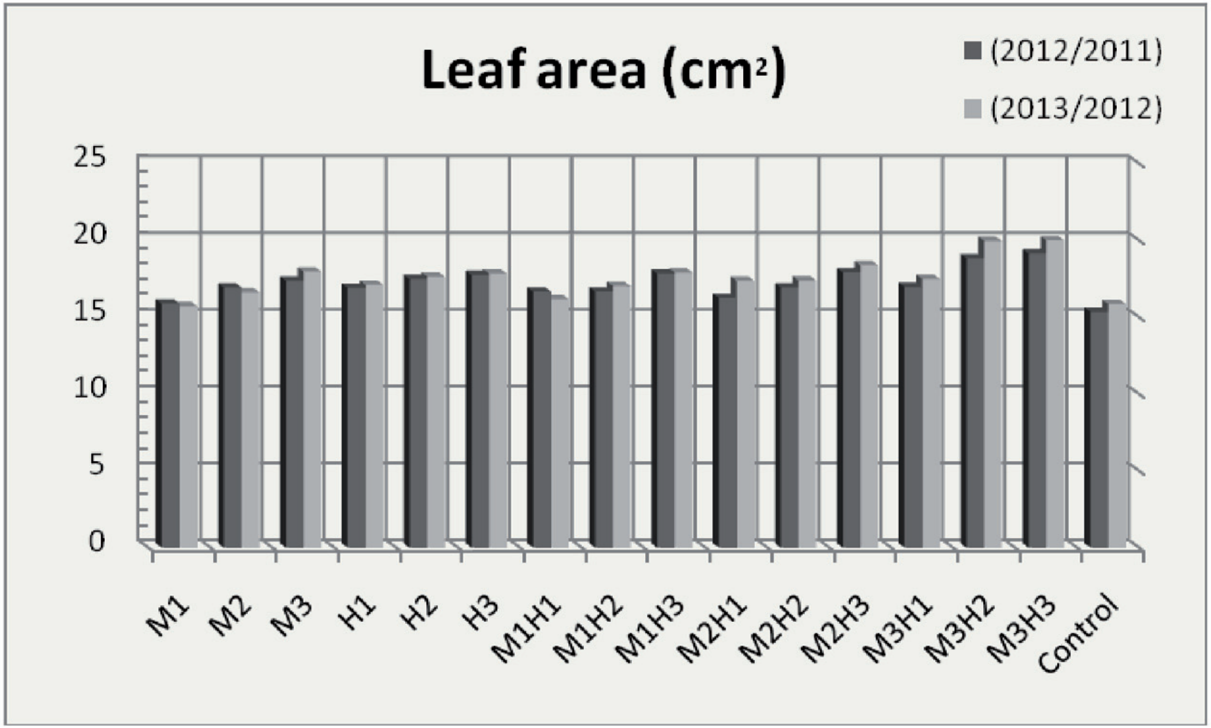


Fig. (1): Effect of Magnetite and K-humate and their combinations on leaf area of Valencia orange trees.

1.4. Tree canopy volume:

In this concern data in **Table (3)** and **Fig (2)** reveled that, M_3H_2 treatment was statistically increased tree canopy volume ($20.59m^3$) when compared to M_1; M_2; M_3H_1; H_2; H_3; M_1H_1; M_1H_2; M_1H_3; M_2H_1 and control respectively, and was insignificant effect with M_2H_2; M_2H_3 and M_3H_3 treatments. Moreover, M_2H_3 and M_3H_3 treatments were significantly increased the tree canopy volume in compared to the control treatment in the 1st season (2011-012).

Whereas, M_3H_2 treatment was significantly the highest tree canopy value ($33.41m^3$) when compared to other treatments in this study. Also, M_3H_3 ($28.80m^3$) treatment was significantly increased in compared to M_1 and control treatments (21.86 and $19.29m^3$) respectively, during the 2nd season (2012-013).

These results are in line with, **Chen and Aviad (1990); Alva and Obreza (1998)**; **Ayas and Gulser (2005)**; **Abd el-Aziz *et al.*, (2010) Behrouz and Mojtaba (2011)** Whom found that**,** humic substances is one of the most important organic matter effecting in tree growth such as improved tree size and trunk cross-sectional area of nonbearing orange trees by iron-humate treatments, improved canopy volume of Valencia orange trees by soil and spray application of humic acid. Moreover, the enhancement of plant growth using potassium humate had been reported to be due to the increase in nutrients uptake and humic acids could be used as growth regulator such as gibberlic acid, to improve plant growth and enhance stress tolerance, increased nitrogen uptake caused by humic acid application was the main reason of enhanced vegetation growth.The presence of iron in magnetite or their colloidal nature may be have a positive effect on the growth of various groups of microorganisms which may excrete a range of vitamins, growth substances and antibiotics and

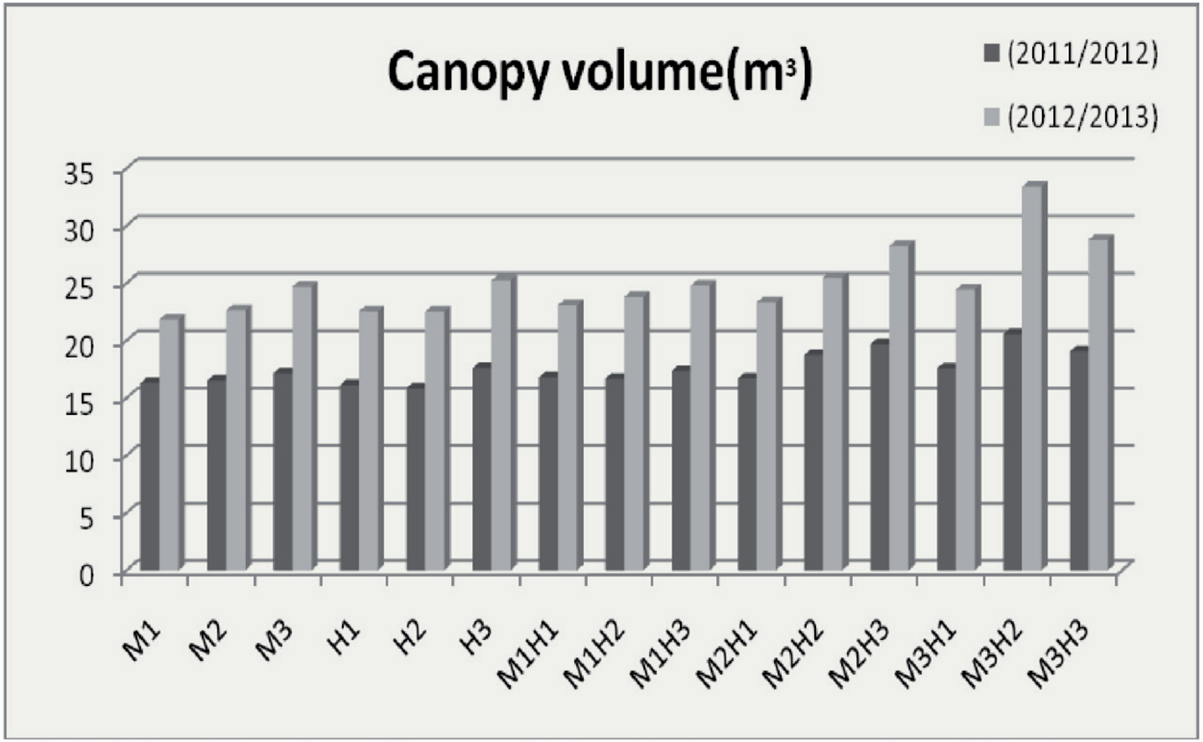


Fig. (2): Effect of Magnetite and K-humate and their combinations on canopy volume of Valencia orange trees.

these may promote plant growth. Magnetic treatment caused more salts out of the soil and at the same time oxygen concentration was increased by 10% and resulted in a better assimilation of nutrients and fertilizer in plants during the vegetative period

Finally, from the aforementioned results in **Table (3) and Fig (1) and Fig (2),** it can be conclude that all application treatments were effective in improving Valencia orange cv., trees vegetative growth characters when compared to the untreated trees, and the highest values of the studied characters were achieved when soil mixed with magnetite at high levels plus medium level of K-humate treatments in both seasons under this study.

2. Flowering behavior:

With respect of the effect of magnetite and K-humate application on flowering behavior of Valencia orange trees, data in **Table (4)** cleared that Magnetite; K-humate and their combinations applications were positively effect on flowering parameters (Leafy inflorescences % , woody inflorescences %, flowers number % in leafy and woody inflorescences of Valencia orange trees in the present study as follows:

2.1. Leafy inflorescences %:

Regarding of Leafy inflorescences % **Table (4)** indicated that M_3H_3 treatment was significantly increased Leafy inflorescences % content (82.78%) when compared to M_3H_1 treatment (75.10 %) with non significant effect for other treatments in the 1^{st} season (2011-012).

Table (4): Effect of magnetite and K-humate treatments on the flowering characters of Valencia orange trees in 2011/012 and 2012/013 seasons.

Treatm.	Leafy inflorescences %		Woody inflorescences		Flowering % on leafy		Flowering % on woody	
	(2011/2012)	(2012/2013)	(2011/2012)	(2012/2013)	(2011/2012)	(2012/2013)	(2011/2012)	(2012/2013)
M1	77.51 ab	74.63 a	22.49 ab	25.37 a	2.85 a	2.99 a	2.89 a	2.03 b
M2	79.30 ab	77.13 a	20.70 ab	22.87 a	2.89 a	2.86 a	2.80 a	1.95 b
M3	77.25 ab	74.14 a	22.75 ab	25.86 a	2.99 a	3.00 a	2.84 a	1.96 b
H1	80.95 ab	76.95 a	19.05 ab	23.05 a	2.94 a	2.88 a	3.02 a	2.09 b
H2	80.85 ab	76.42 a	19.15 ab	23.58 a	2.81 a	2.87 a	2.98 a	2.14 b
H3	79.04 ab	73.62 a	20.96 ab	26.38 a	2.97 a	2.83 a	2.93 a	2.15 b
M1H1	78.93 ab	75.90 a	21.07 ab	24.10 a	2.91 a	2.86 a	2.83 a	2.22 b
M1H2	81.02 ab	76.13 a	18.98 ab	23.87 a	3.03 a	3.08 a	2.92 a	2.06 b
M1H3	78.48 ab	75.24 a	21.52 ab	24.76 a	3.20 a	3.26 a	2.88 a	2.10 b
M2H1	78.12 ab	78.08 a	21.88 ab	21.92 a	2.83 a	2.85 a	2.81 a	1.96 b
M2H2	77.98 ab	77.99 a	22.02 ab	22.01 a	2.88 a	2.90 a	2.86 a	2.06 b
M2H3	80.74 ab	76.62 a	19.26 ab	23.38 a	3.23 a	3.29 a	2.96 a	2.09 b
M3H1	75.10 b	76.28 a	24.90 a	23.72 a	2.99 a	3.07 a	2.88 a	2.12 b
M3H2	77.13 ab	77.57 a	22.87 ab	22.43 a	3.44 a	3.67 a	2.97 a	2.05 b
M3H3	82.78 a	80.42 a	17.22 b	19.58 a	3.33 a	3.40 a	2.83 a	1.99 b
Control	77.44 ab	72.19 a	22.56 ab	27.81 a	2.78 a	2.82 a	3.14 a	2.61 a

Generally, Magnetite; K-humate and their combinations treatments improved leafy inflorescences % record with insignificant differences, whereas, the highest value was (80.42%) for M_3H_3 treatment and the lowest (72.19%) for the control treatment in the 2nd season (2012-013).

2.2. Woody inflorescences %:

In contrary, data in **Table (4)** reveled that M_3H_1 treatment significantly increased woody inflorescences % (24.90%) when compared to M_3H_3 treatment (17.22%) with non statistical variations for other treatments in this study during the 1st season. In spite of, Magnetite; K-humate and their combinations treatments insignificantly reduced the woody inflorescences percentage, whereas, M_3H_3 was the lowest value (19.58%) and the control treatment was the highest value (27.81%) during the 2nd season.

2.3. Percentage of Flowering on leafy inflorescences:

Data in **Table (4)** illustrated that Magnetite; K-humate and their combinations treatments insignificantly improved flowers number % in leafy inflorescences in compared to control treatment , whereas, M_3H_2 treatment was the highest values (3.44&3.67) and control was the lowest (2.78&2.82) for both seasons.

2.4. Percentage of Flowering on woody inflorescences:

In this regard **Table (4)** showed that Magnetite; K-humate and their combinations treatments insignificantly reduced flowers number % in woody inflorescences in compared to control treatment in the 1st season (2011-012).Whereas, the control treatment significantly increased flowers number % in woody inflorescences (2.61) in compared to all Magnetite; K-humate and their combinations treatments during the 2nd season (2012-

013) in this study.

Referring to the previous results, Magnetite, k-humate and combinations treatments enhanced flowering parameters in compared to the control in both seasons for many reasons: Magnetite as iron ore and K-humate applications improved root absorption; reducing salinity effect, raising of organic matter content in the soil and improved endogenous hormones balance; which has lead to improve the plant nutrient status and photosynthesis process which reflects to plant growth and productivity.

Similar results had been found by, **Goldschmidt and Golomb (1982); Lovatt *et al*., (1988)**; **Ahmed *et al*.,(2011); Khattab *et al*., (2012) and Sugier *et al*.,(2013)** whom mentioned to, Positive correlations have been shown between carbohydrate accumulations and flowering. Adding humic acid can be enhancing flowers number of pomegranate. Roselle plants achieved the flowering stage earlier when soil mixed with magnetic iron plus humic acid and improved the number of open flowering per plant.

3. *Water relations:*

Leaf relative water content ratio (RWC); specific leaf weight (Sp LW) and saturated leaf weight (S LW) were studied under saline water stress during two successive seasons (2011-012 and 2012-013) and results were as follows :

3.1. Leaf relative water content ratio (RWC):

Regarding the effect of Magnetite, K-humate and combinations treatments, data in **Table (5)** quite evident that M_2H_3 treatment was significantly increased RWC (83.58%) when compared to M_1(52.29%); M_2 (45.63%); H_1(46.63%) and the control treatments respectively,

Table (5): Effect of magnetite and K-humate treatments on the water relations of leaves of Valencia orange trees in 2011/012 and 2012/013 seasons.

Treat.	Relative water content%		Specific leaves weight%		Saturated leaf weight	
	(2011/2012)	(2012/2013)	(2011/2012)	(2012/2013)	(2011/2012)	(2012/2013)
M1	52.29 bc	59.37 a	0.233 a	0.214 a	19.047 ab	18.110 ab
M2	45.63 c	63.16 a	0.210 a	0.197 a	18.247 ab	16.944 ab
M3	58.06 abc	67.10 a	0.211 a	0.214 a	17.887 ab	16.085 ab
H1	46.63 c	59.04 a	0.218 a	0.209 a	19.353 ab	18.294 ab
H2	58.00 abc	61.05 a	0.209 a	0.207 a	18.817 ab	18.627 ab
H3	58.25 abc	63.87 a	0.201 a	0.203 a	16.627ab	15.562 b
M1H1	55.61 abc	64.16 a	0.210 a	0.214 a	17.663 ab	16.294 ab
M1H2	71.74 abc	65.92 a	0.236 a	0.231 a	17.147 ab	16.222 ab
M1H3	69.17 abc	70.61 a	0.202 a	0.208 a	16.160 ab	15.980 ab
M2H1	66.59 abc	63.19 a	0.217 a	0.202 a	16.943 ab	16.648 ab
M2H2	65.18 abc	66.23 a	0.226 a	0.222 a	18.083 ab	15.667 ab
M2H3	83.58 a	69.97 a	0.207 a	0.209 a	16.200 ab	15.283 b
M3H1	73.97 abc	66.41 a	0.208 a	0.204 a	16.120 ab	15.488 b
M3H2	71.37 abc	70.36 a	0.206 a	0.208 a	16.113 ab	15.280 b
M3H3	78.77 ab	67.06 a	0.205 a	0.229 a	14.657 b	15.186 b
Control	48.70 bc	58.28 a	0.198 a	0.201 a	19.817 a	19.149 a

and insignificant differences with other Magnetite, K-humate and combinations treatments in the 1st season (2011-012).Whereas, insignificant effect of all treatments on RWC; meanwhile, M_1H_3 treatment was the highest leaf RWC value (70.61%) and the control treatment was the lowest value (58.28%) in the 2nd season in compared to other treatments in the 2nd (2012-013) of this study .

3.2. Specific leaf weight (Sp LW):

Concerning the effect of Magnetite, K-humate and their combinations, the present data in **Table (5)** cleared that all treatments were insignificant effect on Sp LW. Whereas, M_1H_2 treatment was the highest values of Sp LW (0.236&0.231) percentage and the control treatment was the lowest values (0.198&0.201) percentage for both seasons (2011-012 and 2012-013) respectively, in compared to other treatments.

3.3. Saturated leaf weight (S LW):

Regarding the effect of Magnetite, K-humate and combinations treatments, the present data in **Table (5)** showed that the control treatment was significantly the highest SLW value (19.817) when compared to M_3H_3 (14.657) treatment, and insignificant different with other treatments during the 1st season (2011-012). Moreover, the control treatment was significantly increased SLW value (19.149) when compared to H_3 (15.562); M_2H_3 (15.283); M_3H_1 (15.488); M_3H_2 (15.28) and M_3H_3 (15.186) respectively, and insignificant different with other treatments during the 2nd season.

These results are in harmony with those obtained by **Garcia-**

Sanchez *et al*.,(2006); Leakey *et al*.,(2009); Aydin (2011[b]) and Rueangkhanab *et al*., (2012) whom mentioned to RWC was introduced as a best criterion for plant water status which, after wards was used instead of plant water potential as RWC referring to its relation with cell volume, accurately can indicate the balance between absorbed water by plant and consumed through transpiration. Also, it was negatively correlated with leaf Cl^-, Na^+, soluble sugars and proline, the negative correlation between RWC and leaf Cl^- and Na^+ concentrations indicated that this due to increase in leaf Cl^- and Na^+ concentrations. Moreover, Salinity reduced total plant dry weight and leaf dry weight of Valencia orange trees; also, Leaf dry weight/area was decreased by salinity in unshaded Valencia /Carrizo trees. Whereas, Salinity decrease leaf-water content, foliar accumulation of Na^+ and Cl^- enables leaves to maintain normal or higher turgor pressure. Plant water stress represented by reduction in specific leaf weight, carbohydrate accumulation, nutrient metabolism and plant growth. Magnetite and K-humate treatments can mitigate the effects of salinity stress this may be due to applied materials stimulated carbohydrate accumulation in leaves of Valencia orange tree comparing with control.

4. Leaf Physio-chemical characters

4.1 Leaf proline content (mg/g D M):

Valencia orange trees leaf proline content was studied under saline water stress during two successive seasons (2011-012 and 2012-013) and results were in **Table (6)** and **Fig (3)** as follows:

Table (6) showed that Magnetite; K- humate and combinations treatments were significantly reduced leaf proline content when compared to the control treatments (86.570 & 88.374) respectively, during both studied seasons (2011-012 and 2012-013).

Table (6): Effect of magnetite and K-humates treatments on Proline and Carbohydrates leaf content of Valencia orange trees in 2011/012 and 2012/013 seasons:

Treat.	Leaves Proline (mg/g)		Carbohydrates (g/100g)	
	(2011/2012)	(2012/2013)	(2011/2012)	(2012/2013)
M1	73.63 b	67.50 c	15.67 ef	16.01 hi
M2	65.64 d	64.93 c	16.43 def	15.96 hi
M3	69.74 bc	65.16 c	15.81 ef	16.48 ghi
H1	71.97 b	73.01 b	15.59 ef	15.92 i
H2	65.62 d	64.43 c	15.81 ef	15.91 i
H3	58.86 ef	57.04 de	20.14 abc	19.74 def
M1H1	66.62 cd	64.77 c	17.91 cde	18.30 fg
M1H2	62.82 de	61.41 cd	18.21 cde	18.03 fgh
M1H3	55.82 fg	55.61 de	21.78 a	21.66 bcd
M2H1	63.13 d	61.66 cd	20.29 abc	20.62 bcde
M2H2	58.85 ef	61.07 cd	18.48 bcd	18.92 ef
M2H3	56.01 fg	53.94 ef	19.78 abc	22.07 ab
M3H1	62.64 de	57.91 de	18.73 bcd	19.80 cdef
M3H2	51.12 h	50.00 f	20.96 ab	21.84 bc
M3H3	52.93 gh	49.68 f	21.42 a	24.09 a
Control	86.57 a	88.37 a	15.13 f	15.86 i

Moreover, **Fig (3)** indicated that responsible of leaf proline content fluctuated to Magnetite; K- humate and combinations treatments, whereas, the highest effect was resulted of M_3H_2 (51.12 & 50.00) in both seasons (2011-012 and 2012-013) of this study.

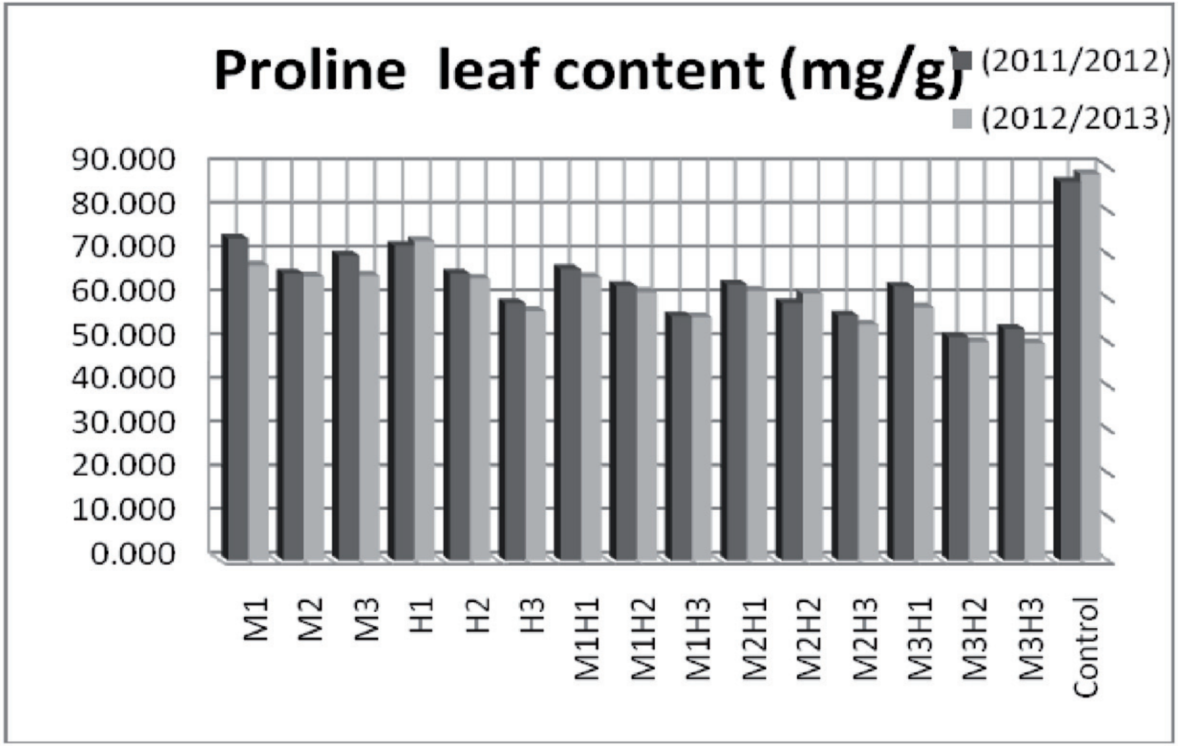


Fig. (3): Effect of Magnetite and K-humate and their combinations on Proline leaf content of Valencia orange trees.

4.2. Total Carbohydrates Content (g/100g DM):

With regard to the effect of magnetite; K-humate and their combinations **Table (6)** and **Fig (4)** indicated that, total carbohydrates content in the leaves were significantly positively affected by different treatments in both seasons, M_1H_3 and M_3H_3 treatments were significantly increased total carbohydrate (21.78 & 21.42%) when compared to other treatments in the 1st season (2011/012) and M_3H_3 (24.09%) in the 2nd (2012/013) when compared to other treatments.

Also, control treatment was significantly the lowest carbohydrate values (15.13%) in the 1st season (2011/012), however, H_1, H_2 and control treatments were significantly the lowest values of carbohydrate (15.92, 15.91 and 15.86%) in the 2nd (2012/013) when compared to other treatments.

The maximum significant values of total carbohydrates content in the leaves were obtained with trees received low rate of magnetite plus highest rate of k-humate in the first seasons, meanwhile, the highest value of total carbohydrates content recorded with maximum rate of both magnetite and k-humate in the second season compared to other treatments in the experimental seasons.

As for other treatments, it was almost improved significantly leaves total carbohydrates content of Valencia orange tree comparing with control treatment.

Total carbohydrates were increased proportionally with the amount of magnetite and k-humate.

The untreated trees showed lower carbohydrates rate due to the increase of hydrolytic enzymes caused by chloride salts and salinity which reduces total carbohydrates **Hsiao (1973)**, also, these results are in harmony with those of **Kilany *et al*., (2006)** who found that water stress due to salinity in the soil and water effectively depressed the synthesis of carbohydrates.

The increase in carbohydrate content may be due to the activation of photosynthetic machinery as a result of stimulating effect of different nutrients on photosynthetic process.

In the present experiment, there is negative correlation between leaves carbohydrates concentrations and leaf proline concentrations **(Table 6)**, suggests that the increment in leaf carbohydrates in trees under application of magnetite and K-humate could have been due to reduce proline synthesis, meanwhile in control treatment the reduction in leaf carbohydrates could be due to a diversion of sugars to increased proline synthesis **(Ennajeh *et al.*, 2006)**

Another role of plant water relations in explaining carbohydrate accumulation in juice sacs of citrus is based on the observation that plant under moderate water deficit stress accumulates more carbohydrates than unstressed plants **(Yakushiji *et al*., 1998)**

The obtained results could be interpreted in view of the effect of magnetite on enhancing the metabolism process of carbohydrates; however, humate improved physiological processes, like water absorption capacity of plants by increasing root hydraulic conductivity **(Munir and Aftab 2009).**

As suggested by **Syvertsen and Lloyd (1994)**, the year-to-year fluctuation in carbohydrate availability may be related to the alternate bearing in some citrus varieties. Also, increased carbohydrate availability to growing citrus fruitlets was associated with a decreased probability of abscission during fruit set, resulting in a greater number of fruits at the end of the growing period. High photosynthesis in citrus leaves has been found to occur simultaneously with high leaf carbohydrate contents in plants under natural conditions. Probably, the photosynthesis of citrus plants is regulated by dynamic aspects of leaf carbohydrate rather than by the absolute carbohydrate content (**Ribeiro and Machado 2007)**

Carbohydrate levels have been suggested as a limiting factor for flower formation in citrus, **Ogaki *et al*., (1963); Goldschmidt and Golomb, (1982)**, as well as in other fruit trees. **Harley *et al*., (1942); Worley, (1979); Monselise and Goldschmidt, (1982)** have been suggested as a limiting factor for flower.

Carbohydrates have also been assumed to play a dominant regulatory role in the nutrient diversion hypothesis of flowering, by **Sachs, (1977); Sachs and Hackett (1983).**

Starch accumulation in leaves has been reported to repress photosynthesis **(Iglesias *et al***. **2007)**.

In subtropical regions, Citrus plants accumulate carbohydrates in roots and leaves as reserves during the winter; these reserves are mobilized and used during the main flush of growth and bloom in spring **(Goldschmidt and Koch 1996).** The positive increment in total carbohydrates content in leaves due to magnetite and k-humate treatments is in harmony with **Zachariakis *et al*., (1999)** on grapevine rootstocks; **Omar and Abdelall (2005)** on superior seedless vines; **El-Seginy (2006)** on young pear and apricot; **El-Ghamry *et al*.,(2009)** on Faba bean; **El-Hefny (2010)** on cowpea**; Mohammed *et al*., (2010**) on Le-Conte pear cv**; El-Khateeb *et al*., (2010 and 2011)** on *Calia secundiflora* plants and *Acacia saligna.*

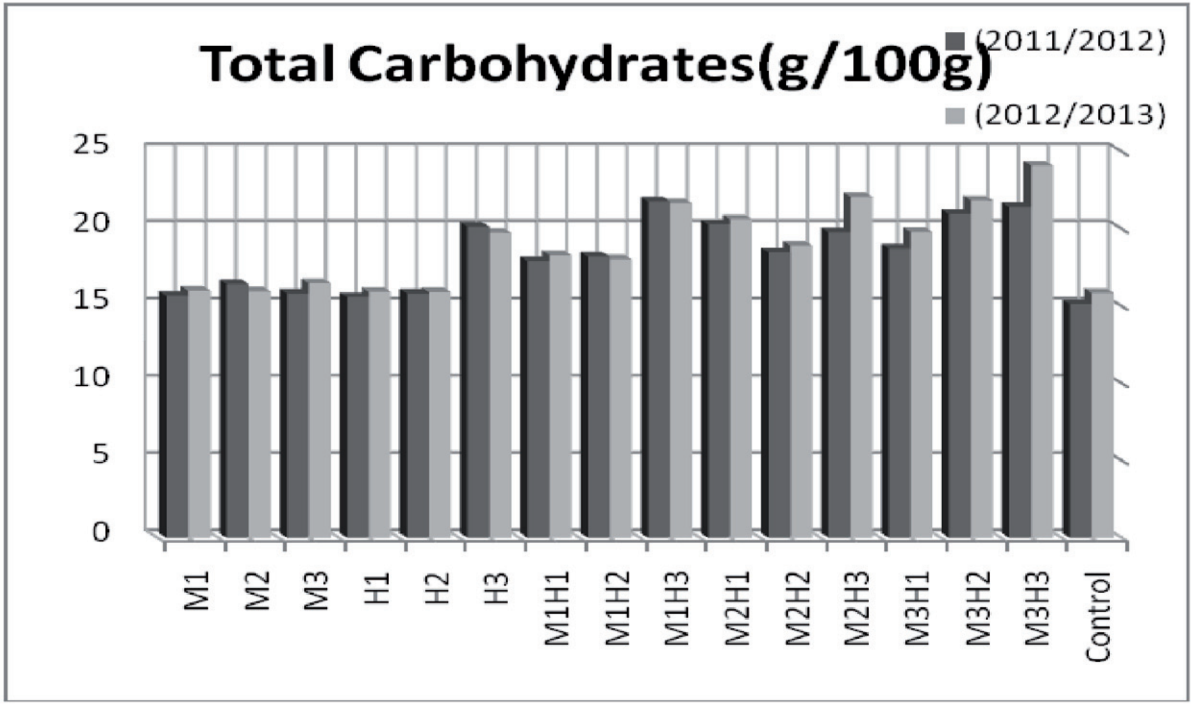


Fig. (4): Effect of Magnetite and K-humate and their combinations on Total Carbohydrates leaf content of Valencia orange trees.

4.3. Leaf pigments:

Regarding to the effect of Magnetite; K-humate and combinations treatments on photosynthetic leaf pigment; Chl. a, Chl. b and carotenoids, data obtained during both 2011-012 and 2012-013 experimental seasons are presented in **Table (7).**

Table (7): Effect of magnetite and K-humate treatments on leaf photosynthetic pigments of Valencia orange trees in 2011/012 and 2012/013 seasons:

Treat.	Chlorophyll A		Chlorophyll B		Carotenoid	
	2011/012	2012/013	2011/012	2012/013	2011/012	2012/013
M1	0.543 ab	0.619 a	0.409 ab	0.411 ab	0.262 a	0.271 a
M2	0.540 ab	0.603 a	0.427 a	0.415 ab	0.259 a	0.269 a
M3	0.558 ab	0.621 a	0.432 a	0.447 a	0.257 a	0.255 a
H1	0.549 ab	0.559 a	0.425 a	0.414 ab	0.258 a	0.273 a
H2	0.515 b	0.566 a	0.434 a	0.462 a	0.250 a	0.263 a
H3	0.495 bc	0.588 a	0.478 a	0.483 a	0.254 a	0.231 ab
M1H1	0.512 b	0.592 a	0.393 ab	0.401 ab	0.261 a	0.268 a
M1H2	0.521 b	0.571 a	0.419 ab	0.412 ab	0.258 a	0.262 a
M1H3	0.527 b	0.583 a	0.441 a	0.440 a	0.259 a	0.261 a
M2H1	0.522 b	0.565 a	0.404 ab	0.411 ab	0.253 a	0.272 a
M2H2	0.496 bc	0.570 a	0.415 ab	0.421 ab	0.259 a	0.256 a
M2H3	0.536 ab	0.615 a	0.402 ab	0.423 ab	0.226 a	0.263 a
M3H1	0.497 bc	0.580 a	0.424 a	0.404 ab	0.258 a	0.248 a
M3H2	0.549 ab	0.609 a	0.413 ab	0.460 a	0.252 a	0.253 a
M3H3	0.606 a	0.625 a	0.433 a	0.428 ab	0.248 a	0.212 b
Control	0.427 c	0.467 b	0.325 b	0.346 b	0.267 a	0.280 a

4.3.1. Chlorophyll a:

Data present in **Table (7)** and **Fig (5)** revealed that Magnetite; K-humate and combinations treatments fluctuated in their effect on leaf Chl. a content in the 1st season (2011-012).In spite of, most of Magnetite; K-Humate and combinations treatments were statistically increased leaf Chl. a content; nevertheless, M_3H_3 treatment was significantly increased Valencia orange leaves Chl. a content (0.606) when compared to H_3 (0.495); M_2H_2 (0.496); M_3H_1 (0.497) and control (0.427) treatments. However, all

Magnetite; K-humate and combinations treatments were significantly increased leaf Chl. a content, whereas, M_3H_3 treatment was the highest value (0.625) in compared to control treatment in the 2^{nd} season of this study.

4.3.2. Chlorophyll b:

Also, Table (7) and Fig (6) obtained that M_2 (0.427); M_3 (0.432); H_1 (0.425); H_2 (0.434); H_3 (0.478); M_1H_3 (0.441); M_3H_1 (0.424); and M_3H_3 (0.433) treatments significantly increased leaf Chl. b content when compared to the control treatment (0.325) in the 1st season (2011-012). In addition M_3 (0.447); H_2 (0.462); H_3 (0.483); M_1H_3 (0.440) and M_3H (0.460) treatments were statistically increased leaf Chl. b content when compared to control treatment in the2nd season (2012-013).

4.3.3. Carotenoids:

Regarding to the effect of Magnetite; K-humate and combinations treatments on Valencia orange leaf Carotenoids content **Table (7)** and **Fig** illustrated that insignificant effect of treatments on leaf Carotenoids content in the 1^{st} season (2011-012), whereas, M_3H_3 treatment (0.212) was significantly reduced leaf Carotenoids content in the 2^{nd} season (2012-013) of this study.

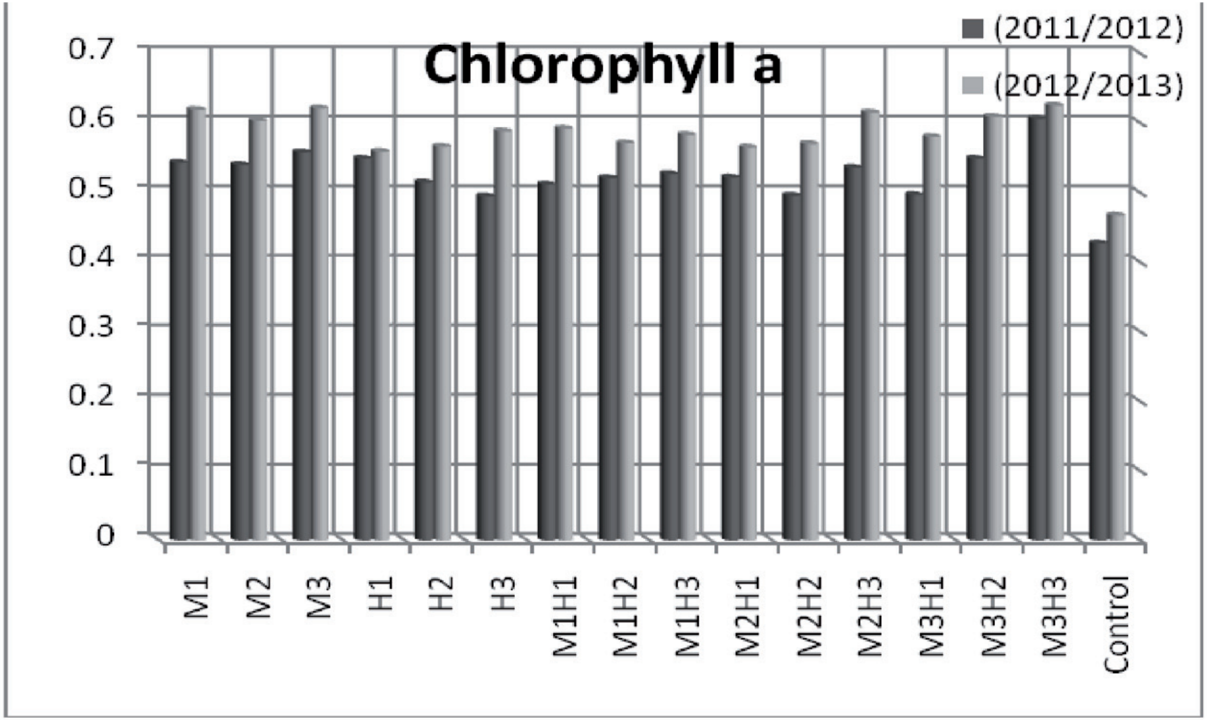


Fig. (5): **Effect of Magnetite and K-humate and their combinations on Chlorophyll a leaf content of Valencia orange trees.**

Generally, the previous positive effect of Magnetite; K-humate and combinations applications on photosynthetic pigments and carbohydrates in leaves due to magnetite and K-humate applications could be contributed to the nutritional regulation and adaptability of orange trees and enhancing photosynthesis and increase the uptake of nutrient elements and accumulation of nutrients in different plant origin. Also, there was a positive effect by using these materials on reducing salinity and increasing total chlorophyll in leaves. These results are similar with those obtained by **Hoff (1981), Zekri (1991); Zachariakis *et al*.,(1999); Munir and Aftab (2009);** and **Ali, *et al*., (2013)**, whom mentioned to an increase in leaf chlorophyll content, as a consequence of humic substances application, while, the loss of chlorophyll due to Cl accumulation. The reduced photosynthetic ability under salinity is due to stomata closure and suppression of specific enzymes that are responsible for the synthesis of photosynthetic pigments. Also, an increasing in photosynthetic rate, a positive effect as a result of magnetic which leads to a better photo stimulation. The effect of magnetite on enhancing the metabolism process of carbohydrates; however, humate improved physiological processes, like water absorption capacity of plants by increasing root hydraulic conductivity.

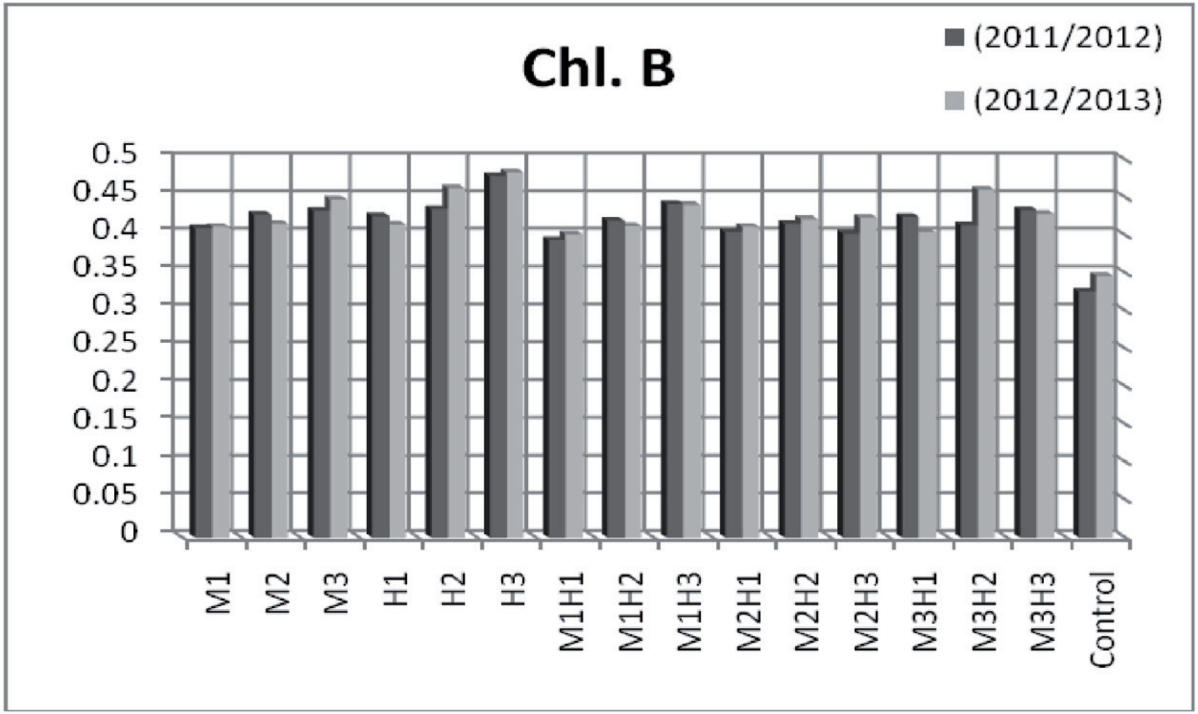


Fig. (6): **Effect of Magnetite and K-humate and their combinations on Chlorophyll b leaf content of Valencia orangetrees.**

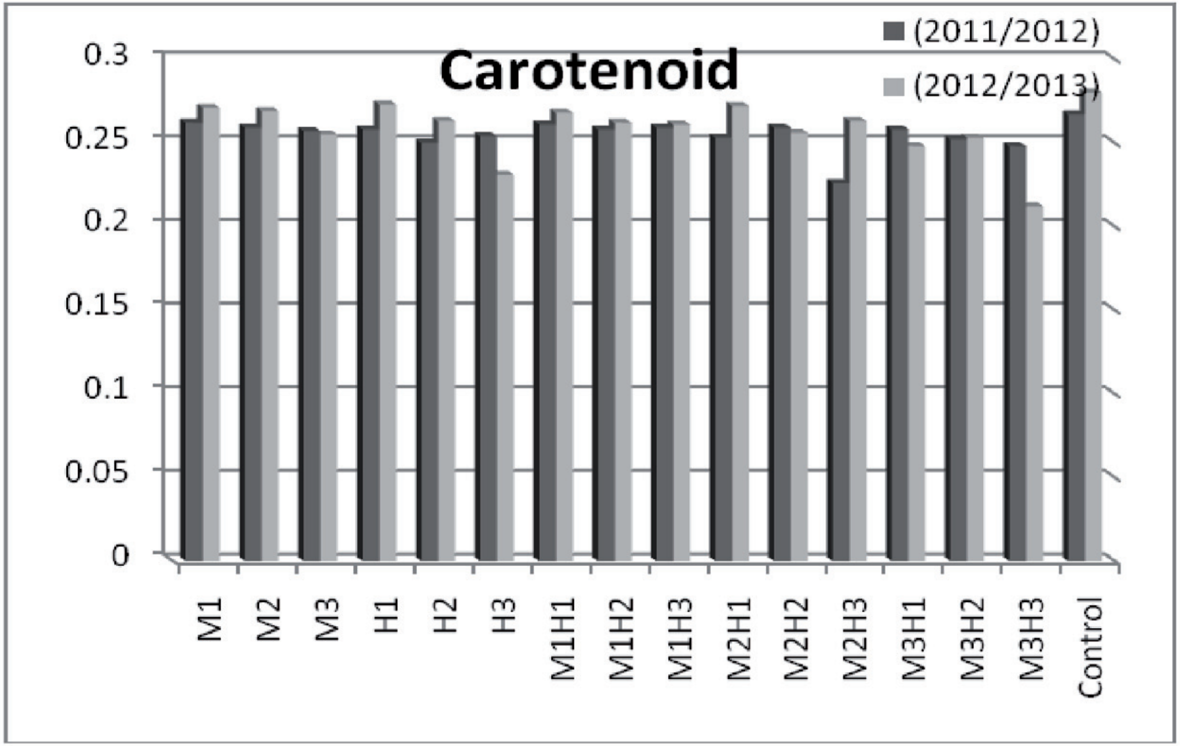


Fig. (7): Effect of Magnetite and K-humate and their combinations on Carotenoid leaf content of Valencia orange trees.

On contrary **Ursache-Oprisan, *et al*., (2011)** reported that magnetite nanoparticles influenced negatively the photosynthetic pigment biosynthesis by diminishing chlorophyll content with up to 50 % in the Wheat ; also, **Ameen and Kassim (2009)** showed that magnetized saline irrigation water decreased leaves chlorophyll content of Gerbera.

5. Fruit set and trees production:

Regarding to the effect of Magnetite, K-humate and its combinations treatments on Valencia orange cv.: initial fruit set ratio; final fruit set ratio and trees production as total yield (**k gm/tree**), fruit number per tree and yield efficiency (**kg m/m^3 canopy**}. Data obtained during both seasons are presented in **Table (8)**.

5.1. Initial fruit set ratio:

Data in **Table (8)** and **Fig (8)** cleared that Magnetite; K- humate and combinations treatments were insignificant effect on initial fruit set ratio during both experimental seasons (2011-012 &2012-013). Nevertheless, M_2H_3 treatment was the highest value (57.63) in the 1st season and M_3H_2 treatment (53.87) in the 2nd season in compared to other treatments .Whereas, H_1 treatment was the lowest value (42.13) in the 1st season and M1 treatment (39.30) in the 2nd season.

Table (8): Effect of magnetite and K-humate treatments on the Fruit set and trees production of Valencia orange trees in 2011/012 and 2012/013 seasons.

Treat.	Initial fruit set %		Final fruit set %		Total Yield (kg/ tree)		Fruit number / tree		Yield efficiency	
	2011/012	2012/013	2011/012	2012/013	2011/012	2012/013	2011/012	2012/013	2011/012	2012/0
M1	47.60 a	39.30 a	1.58 a	1.93 a	39.83 bc	52.00 d	223.00 a	282.33 b	2.46 a	3.19
M2	44.86 a	41.03 a	1.98 a	2.08 a	40.60 bc	53.33 d	224.67 a	299.33 ab	2.47 a	3.24
M3	52.60 a	46.82 a	2.36 a	2.12 a	44.17 abc	56.67 cd	231.67 a	294.33 ab	2.57 a	3.30
H1	42.13 a	45.37 a	1.92 a	1.87 a	39.50 bc	52.60 d	233.33 a	294.00 ab	2.46 a	3.27
H2	45.33 a	44.99 a	2.04 a	2.09 a	42.67abc	52.67 d	233.00 a	302.00 ab	2.70 a	3.33
H3	46.22 a	47.90 a	2.13 a	2.21 a	44.50 abc	57.33 bcd	232.33 a	306.67 ab	2.54 a	3.26
M1H1	50.89 a	51.28 a	1.90 a	2.02 a	42.67 abc	52.67 d	233.67 a	291.33 ab	2.55 a	3.14
M1H2	52.52 a	51.01 a	1.97 a	2.09 a	43.00abc	54.67 cd	238.67 a	300.00 ab	2.57 a	3.28
M1H3	55.47a	52.33 a	2.34 a	2.50 a	47.68 ab	61.00 ab	218.33 a	288.00 ab	2.75 a	3.52
M2H1	51.40 a	52.73 a	2.07 a	2.23 a	44.17 abc	52.67 d	228.00 a	295.33 ab	2.65 a	3.17
M2H2	49.58 a	48.73 a	2.08 a	2.17 a	43.67 abc	54.67cd	229.33 a	293.00 ab	2.35 a	2.94
M2H3	57.63 a	52.01 a	2.15 a	2.40 a	47.17 abc	58.33ab	243.33 a	301.00 ab	2.40 a	2.96
M3H1	50.14 a	52.16 a	2.25 a	2.15 a	45.67 abc	55.33 cd	236.67 a	301.00 ab	2.60 a	3.15
M3H2	49.39 a	53.87 a	2.76 a	2.78 a	51.00 a	62.00 a	257.00 a	310.33 a	2.48 a	3.02
M3H3	49.11 a	44.50 a	2.73 a	2.99 a	50.00 a	61.67 a	252.67 a	306.00 ab	2.63 a	3.25
Control	46.73 a	43.55 a	1.25 a	1.85 a	38.33 c	42.33 e	199.67 a	251.33 c	2.50 a	2.76

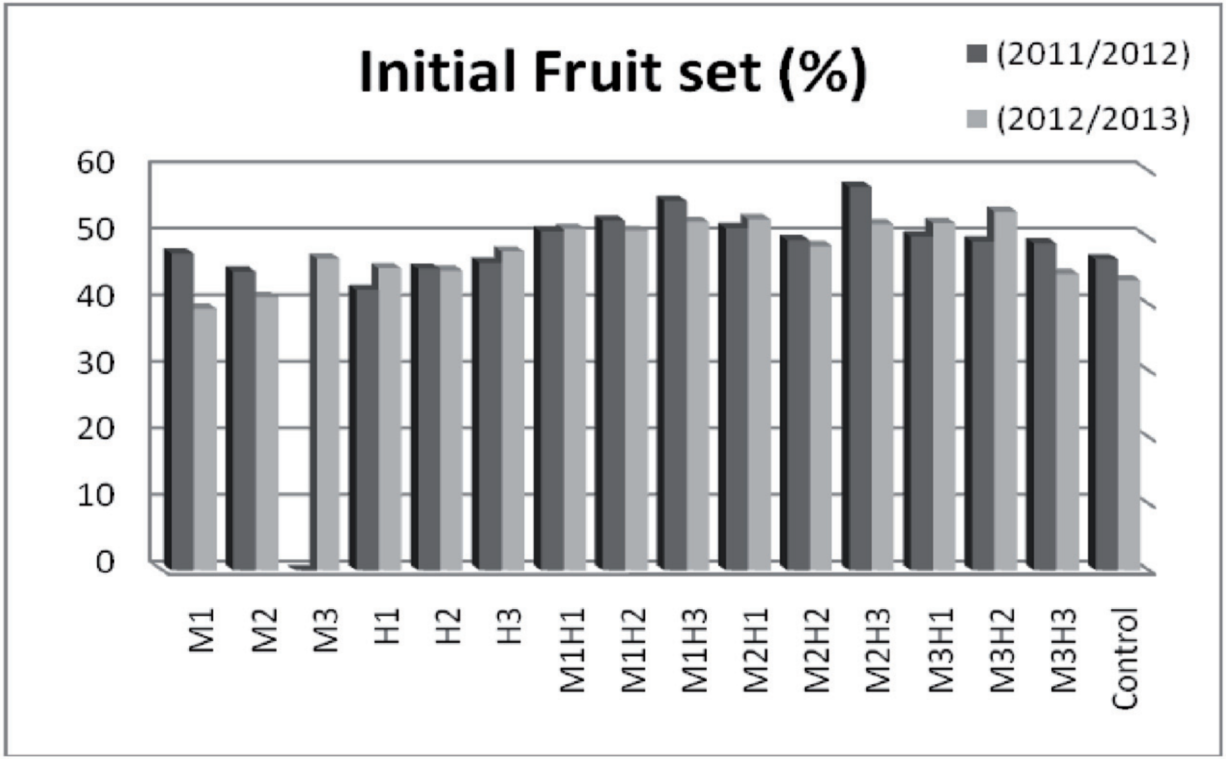


Fig. (8): Effect of Magnetite and K-humate and their combinations on initial fruit set (%) of Valencia orangetrees.

5.2. Final fruit set ratio:

With this respect, data in **Table (8)** and **Fig (9)** illustrated that Magnetite K- humate and combinations treatments improved the final fruit set of Valencia orange trees with insignificant differences when compared to control treatment for both seasons (2011-012&2012- 013).Whereas, M_3H_2 treatment in the 1^{st} season and M3H3 treatment in the 2^{nd} season were the highest values (2.76&2.99) percentage respectively and control treatment was the lowest (1.25 and 1.85) percentage during the two seasons of this study.

5.3. Tree yield (k gm/tree):

Data in **Table (8)** and **Fig (10)** cleared that Magnetite; K-humate and combinations treatments were statistically increased Valencia orange cv., tree yield (k gm) with some variations in there effect when compared to the control treatment during the two seasons (2011-012&2012-013) of this study. Also, high doses of Magnetite and K-humate and there combinations were the highest tree yield values, whereas, M_3H_2 treatment was the highest (51.00&62.00) and the control was the lowest (38.33&42.33) k gm/tree respectively, for both seasons.

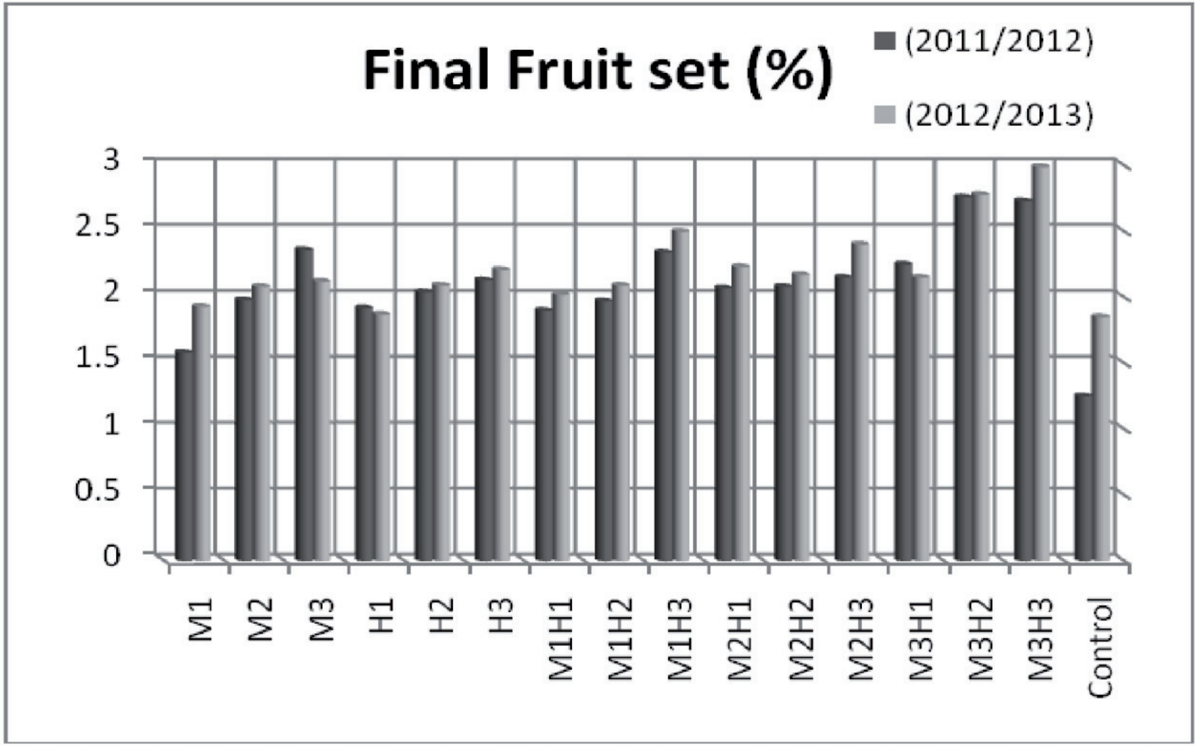


Fig. (9): Effect of Magnetite and K-humate and their combinations on final fruit set (%) of Valencia orange trees.

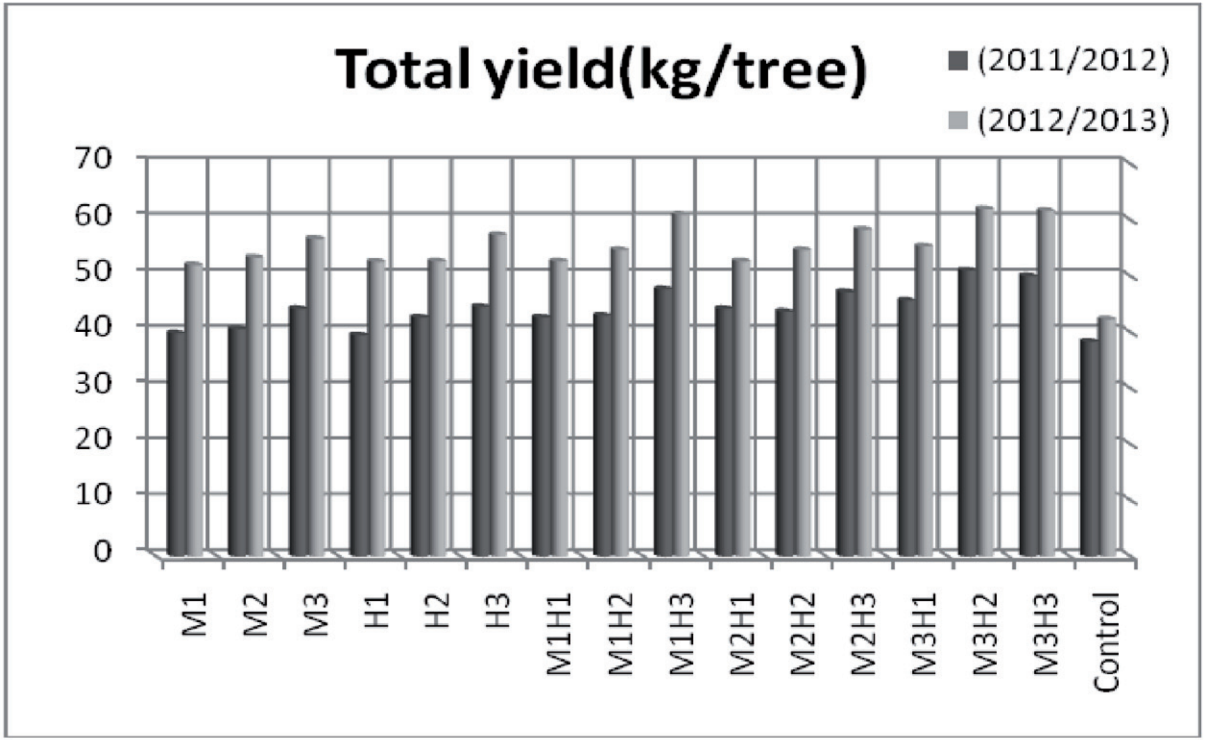


Fig. (10): Effect of Magnetite and K-humate and their combinations on total yield (kg/tree) of Valencia orange trees.

5.4. Fruit number per tree:

Effect of Magnetite; K- humate and their combinations treatments .**Table (8)** and **Fig (11)** cleared that, insignificant effect of treatments on Valencia orange production as fruit number/tree when compared to the control treatment in the first season (2011-012). Whereas, M_3H_2 treatment was the highest fruit number/ tree (257) and the control treatment was the lowest (199.67). In spite of, M_3H_2 treatment was statistically increased the average number of fruits per tree (310.33) when compared to M_1 (282.33) and the control (251.33) treatments respectively.

Nevertheless, other Magnetite; K- humate and there combinations treatments increased tree yield as fruit number / tree with insignificant effect in the 2nd season (2012-013).

5.5. Tree yield efficiency (k gm/ m^3 tree canopy):

Under the open orchards, there are some variations in the tree canopy volume for many reasons. Therefore, tree yield efficiency measurement considers the best method to correct these variations. Therefore, data in **Table (8)** and **Fig (12)** indicated that insignificant differences in Valencia orange tree yield efficiency (k gm/tree canopy volume) when compared Magnetite; K-humate and combinations treatments to control treatment in the 1st season (2011-012). While, M_1H_3 treatment (3.52 k gm/m^3 canopy volume) was significantly increased tree yield efficiency in compared to the control treatment (2.76 m^3 canopy volume) in the 2nd season (2012-013) of this study.

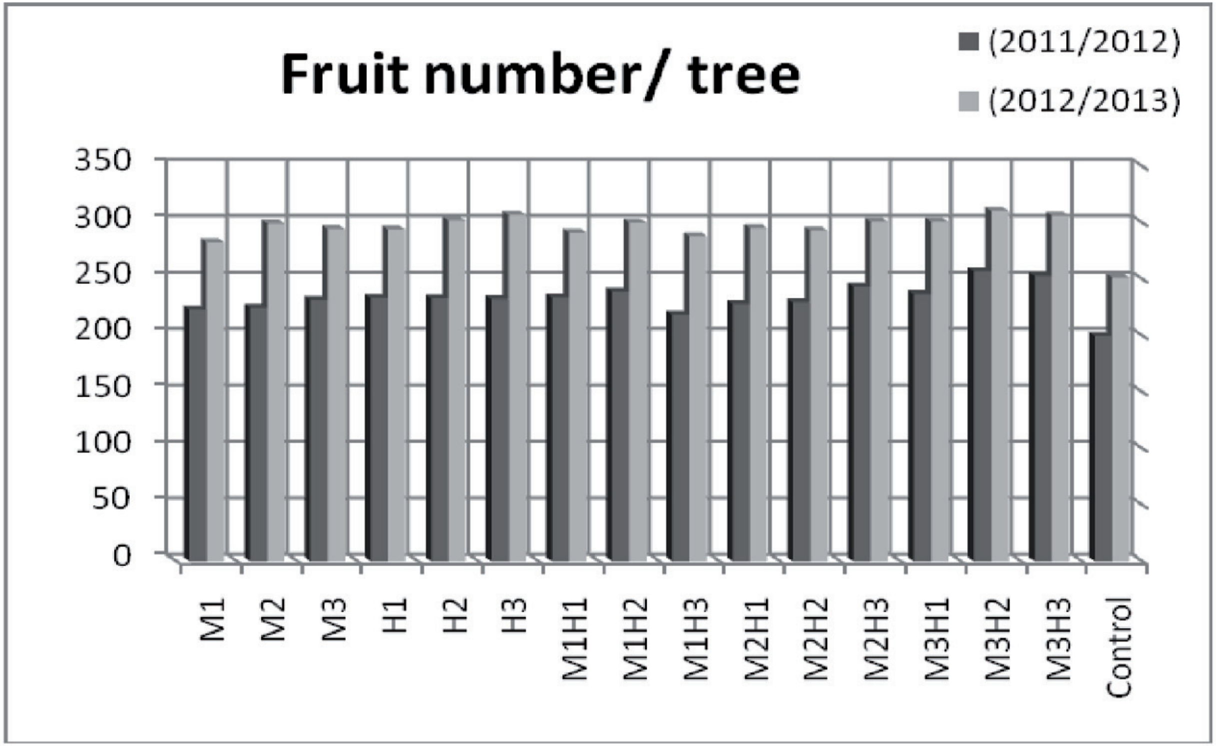


Fig. (11): Effect of Magnetite and K-humate and their combinations on fruit number of Valencia orange trees.

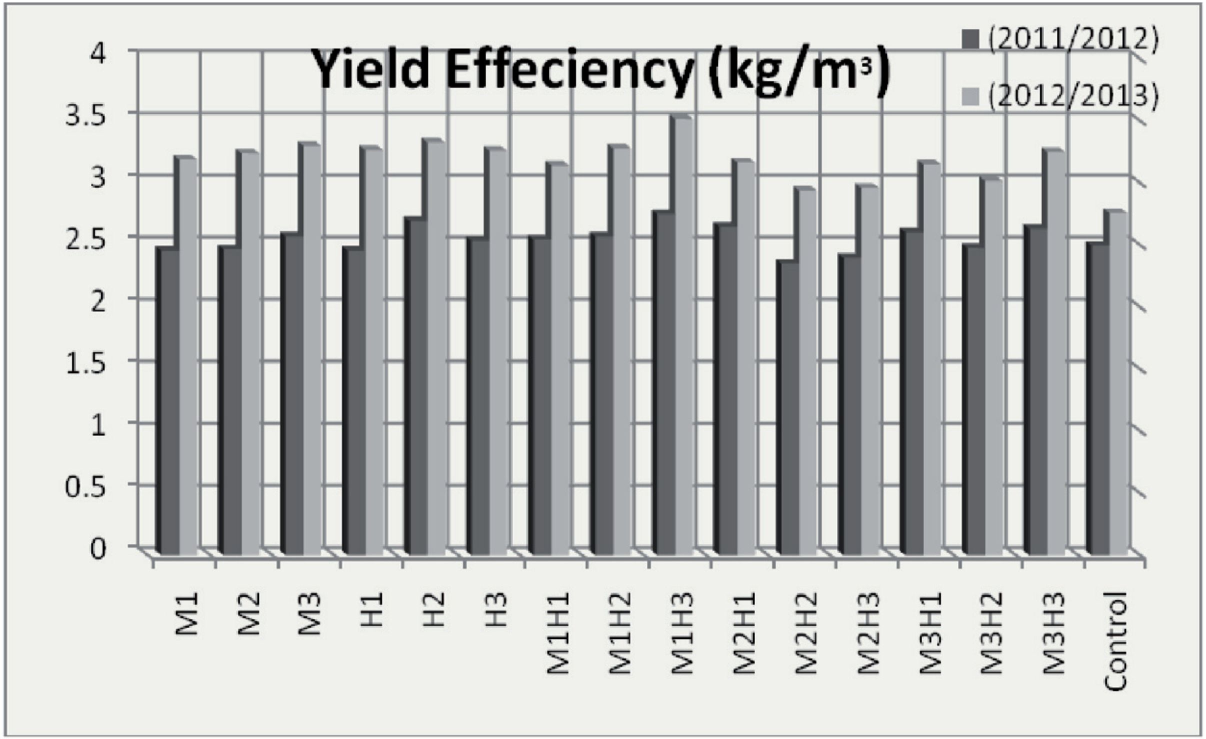


Fig. (12): Effect of Magnetite and K-humate and their combinations on yield efficiency (kg/m^3) of Valencia orange trees.

Generally, initial fruit set ratio; final fruit set % and trees production results under this study are in line were obtained by **Zekri *et al*., (2003)**; **Syvertsen and Lloyd (1994**); **Sayed *et al.,* (2007); El-Mohamdy and Ahmed (2009); Abdel-Aziz *et al.,* (2010); Du *et al.,* (2011) and Asgharzade and Babaeian (2012),** Whom mentioned that Citrus fruit set is highly dependent upon the type of inflorescence, whereas, flowers in leafy inflorescences that can be terminal or distributed among leaves along the shoot are commonly associated with higher fruit set. Also, Humic acid addition could enhance the efficacy of applied chemical fertilizers and Magnetic iron increased ability of soil to get rid of salts which resulting in increases in vegetative growth and fruit yields, also, better supply of soil nutrients and organic matter contributes to improvement of vegetative growth, leaf quality and fruit yield of many fruit trees including citrus.

6. ***Fruit characters***

Concerning to the effect of magnetite and K-kumate and their combinations on physical and chemical fruit properties of Valencia orange trees during both studied seasons (2011-012 &2012-013), results in **Tables (9 and 10)** revealed that fruit quality parameters were statistically affected by different treatments as follows :

6. 1. Physical parameters:

6.1.1 Fruit weight:

Regarding the effect of Magnetite; K- humate and there combinations applications,Data in **Table (9)** and **Fig (13)** quite evident that M_1H_3 treatment was significantly increased fruit weight (218.67 gm) when compared to M_1(178.67gm); M_2 (181.00gm); H_1 (169.33gm); H_2

(183.00gm); M_1H_1 (183.33gm) and M_1H_2 (181.00gm) treatments respectively, in the 1st season (2011-012). Whereas, M_1H_3 treatment was significantly increased Valencia orange fruit weight (211.33 gm) when compared to most of other treatments. Also, fruit weight fluctuated from treatment to another during the 2nd season (2012-013), this may be due to the accumulation effect of Magnetite and K-humate application in compared to the 1st season of this study.

Table (9): Effect of magnetite and K-humate treatments on fruit weight and fruit volume of Valencia orange trees in 2011/012 and 2012/013 seasons.

Treat.	Fruit weight (gm)		Fruit Volume (ml)	
	2011/012	**2012/013**	**2011/012**	**2012/013**
M1	178.67 b	184.67 bcde	211.83 abc	195.67 abc
M2	181.00 b	178.67 cde	215.17 abc	195.00 abc
M3	191.67 ab	193.33 bcd	212.00 abc	204.33 ab
H1	169.33 b	179.00 cde	190.33 bc	190.00 bc
H2	183.00 b	174.67 de	208.00 abc	186.00 bc
H3	191.33 ab	186.67 bcde	209.00 abc	204.67 ab
M1H1	183.33 b	181.00 bcde	213.00 abc	198.00 abc
M1H2	181.00 b	185.00 bcde	212.33 abc	196.00 abc
M1H3	218.67 a	211.33 a	238.67 a	223.67 a
M2H1	193.67 ab	180.00 cde	217.67 abc	199.33 abc
M2H2	191.33 ab	186.33 bcde	213.33 abc	198.33 abc
M2H3	194.00 ab	193.33 bcd	215.33 abc	206.67 ab
M3H1	192.67 ab	183.00 bcde	224.00 ab	201.00 ab
M3H2	198.67 ab	200.00 abc	228.67 ab	213.67 ab
M3H3	198.33 ab	201.33 ab	226.33 ab	215.67 ab
Control	195.67ab	168.33 e	179.00 c	173.00 c

6.1.2. Fruit volume:

Data in **Table (9)** showed that M_1H_3 treatment was significantly increased fruit volume (238.67 &223.67 ml) when compared to control treatment which was the lowest values (179.00 & 173.00 ml). Moreover, results in **Fig (14)** cleared that Magnetite; K-humate and there combinations applications were insignificant effect on Valencia orange fruits volume for both seasons (2011-012 &2012-013).

Nevertheless, other Magnetite; K- humate and there combinations treatments increased tree yield as fruit number/ tree with insignificant effect in the 2nd season (2012-013).

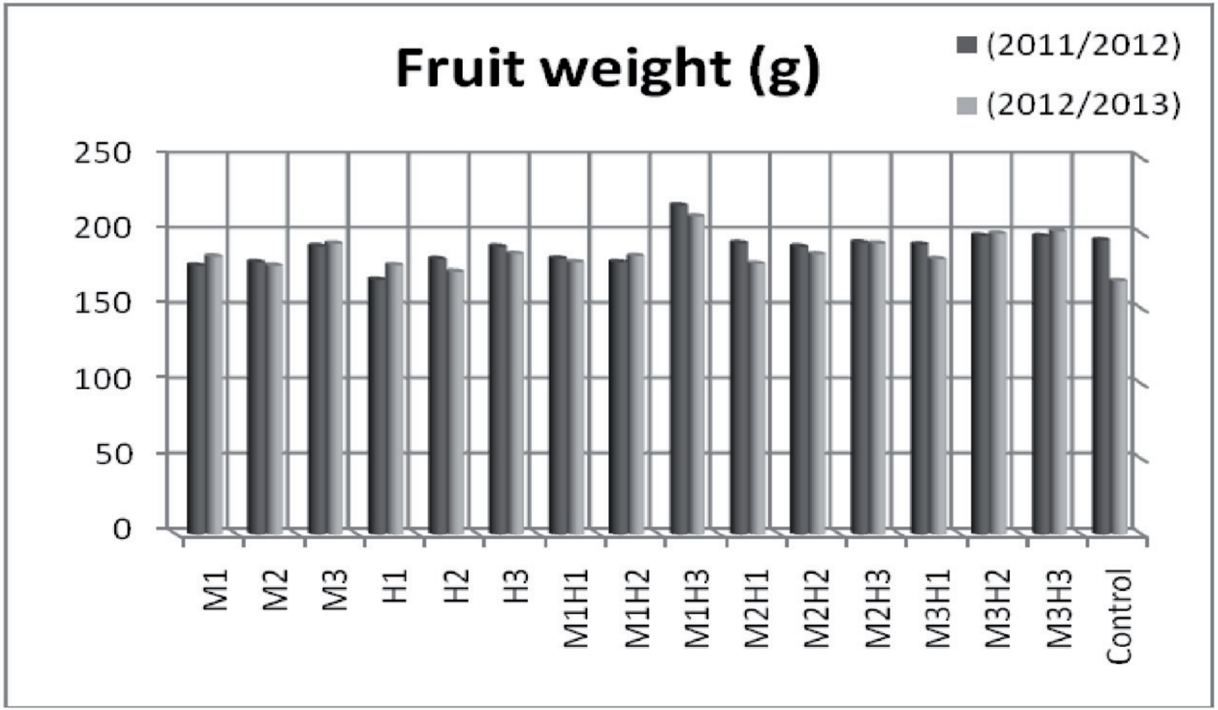


Fig. (13): Effect of Magnetite and K-humate and their combinations on fruit weight (g) of Valencia orange trees.

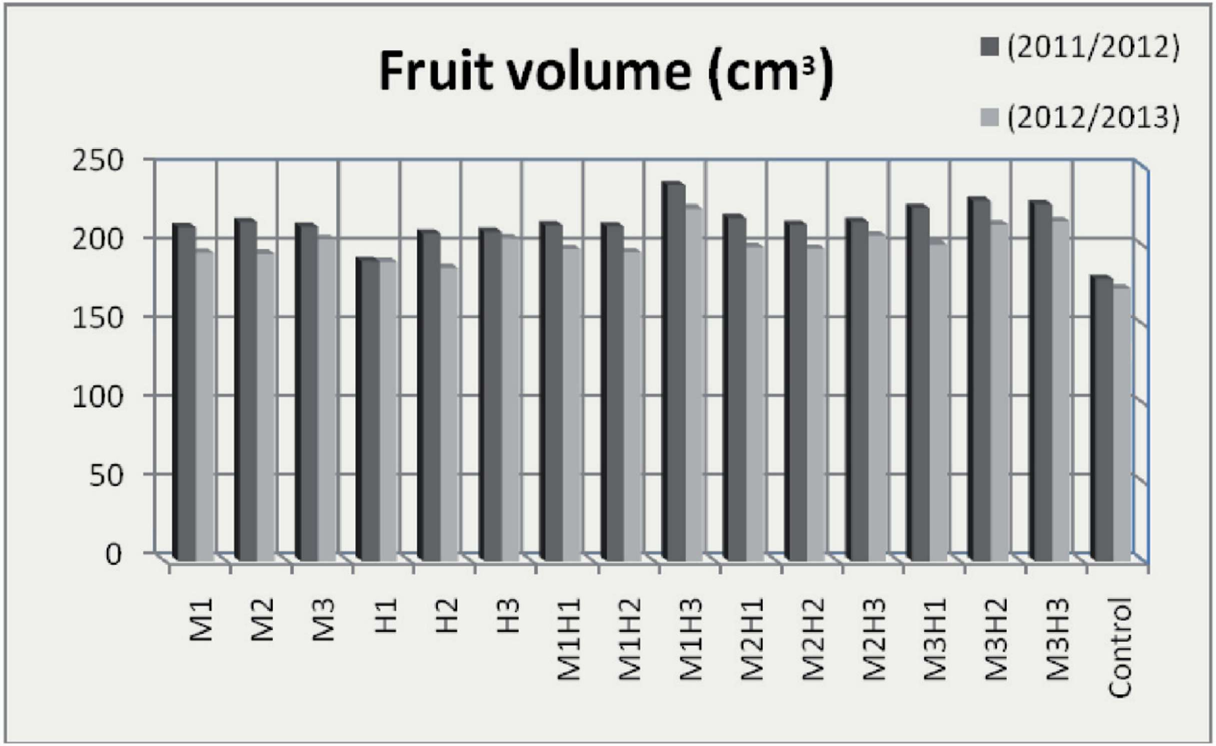


Fig. (14): Effect of Magnetite and K-humate and their combinations on fruit volume (cm^3) of Valencia orange trees.

6.1.3. Fruit shape index:

With this respect, data in **Table (10)** and **Fig (15)** indicated that Magnetite; K-humate and their combinations treatments had a positive effect on Valencia orange fruit shape (from round or semi oval to oval shape) under this experimental condition during both seasons. Whereas, M_1H_3 treatment had a significant effect on of fruit shape index (1.079 &1.151) when compared to M_3H_3 (0.968) and control 0.927) treatments respectively, in the 1st season (2011-012) and other treatments in the 2nd season (2012-013) with insignificant effect between all other treatments.

Table (10): Effect of magnetite and K-humate treatments on fruit shape index and pell thickness of Valencia orange trees in 2011/012 and 2012/013 seasons

Treat.	Fruit shape index		Peel thickness (cm)	
	2011/2012	2012/2013	2011/2012	2012/2013
M1	0.996 abc	0.988 b	0.412 a	0.416 ab
M2	0.994 abc	0.994 b	0.410 a	0.423 ab
M3	1.004 abc	0.988 b	0.433 a	0.417 ab
H1	0.981 abc	0.982 b	0.424 a	0.413 ab
H2	1.028 ab	1.031 b	0.415 a	0.432 ab
H3	1.013 abc	1.003 b	0.431 a	0.436 ab
M1H1	1.040 ab	1.037 b	0.444 a	0.435 ab
M1H2	1.027 ab	1.013 b	0.413 a	0.433 ab
M1H3	1.079 a	1.151 a	0.497 a	0.451 a
M2H1	1.032 ab	1.032 b	0.455 a	0.427 ab
M2H2	1.030 ab	1.026 b	0.450 a	0.448 a
M2H3	0.987 abc	1.008 b	0.484 a	0.458 a
M3H1	0.986 abc	1.037 b	0.447 a	0.453 a
M3H2	0.996 abc	0.995 b	0.463 a	0.448 a
M3H3	0.968 bc	1.004 b	0.470 a	0.467 a
Control	0.927 c	0.980 b	0.387 a	0.376 b

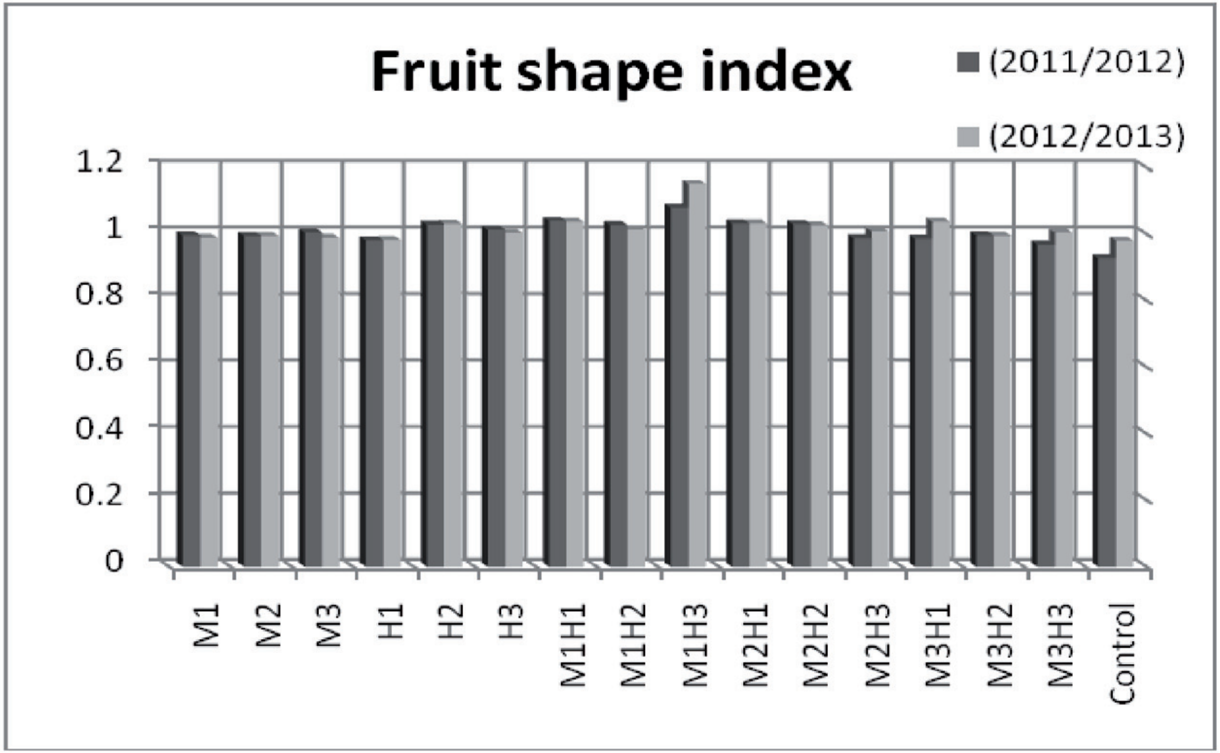


Fig. (15): Effect of Magnetite and K-humate and their combinations on fruit shape index of Valencia orange trees.

Generally, Magnetite; K-humate and there combinations applications improved physio-chemical parameters as compared with control treatment in both seasons.

These results are confirmed with those obtained by; **El-Otmani *et al.*,(1995)**; **Guardiola and Garcia-luis (2000)**; **De-Souza *et al.,(*2005)**; **Ferrara and Brunetti (2010); Ismail *et al.,* (2010); Maheshwari and Grewal (2009)**; **El-zaawely *et al.*, (2013) and Hagagg, *et al.*, (2013[b])** whom indicated to increased average fruit weight by magnetic field (magnetic iron ore) this effect can be explained by alterations in the transport properties of cellular plasmatic membranes, which play an extremely important role in regulating the assimilation by a cell of the nutrients . Also, humic acid has been utilized to reduce the effect of soil salinity on plant growth and development. And the increase in fruit size as a consequence of magnetite and k-humate application is probably ascribed to the uptake of mineral nutrients by the trees, but the possible hormone-like activity of the humic acid (i.e., auxin-, gibberellin and cytokinin-like activity) should also be taken into consideration.

Moreover, the reason for obtained highest fruit number per tree with magnetite plus humic is due to their effect on plant growth stimulation through increased photosynthetic and carbohydrate contents, as well as improved uptake of nutrients and water the regulation of the hormone level, improvement of plant growth and enhancement of stress tolerance . In addition, humic substances improved fruit length& diameter of many species; this increasing may be partially ascribed to the possible hormone-like activity of humic.

6.1.4. Fruit peel thickness (cm):

Concerning the effect of Magnetite; K-humate and their combinations treatments, **Table (10)** and **Fig (16)** showed that, insignificant effect of treatments on peel thickness. Whereas, M_1H_3 treatment was the highest value (0.497cm) and the control was the lowest (0.387cm) in the 1st season (2011-012). In spite of Magnetite; K- humate combinations treatments were statistically increased fruit peel thickness when compared to the control treatment, whereas, M_3H_3 treatment was the highest value (0.467cm). Nevertheless, fruit peel thickness differences between all Magnetite; K- humate and there combinations treatments were insignificant in the 2nd season.

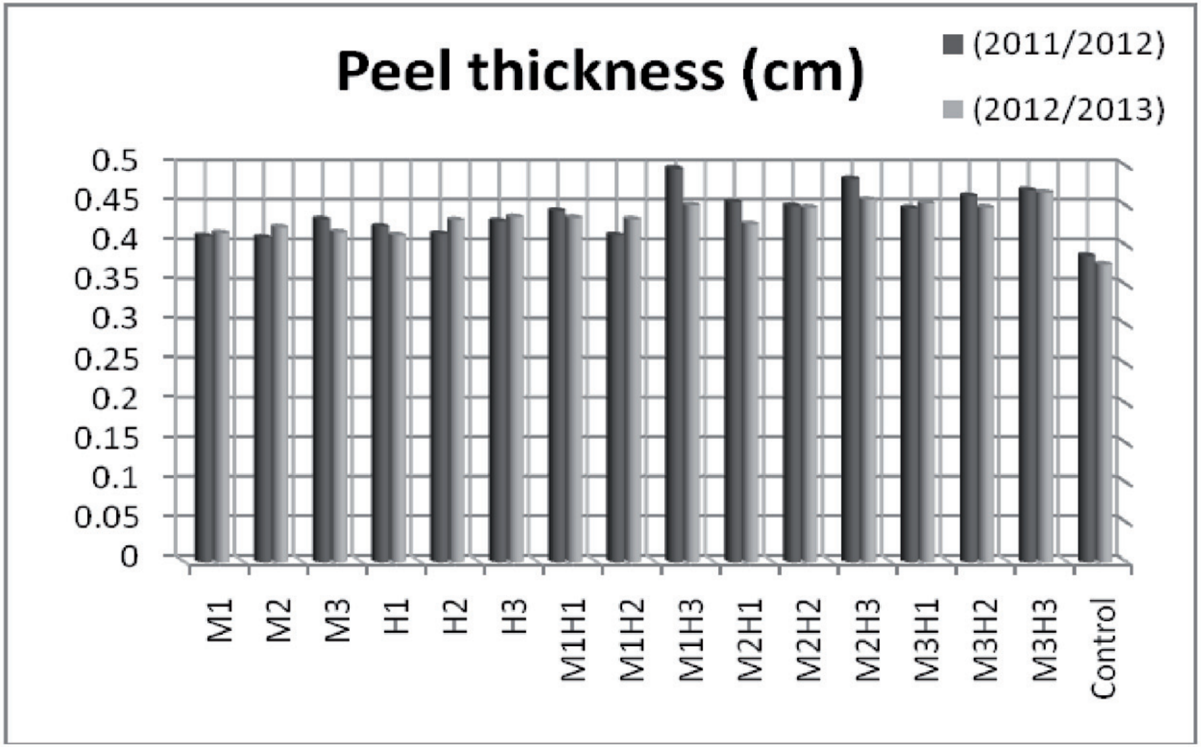


Fig. (16): Effect of Magnetite and K-humate and their combinations on fruit peel thickness (cm) of Valencia orange trees.

6.1.5. Fruit peel color:

6.1.5.1. Hue angle:

Hue angle was determined as a criterion for appearance which considered as a significant indicator for fruit quality. The present data in **Table (11)** and **Fig (17)** showed that the Valencia orange fruit peel color positively affected by Magnetite, K-humate and combinations treatments. Whereas, M_3H_3, M_1H_3 and H_1treatments had the best color (67.14, 68.02 and 68.57) respectively, in the 1st season (2011-012) with insignificant difference with control treatments. Moreover, M_3H_3, M_1H_3 and H_1treatments was significantly had the best values (71.37, 72.04 and 3.09) respectively, in the 2nd season (2012-013). Whereas, the lowest fruit color values were obtained from M_1H_1 treatment in both seasons.

Generally, depending on Hue angle method for measuring the color angle. A decrease of hue angle in Valencia peel color which represent the area from greenish yellow to orange yellow in both seasons respectively.

6.5.1.2. A/B Ratio:

Also, data in **Table (11)** and **Fig (18)** illustrated that, during fruit growth development peel color of Valencia orange fruits **(A/B Ratio)** fluctuated as affected by Magnetite, K-humate and combinations treatments during both seasons (2011-012 and 2012-013). Insignificant differences between all treatments in the 1st season (2011-012), while, in the 2nd season (2012-013) Magnetite, K-humate and combinations treatments significantly improved the **(A/B ratio)** of fruits, whereas, the H_2 treatment was the best value (0.278) when compared to the H_3 treatment which the lowest (0.216).

Table (11): Effect of magnetite and K-humate treatments on fruit color of Valencia orange trees in 2011/12 and 2012/13 seasons:

Treat.	Hue		a/b ratio	
	(2011/2012)	(2012/2013)	(2011/2012)	(2012/2013)
M1	72.94 ab	78.18 ab	0.283 a	0.211 b
M2	70.88 ab	78.07 ab	0.354 a	0.208 b
M3	73.66 ab	75.89 b	0.299 a	0.254 ab
H1	68.57 b	73.09 c	0.300 a	0.241 b
H2	73.06 ab	77.04 ab	0.328 a	0.278 a
H3	72.16 ab	77.68 ab	0.318 a	0.216 c
M1H1	75.97 a	79.60 a	0.255 a	0.251 ab
M1H2	77.93 a	78.18 ab	0.222 a	0.217 b
M1H3	68.02 b	72.04 c	0.271 a	0.202 b
M2H1	72.32 ab	76.76 b	0.315 a	0.235 ab
M2H2	71.92 ab	78.12 ab	0.312 a	0.210 b
M2H3	73.58 ab	77.83 ab	0.285 a	0.217 b
M3H1	74.47 ab	78.42 ab	0.315 a	0.204 b
M3H2	71.11 ab	76.80 b	0.291 a	0.237 ab
M3H3	67.14 b	71.37 c	0.268 a	0.218 b
Control	77.00 a	77.58 ab	0.286 a	0.232 b

These observations are in line with those obtained by **Campbell *et al*., (2004)**; **Hatcher *et al*., (2004)** and **Mohamed *et al*., (2013)** whom cleared that fruit peel color is one of the most important attributes of agrifood products, since consumers associate it with freshness and is critical in the acceptance of a particular product among others Producers strive to prevent products with defective colorations from reaching the market. Magnetite treatments had more lightness and good rind fruit color, so it seems more attractive than other treatments.

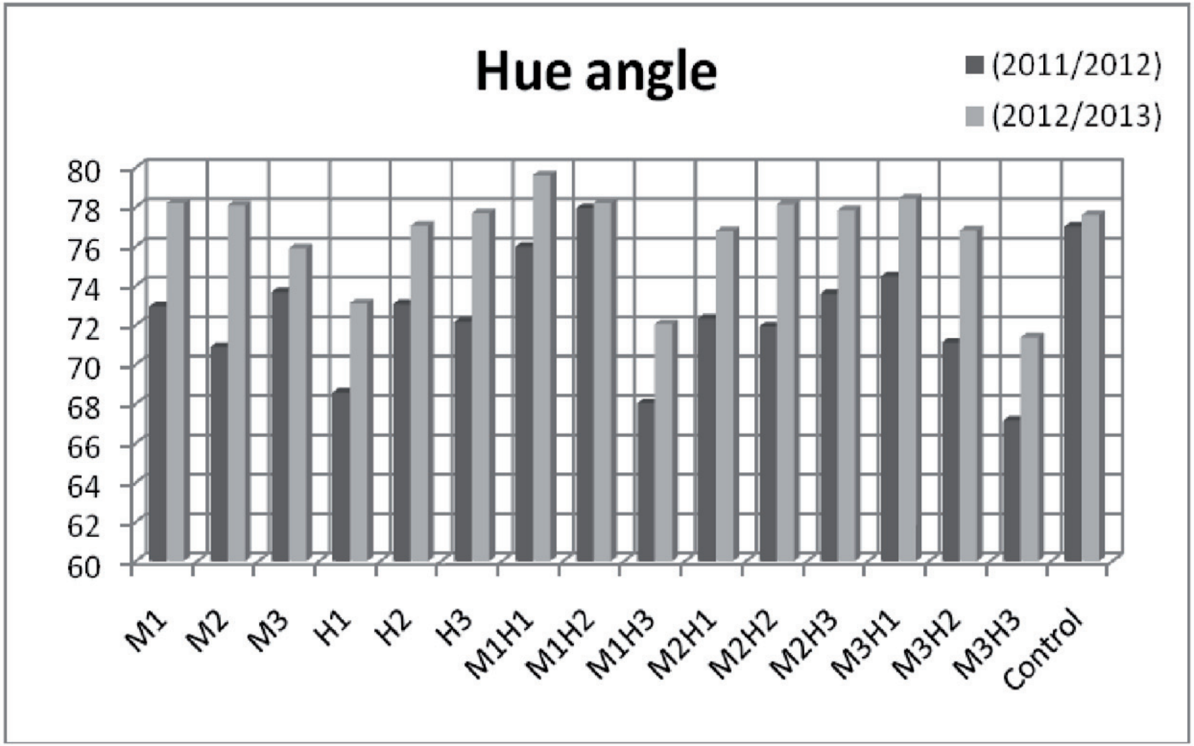


Fig. (17): Effect of Magnetite and K-humate and their combinations on fruit peel color (Hue angle) of Valencia orange trees.

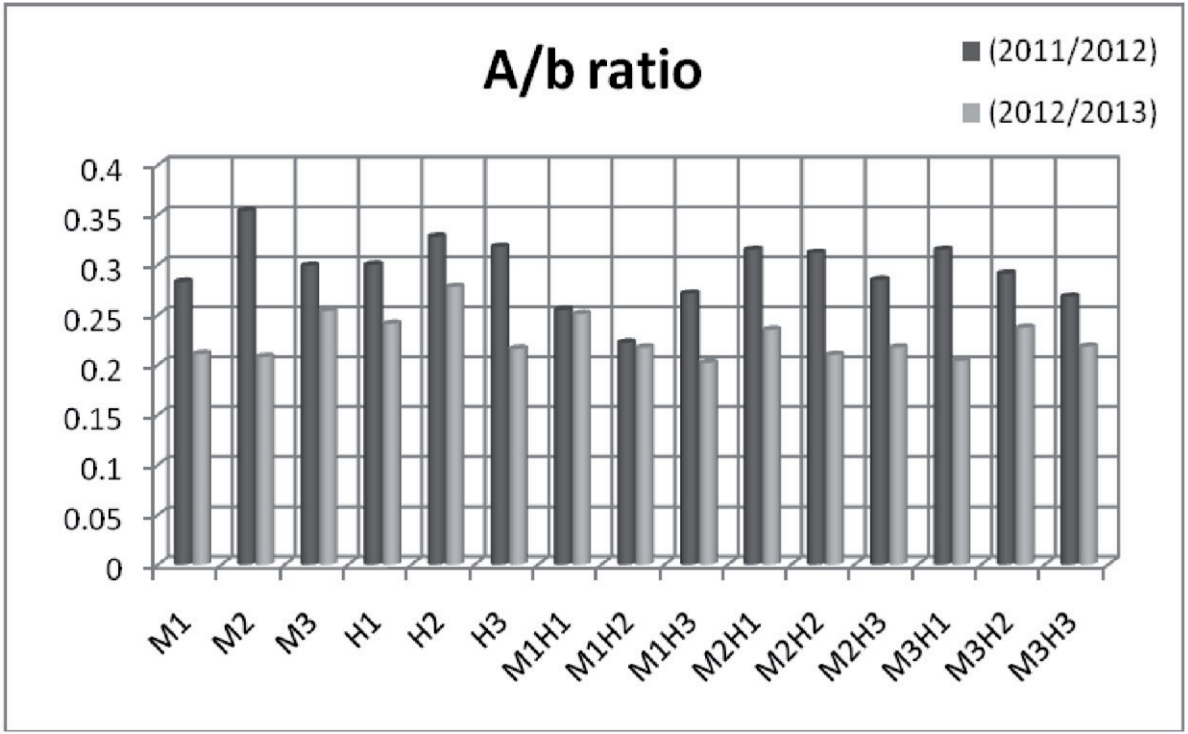


Fig. (18): Effect of Magnetite and K-humate and their combinations on fruit peel color (a/b ratio) of Valencia orange trees.

6.1.6. Fruit Juice Weight (gm):

Data in **Table (12)** showed that M_1H_3 treatment was significantly the highest increment of juice weight (102.333 & 104.000 gm) in compared to other treatments and the control treatment which was significantly reduced Valencia orange fruit juice content (59.00 & 56.667gm) respectively, for both seasons (2011-012&2012-013).

Also, Magnetite; K-humate and their combinations treatments were fluctuated in there effect, whereas, H_2 and H_1 treatments were the lowest values (68.00 & 68.667 gm) respectively, in the 1st season (2011-012) and H_1 and H_2 treatments (68.667 & 71.667gm) in the 2nd season (2012-013) of this study.

6.1.7. Fruit Juice volume (ml):

Present data in **Table (12)** indicated that Magnetite; K-humate and their combinations treatments were significantly increased Valencia orange fruit juice volume when compared to the control treatment with some statistical differences for the effect of Magnetite or K-humate as a single treatment in the 1st season (2011-012). Whereas, M_1H_3 treatment was the highest value (106.67 ml) and the control treatment was the lowest (66.33 ml). In contrary, Magnetite; K-humate and their combinations treatments were significantly improved fruit juice content with some fluctuations between Magnetite; K-humate treatments in the 2nd season (2012-013). Moreover, H_3 (99.56 ml); M_1H_3 (112.67 ml); M_2H_3 (98.89 ml); M_3H_1 (103.89 ml); M_3H_2 (108.33 ml) and M_3H_3 (110.00 ml) Treatments respectively, significantly increased juice volume when compared to the control treatment (69.00 ml) and were insignificant effect with other treatments.

Table (12): Effect of magnetite and K-humates treatments on some physical characters of Fruit juice of Valencia orange trees in 2011/012 and 2012/013 seasons.

Treat.	Juice Weight (gm)		Juice Volume (ml)		Juice %(w/w)	
	(2011/2012)	(2012/2013)	(2011/2012)	(2012/2013)	(2011/2012)	(2012/2013)
M1	80.33 b	79.67 abcd	89.00 bcd	85.33 ab	45.38 a	42.98 ab
M2	82.50 b	76.67 abcd	97.33 abc	90.00 ab	45.66 a	43.10 ab
M3	80.83 b	84.67 abc	88.33 bcd	94.78 ab	42.60 a	43.70 ab
H1	68.67 c	68.67 cd	77.33 d	86.11 ab	40.71 a	38.37 ab
H2	68.00 c	71.66 bcd	86.00 cd	88.00 ab	37.21 a	41.21 ab
H3	89.83 b	87.33 abc	90.33 bcd	99.56 a	47.02 a	46.90 ab
M1H1	86.17 b	83.33 abc	96.67 abc	93.33 ab	46.99 a	46.04 ab
M1H2	85.00 b	83.67 abc	93.83 abc	90.78 ab	47.12 a	45.27 ab
M1H3	102.33 a	104.00 a	106.67 a	112.67 a	46.88 a	49.21 ab
M2H1	91.00 b	80.33 abcd	95.00 abc	91.33 ab	46.98 a	44.56a
M2H2	89.83 b	78.67 abcd	90.00 bcd	88.00 ab	47.08 a	42.42 ab
M2H3	91.17 b	93.33 abc	94.67 abc	98.89 a	47.01 a	48.32ab
M3H1	89.50 b	94.67 abc	100.43 abc	103.89 a	46.39 a	51.68 a
M3H2	90.00 b	97.67 ab	102.67 ab	108.33 a	45.36 a	48.79 ab
M3H3	92.50 b	99.33 ab	102.00 ab	110.00 a	46.67 a	49.43a
Control	59.00 d	56.67 d	66.33 e	69.00 b	30.17 b	33.73 b

6.1.8. Fruit Juice ratio (w/w):

With this respect, **Table (12)** cleared that, Magnetite; K-humate and there combinations treatments were significantly increased Valencia orange fruit juice ratio (w/w) when compared to the control treatment in the 1st season (2011-012). M1H2 treatment was the highest value (47.12).

In addition, **Fig (19)** showed that, M2H1 (44.56); M3H1 (51.68) and M3H3 (49.43) respectively, treatments were significantly increased fruit juice ratio as a weight when compared to the control treatment (33.73) , and insignificant differences with other Magnetite ; K-humate and their combination treatments in the 2nd season (2012-2013).

These foundations are in line with those obtained by **Mass (1993); Sayed *et al*., (2007); Abdel Rahman *et al.*, (2009); Abel-Aziz *et al*. (2010) and Mohamed *et al* .(2013)** Who indicated that salinity reduced rind thickness and humic acid applications improved fruit juice weight of mandarin. Also, Magnetite treatments were enhancing Valencia orange fruit juice weight percentage. Generally, Magnetite or humic acid applications will be improved physical fruit quality which gave extra advantage for such fruits to be exported.

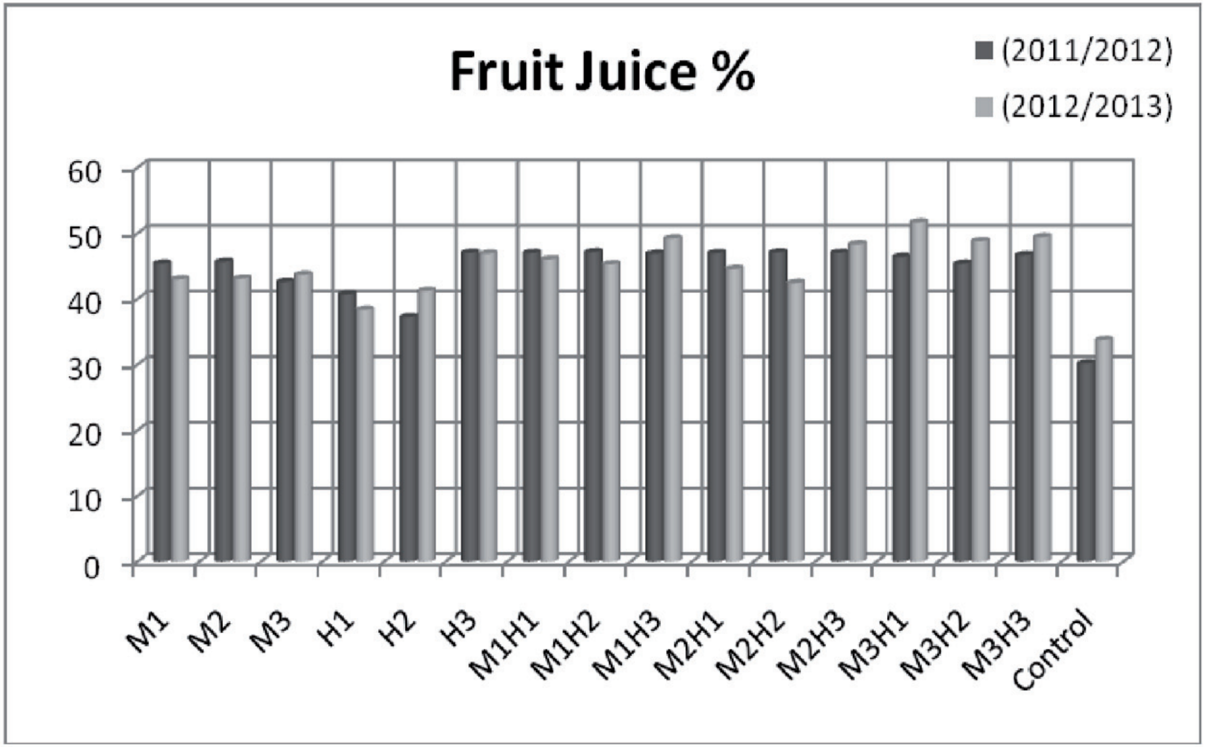


Fig. (19): Effect of Magnetite and K-humate and their combinations on fruit juice ratio of Valencia orange trees.

6. 2. ***Chemical parameters***

6.2.1. Fruit juice TSS % content:

Regarding the effect of Magnetite; K-humate and their combinations treatments, data in **Table (13)** showed that, the control treatment was significantly increased Valencia orange fruit juice T. S. S. content (12.83) when compared to H_3 (11.03); M_2H_3 (11.00); M_3H_2 (10.83) and M_3H_3 (10.67) percentage treatments respectively, While, the control treatment was insignificant effect with other treatments during the 1st season (2011-012). Moreover, the control treatment was significantly increased juice TSS content (13.00) when compared to Magnetite; K-humate and their combinations treatments, whereas, M_3H_3 treatment was the lowest value (11.00) in the 2nd season of this study.

6.2.2. Fruit juice total acidity % content:

Present data in the **Table (13)** indicated that the control treatment was statistically increased fruit juice total acidity content (1.69&1.63) percentage respectively, when compared to Magnetite; K-humate and their combinations treatments. Whereas, M_1H_3 treatment was the lowest values (1.19&1.13) percentage respectively, in both experimental seasons (2011-012&2012-013).

6.2.3. T S S/acid Ratio:

Fig (20) indicated that, In spite of the control treatment clearly increased both TSS and total acidity in compared to Magnetite; K-humate and their combinations treatments. Nevertheless, M_1H_2 (9.86&10.30) was significantly increased TSS/acid Ratio when compared to the control treatment (7.61&8.01) respectively, during both seasons.

Table (13): Effect of Magnetite and K-humate treatments on some chemical Fruit Juice characters of Valencia orange trees in 2011/012 and 2012/013 seasons.

Treat.	**T. S. S**		**Acidity**		**T. S. S / Acid %**	
	2011/2012	**2012/2013**	**2011/2012**	**2012/2013**	**2011/2012**	**2012/2013**
M1	12.50 ab	11.57 b	1.59 ab	1.42 b	7.88 b	8.14 b
M2	11.93 abc	11.80 b	1.43 bcde	1.43 b	8.33 ab	8.25 b
M3	11.57 abc	11.50 b	1.38 cdef	1.35 b	8.40 ab	8.50 b
H1	12.00 abc	11.92 b	1.53 bc	1.47 b	7.85 ab	8.14 b
H2	11.77 abc	11.33 b	1.47 bcd	1.40 b	8.03 b	8.11 b
H3	11.03 bc	11.53 b	1.31 defg	1.37 b	8.44 ab	8.42 b
M1H1	11.65 abc	11.50 b	1.40 cdef	1.42 b	8.32 ab	8.12 b
M1H2	11.80 abc	11.57 b	1.45 bcd	1.40 b	8.15 b	8.28 b
M1H3	11.73 abc	11.66 b	1.19 g	1.13 c	9.86 a	10.30 a
M2H1	11.60 abc	11.67 b	1.40 cdef	1.38 b	8.32 ab	8.42 b
M2H2	11.50 abc	11.63 b	1.38 cdef	1.42 b	8.35 ab	8.23 b
M2H3	11.00 bc	11.17 b	1.26 efg	1.27 bc	8.75 ab	8.83 b
M3H1	11.40 abc	11.75 b	1.38 cdef	1.40 b	8.28 b	8.44 b
M3H2	10.83 bc	11.68 b	1.25 efg	1.33 b	8.68 ab	8.81 b
M3H3	10.67 c	11.00 b	1.23 fg	1.25 bc	8.66 ab	8.80 b
Control	12.83 a	13.00 a	1.69 a	1.63 a	7.61 b	8.01 b

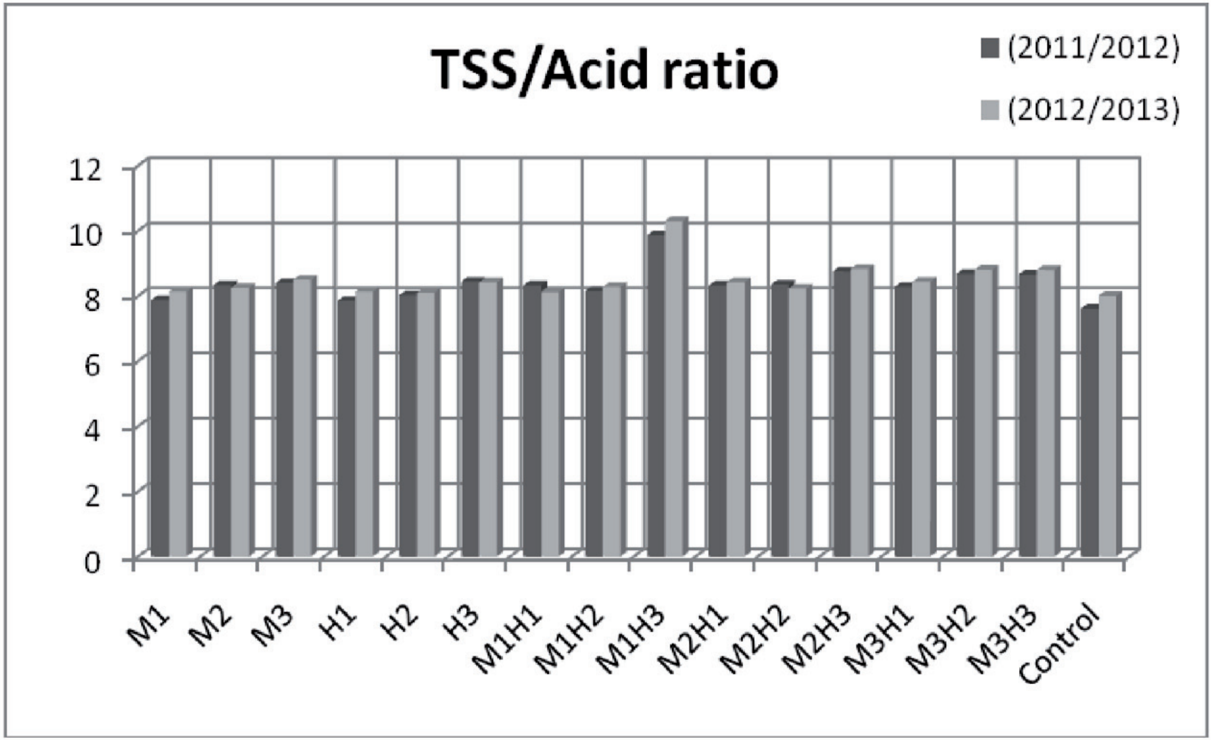


Fig. (20): Effect of Magnetite and K-humate treatments on fruit juice TSS/Acid ratio of Valencia orange trees.

6.2.4. Fruit juice Vit. C content (mg/100gm):

Concerning to the effect of Magnetite; K-humate and their combinations treatments, data in the **Table (14)** and **Fig (21)** indicated that, most of the Magnetite and K-humate combinations treatments were significantly increased Valencia orange fruit juice Vit. C (mg/100gm.) content when compared to the single Magnetite and K-humate and the control treatments for both seasons,

So, M_3H_2 treatment (52.62&58.27 mg/100gm) Vit. C respectively, was the highest values and the control treatment (37.19&40.23) mg/100gm. Vit. C respectively, was the lowest for both studied seasons.

These results are similar with those obtained by, **Francois and Clarck (1980)**; **Dasberg *et al.* (1991)**; **Sayed *et al*., (2007)**; **Fathy *et al*., (2010)**; **Navarro *et al*., (2010)**; **Abd El-Razek (2012)**; **Ali *et al*., (2013)** and **Mansour *et al.*, (2013)**, Whom indicated that saline conditions and water deficit stress enhanced sugar accumulation of Valencia orange fruit cause an increase TSS and acid concentration in the fruit juice which caused a delay in the ripening of the fruit of Valencia orange. Humic acid improved chemical properties due to increasing soil microorganism activity which enhance nutrient cycling that induce growth and enhance fruit quality. Moreover, humic substances decreased acidity in different fruit. Whereas, Magnetic field and Magnetite treatments increased TSS and reduced acidity in Valencia orange fruit juice content.

Table (14): Effect of magnetite and K-humate treatments on some chemical Fruit juice characters of Valencia orange trees in 2011/012 and 2012/013 seasons.

Treat.	Vit. C (mg/100g)		Total sugars		Reducing sugars	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
M1	42.53 def	43.87 cde	9.027 abc	8.583 b	4.097 ab	4.197 ab
M2	39.80 fg	49.23 abcd	9.167 abc	8.610 b	4.117 ab	4.202 ab
M3	43.97 cde	47.30 bcde	9.110 abc	9.813 ab	4.027 b	3.904 bcd
H1	39.61 fg	41.67 de	8.890 abc	8.293 b	4.373 a	4.298 a
H2	40.80 ef	49.53 abcd	9.100 abc	8.820 ab	4.203 ab	4.198 ab
H3	47.21 bc	50.57 abc	9.863 ab	9.400 ab	3.953b	3.967 bcd
M1H1	43.37 def	49.33 abcd	9.277 abc	8.353 b	4.117 ab	4.165 ab
M1H2	44.09 cde	50.13 abc	9.250 abc	8.827 ab	4.097 ab	4.112 abc
M1H3	49.75 ab	57.83 a	10.433 a	10.513 a	4.000 b	3.971 bcd
M2H1	42.35 def	51.70 abc	9.200 abc	9.160 ab	4.180 ab	4.174 ab
M2H2	45.76 cd	50.67 abc	8.667 bc	8.793 ab	4.097 ab	4.055 abcd
M2H3	51.66 a	54.03 ab	9.973 ab	9.803 ab	3.940 bc	3.930 bcd
M3H1	49.75 ab	52.80 abc	9.267 abc	9.710 ab	4.027 b	4.061 abcd
M3H2	52.62 a	58.27 a	10.000 ab	9.803 ab	3.673 c	3.784 d
M3H3	51.46 a	54.80 ab	9.777 ab	9.930 ab	3.953 b	3.825 cd
Control	37.19 g	40.23 e	8.117 c	8.127 b	4.180 ab	4.303 a

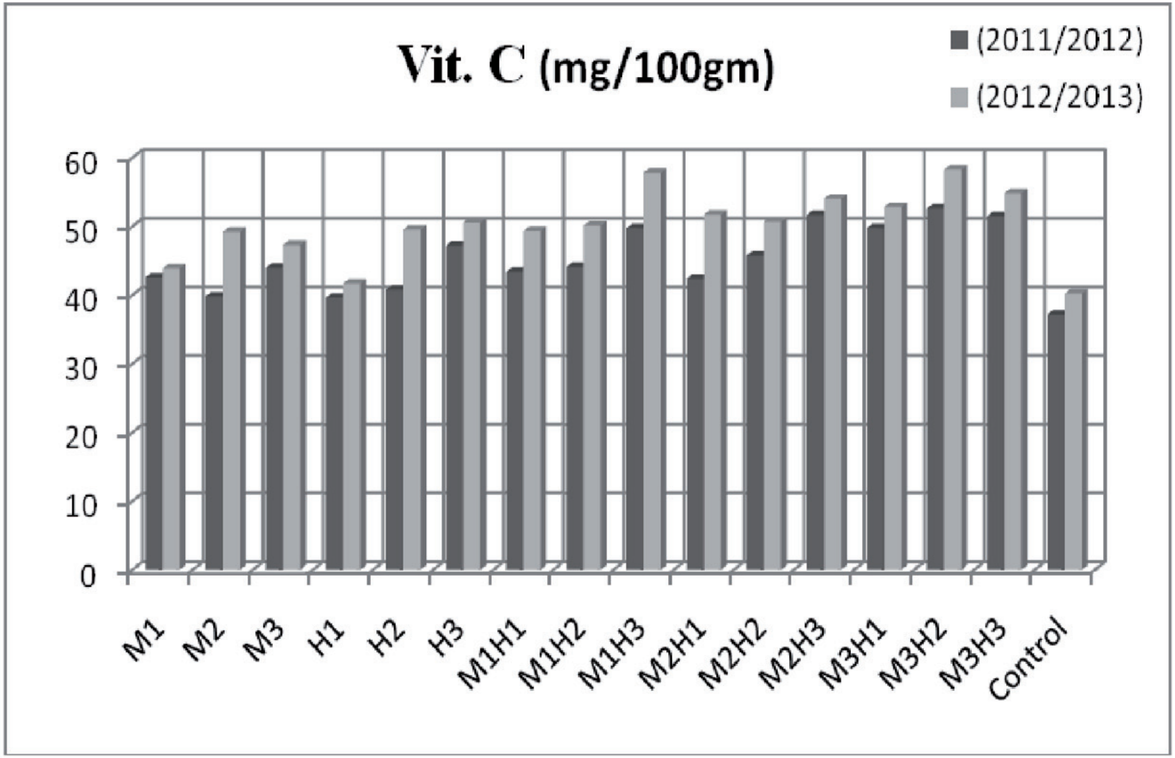


Fig. (21): Effect of Magnetite and K-humate and their combinations on Vit. C. of Valencia orange trees.

6. 2.5. Juice fruit total and reducing sugars content:

It is well known that, citrus tree blooming; fruit-set; yield and fruit quality depend on physiological relations and orchard management. Mainly factor leaves total and reducing sugars / nitrogen ratio (C / N) R. So, response of Valencia orange fruit juice total and reducing sugars content to Magnetite; K-humate and their combinations treatments effect were as follows:

6.2.5.1. Total sugars:

In spite of, data in **Table (14)** showed that most of Magnetite; K-humate and their combinations treatments were insignificantly increased fruit juice total sugars content, nevertheless, M_1H_3 treatment was the highest value (10.433& 10.513) percentage respectively, when compared to the control treatment which was the lowest value (8.117 & 8.127) percentage for both seasons (2011-012 & 2012-013).

6.2.5.2. Reducing sugars:

With this respect, Data in **Table (14)** cleared that most of high doses of Magnetite and K-humate or its combination treatments were statistically reduced Valencia orange fruit juice reducing sugars content when compared to other Magnetite; K-humate and their combinations treatments and the control. Whereas, M_3H_3 were the highest effect in reducing fruit juice reducing sugars content (3.673 & 3.784%) percentage respectively, when compared to H_1 treatment (4.373%) in the 1^{st} season (2011-012) and the control treatment (4.303%) in the 2^{nd} season (2012-013) respectively, which were the lowest effect in reducing of reducing sugars in both seasons .

Hence, increased concentration of reducing and total sugars in response to salinity could be attributed as osmotic adjustment to lower down the osmotic potential of plant cell. Thereby, results indicated that both Magnetite and K-humate treatments were significantly improved Valencia orange trees salinity stress tolerance under this study.

These results are in line with those obtained by, **Purvis and Yelenosky (1983); Thanaa and Nawar (1994); Kerepesi and Galiba (2000)** and **El-Kosary *et al*., (2011)** whom illustrated that Magnetic field and humic acid applications enhancement total sugars. Whereas, free proline accumulation during stress may reinforce the accumulation of reducing sugar to be used in meeting abrupt increases in energy demands during changing growing conditions and/ or recovery from stresses.

Also, both reduced and non-reduced sugars with nitrogen compounds accumulate in cells under stress conditions and they play a role as osmotic regulators**.**

Moreover, the role of reduced sugars is more complicated in adaptation mechanism. Monosaccharides which play an important role in the metabolic processes during stress conditions**.**

7. Leaf minerals content:

Improving plants mineral uptake by Magnetite ore and K-humate compounds applications might be related to conversion of unavailable minerals into soluble forms. So, some mechanisms have been suggested to explain effects of Magnetite and K-humate such as increasing ability of soil to get rid of salts and results in a better assimilation of nutrients and fertilizer in plants. However magnetite treatments easily take up mineral salts out from the soil and no sediment is formed on the soil surface.

7.1. Macro elements:

Valencia orange leaves minerals content of macro-elements (N, P, K, Ca and Mg) are presented in **Table (15)** as follows:

7.1.1. Nitrogen (%):

With regard to the effect of Magnetite; K-humate and their combinations treatments, data in **Table (15)** and **Fig (22)** showed that both M_3H_2 and M_3H_3 treatments were significantly increased leaf nitrogen (2.38& 2.41%) and (2.35&2.42%) percentage content respectively, when compared to other Magnetite; K-humate and their combinations and the control treatment (1.97&1.98%) in both experimental seasons (2011-012&2012-013). Moreover, Magnetite; K-humate and their combinations treatments were significantly increased leaf nitrogen contents in compared to control treatment in the 2^{nd} season.

Table (15): Effect of magnetite and K-humate treatments on the percentage of macro elements in leaves of Valencia orange trees in 2011/012 and 2012/013 seasons.

Treat.	N%		P%		K%		Ca%		Mg %	
	2011/201	2012/20	2011/201	2012/20	2011/201	2012/201	2011/20	2012/201	2011/201	2012/201
M1	2.08 cde	2.11 fg	0.115 a	0.118	1.137 f	1.169 fgh	2.81 efghi	2.86 gh	0.224 c	0.259 d
M2	2.05 ef	2.12 fg	0.117 a	0.120	1.140 ef	1.148 gh	2.80 fghi	2.84 hi	0.236 c	0.282 cd
M3	2.11 cde	2.17 efg	0.114 a	0.119	1.160 def	1.177 fgh	2.85	2.93 cde	0.226 c	0.333 ab
H1	2.04 ef	2.10 g	0.120 a	0.123	1.190 cde	1.217	2.76 hi	2.80 ij	0.220 c	0.250 d
H2	2.06 def	2.13 fg	0.124 a	0.127abcd	1.223 abc	1.231 cde	2.79 ghi	2.85 hi	0.229 c	0.258 d
H3	2.15 cd	2.26 bcde	0.122 a	0.126	1.237 abc	1.254	2.89 bcde	2.92 def	0.281 b	0.355 ab
M1H1	2.09 cde	2.21 cdef	0.116 a	0.115 cde	1.200 bcd	1.205 def	2.88	2.87 fgh	0.273 b	0.309 bc
M1H2	2.12 cde	2.20 cdef	0.119 a	0.117	1.227 abc	1.238 bcd	2.85	2.88 efgh	0.277 b	0.306 bc
M1H3	2.16 c	2.31 b	0.112 a	0.120	1.233 abc	1.247	2.96 ab	2.98 bc	0.286 b	0.360 ab
M2H1	2.10 cde	2.19 defg	0.111 a	0.114 de	1.150 def	1.178 efg	2.87	2.90 efg	0.279 b	0.324 abc
M2H2	2.13 cde	2.28 bcd	0.113 a	0.122	1.223 abc	1.243 bcd	2.83	2.89 efgh	0.283 b	0.277 cd
M2H3	2.27 b	2.29 bc	0.121 a	0.124	1.253 a	1.268 abc	2.93 abc	2.96 bcd	0.293 b	0.352 ab
M3H1	2.11 cde	2.24bcde	0.133 a	0.138 a	1.243 ab	1.253	2.90 bcde	2.91 efg	0.282 b	0.311 bc
M3H2	2.38 a	2.41 a	0.126 a	0.128 abc	1.273 a	1.297 a	2.99 a	3.05 a	0.326 a	0.359 ab
M3H3	2.35 ab	2.42 a	0.121 a	0.129 ab	1.247 ab	1.289 ab	2.92 abcd	2.99b	0.322 a	0.370 a
Control	1.97 f	1.98 h	0.107 a	0.113 e	1.070 g	1.125 h	2.74 i	2.78 j	0.215 c	0.234 d

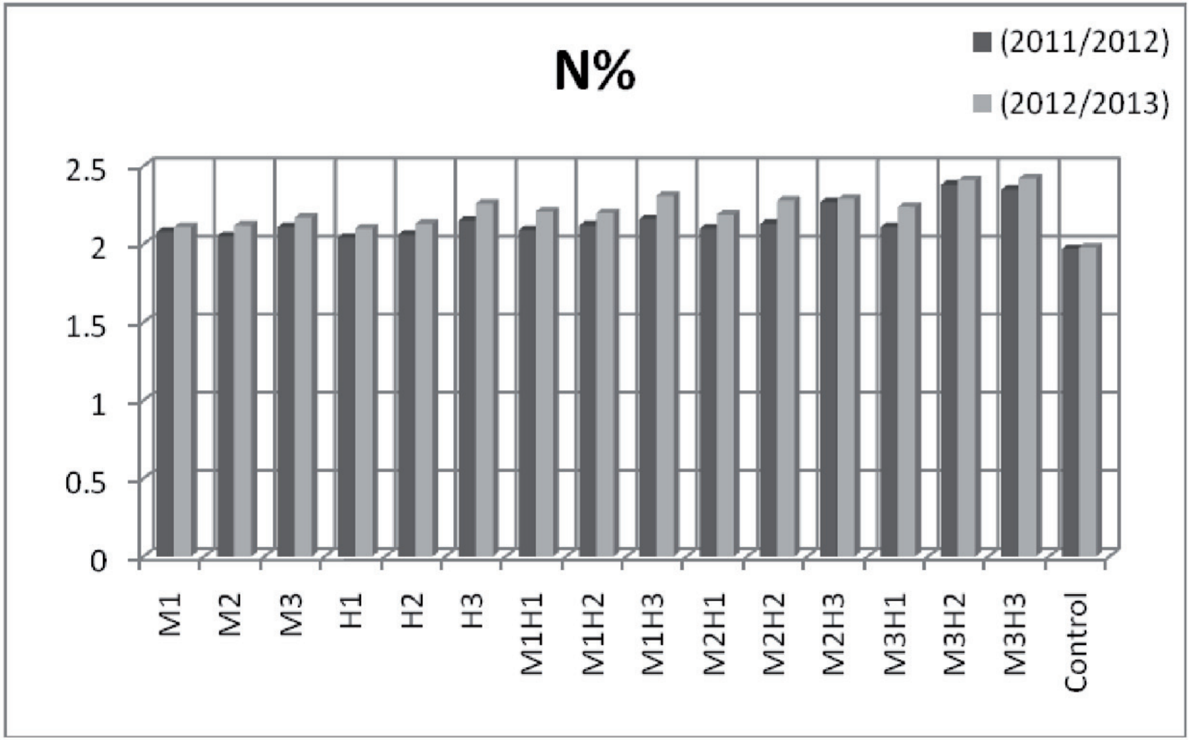


Fig. (22): Effect of Magnetite and K-humate and their combinations on N% leaf content of Valencia orange trees.

7.1.2. Leaf P %:

Concerning the effect of Presented data in **Table (15)** cleared that Magnetite; K-humate and their combinations treatments were insignificantly effect on leaf P % content when compared to the control treatment. Whereas, M_3H_1 treatment was the highest values (0.133 %) and the control was the lowest (0.107%) in the 1st season (2011-012). Whereas, M_3H_1 treatment was significantly increased leaf P % content (0.138) when compared to the most of Magnetite; K-humate and their combinations treatments and the control treatment which was the lowest value (0.113%) in the 2nd season (2012-013). In addition, results in **Table (15) and Fig (23)** indicated that high doses of Magnetite with low doses of K-humate were the best effect on P element uptake which increased Valencia orange leaves P content. While, most of Magnetite; K- humate and their combinations treatments fluctuated in their effect on P uptake under this study.

7.1.3. Leaf k %:

Regarding of leaf K content **(Table15)** and **Fig (24)** indicated that Magnetite; K-humate and their combinations treatments had the same trend of their effect on P element. Whereas, the high doses of Magnetite with low doses of K-humate were the best effect on K element uptake which increased Valencia orange leaves K content. Meanwhile, M_3H_2 treatment was significantly improved K element uptake which increased in leaves (1.273&1.297) percentage content respectively, when compared with some Magnetite; K-humate and their combinations treatments and the control treatment (1.070&1.125%) for both seasons (2011-012 & 2012-013).

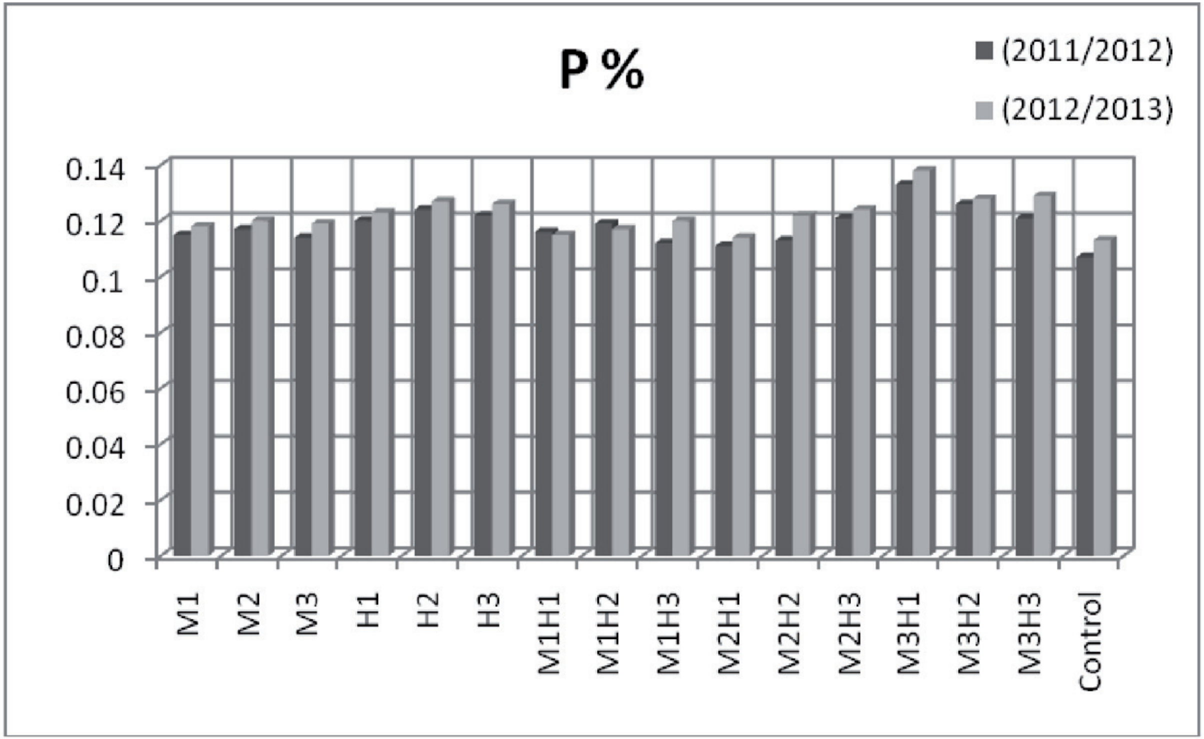


Fig. (23): Effect of Magnetite and K-humate and their combinations on P % leaf content of Valencia orange trees.

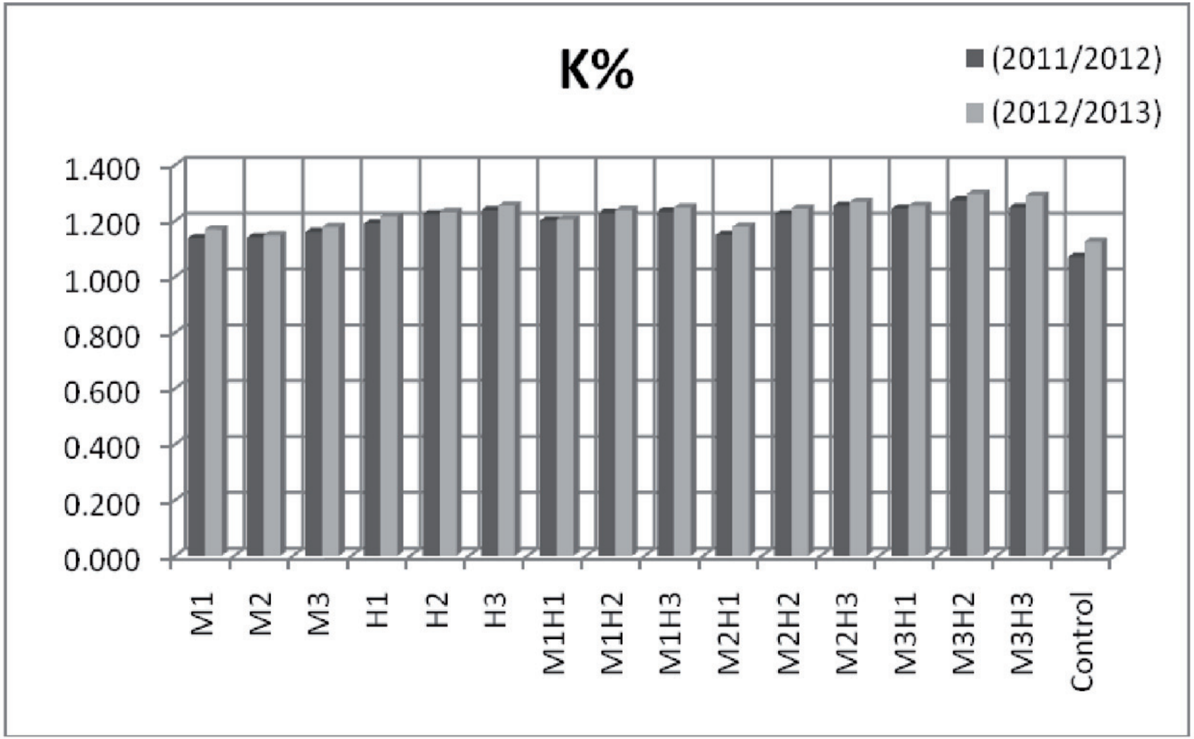


Fig. (24): Effect of Magnetite and K-humate and their combinations on K% leaf content of Valencia orange trees.

Generally, leaf K % content was at the low level when it compared to the standard concentration under citrus nutrient requirements recomendations which may be reflected on the final yield and fruit quality under this orchard conditions.

7.1.4. Leaf Ca %:

Concerning the effect of Magnetite; K-humate and their combinations treatments, **Table (15)** and **fig (25)** cleared that, M_3H_2 treatment was statistically increased leaf calcium content (2.99 &3.05) percentage respectively, when compared to the control (2.74&2.78) percentage and some treatments which were significantly varied in their response to Magnetite and K-humate applications for both seasons (2011-012 and 2012-013).

7.1.5. Leaf Mg %:

In this concern data in **Table (15)** and **Fig (26)** revealed that Magnetite and K-humate and its combinations treatments were significantly improved Valencia orange leaf Mg content particularly the high doses of Magnetite and K-humate. So, no surprise M_3H_2 treatment was statistically increased leaf Mg content (0.326&0.359) percentage respectively, when compared to the control (0.215&0.0234%) and most of Magnetite and K-humate treatments for both seasons (2011-012 and 2012-13).

In spite of, Magnetite and K-humate combinations applications were positively effectiveness in N; P; K; Ca and Mg element uptake without any disorders phenomena on Valencia trees for both seasons. Nevertheless, the 2nd season was the best; this may be due to elements accumulation property.

These results are harmony with those obtained by, **Randhawa and Broadbent (1965)**; **Petrovic *et al*.,(1982); Sharma *et al*.,(2003); Abada (2009)**; **Mohammed *et al*., (2010); Abd El-Monem *et al.,* (2011)** and **Aydin *et al*., (2012)** whom indicated that there are many benefits to crop growth resulted from addition natural mineral product like magnetic iron ore including improved soil structure, increased soil organic matter, improved water properties and become more energy and vigor and this known as "Magneto biology', improving water holding capacity and cation exchange capacity, Improved crop nutrition from macro and micro elements. Moreover, the magnetic process separate all chlorine, toxic and harmful gases from soil, increased salt movement and solubility of nutrients increasing water retention by soil and this help on plant growth, moderation of soil temperature.

Magnetic treatment of water may be influencing desorption of P and K from soil adsorbed P on colloidal complex, and thus increasing its availability to plants, and thus resulting in an improved plant growth and productivity.

Improving plant nutrition by humic acid which stimulating the absorption of mineral elements through stimulating root growth and increases the rate of absorption of mineral ions on root surfaces and their penetration into the cells of the plant tissue, so plants show more active metabolism and increase respiratory activity.

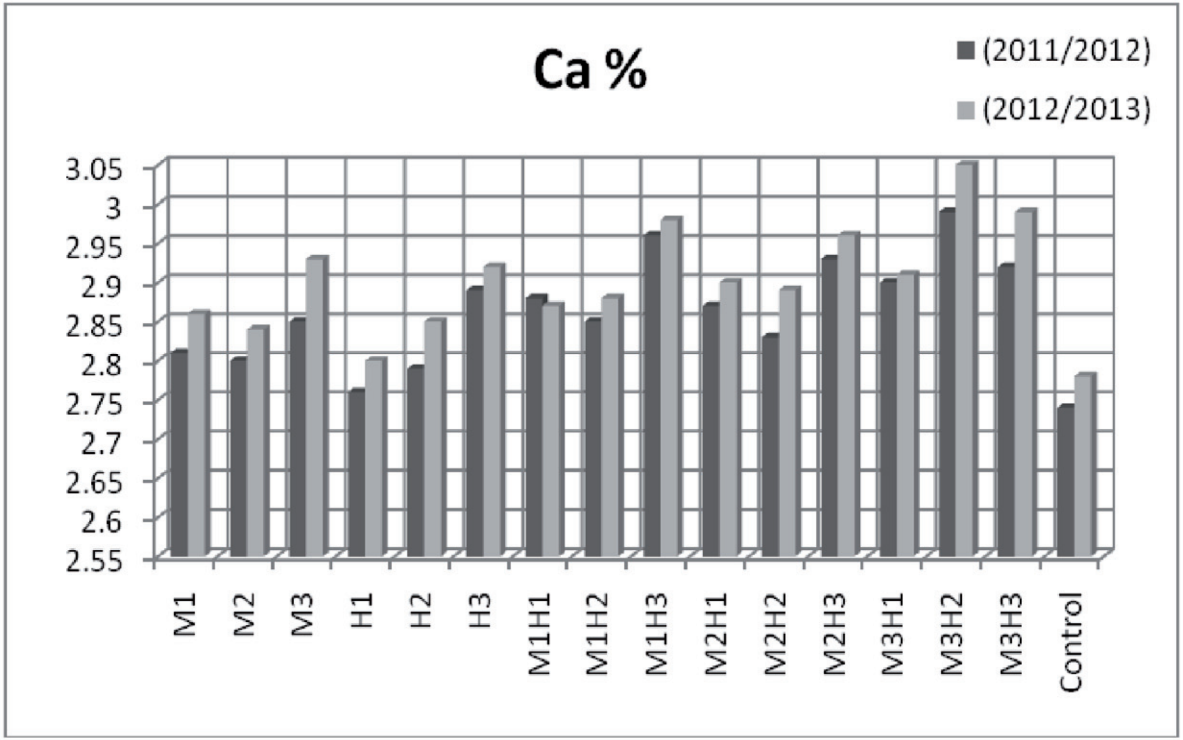


Fig. (25): Effect of Magnetite and K-humate and their combinations on Ca % leaf content of Valencia orange trees.

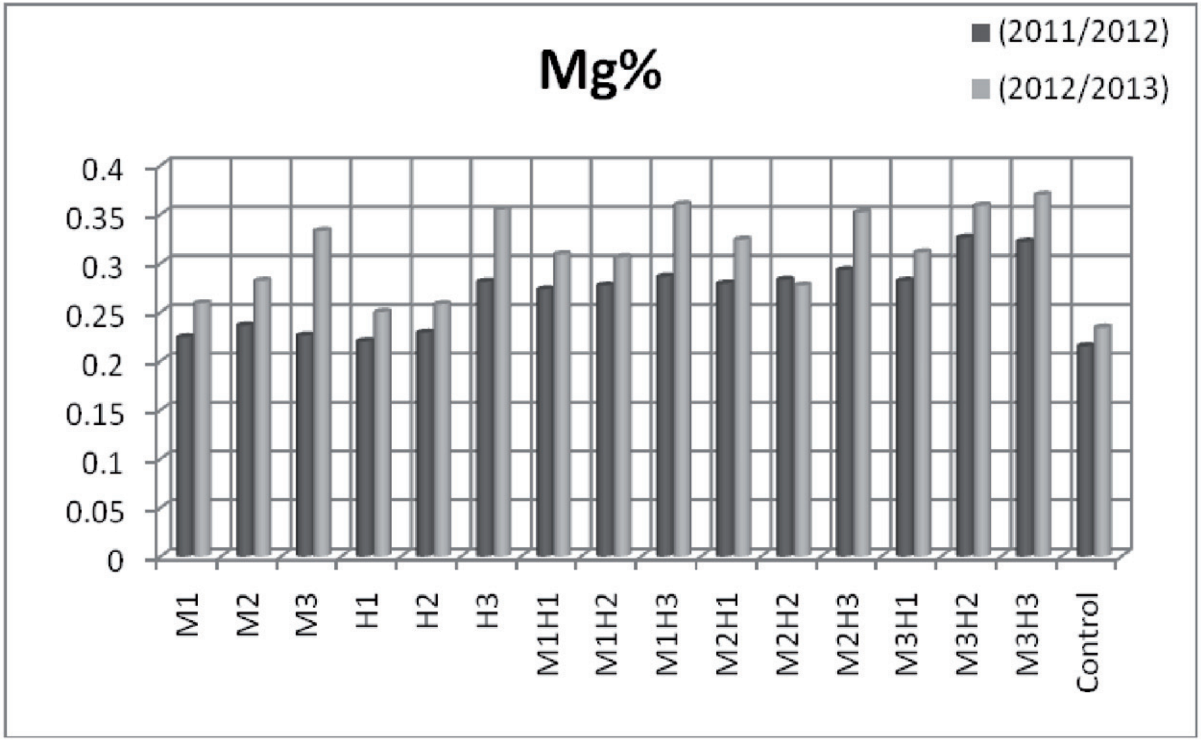


Fig. (26): Effect of Magnetite and K-humate and their combinations on Mg % leaf content of Valencia orange trees.

Humic acid when applied to sandy soils, affect the physic-chemical properties of soil, which are important in controlling the uptake of nutrients by slowly release micronutrient to plants. Add, essential organic materials necessary for water retention, thus improving the root growth and enhancing the sandy soil ability to retain and not leach out vital plant nutrients .Also, effect on soil acidity which increase soil fertility and increase the availability of nutrient elements.

7.2. Micro elements:

With regard to the effect of Magnetite; K-humate and their combination treatments on Valencia orange leaf Fe; Zn and Mn content are presented in **Table (16)**.

7.2.1. Leaf Iron (ppm):

It is well known that Magnetite Ore the mining product which used in agriculture field as soil improvement under alkaline conditions and water logging soil.

So, it is not available for plant feeding as Fe source. For this, data in **Table (16)** and **Fig (27)** showed that**,** Magnetite; K-humate and there combination treatments were significantly improved Valencia orange leaves Fe contents during experimental seasons (2011-012 and 2012- 013), also, M_3H_3 treatment (95.58 & 100.42) ppm respectively, were the highest Fe values when compared to the control treatment which was the lowest (59.60 &57.58) ppm in both seasons of this study.

7.2.2. Zinc (ppm):

With this respect, data obtained in **Table (16)** cleared that Magnetite; K-humat acid and its combinations treatments fluctuated in their effect on leaf Zn content during both studied seasons (2011-012 and 2012-013). Whereas, Magnetite and K-humat combinations treatments were significantly increased leaf Zn content. So, M_1H_3 treatment (83.50 ppm) in the 1st season and M_3H_3 treatment (85.75 ppm) in the 2nd season respectively, were the highest values when compared to the control treatment (59.04 & 60.37) ppm during both experimental seasons.

Table (16): **Effect of magnetite and K-humate treatments on Fe; Zn and Mn leaf content of Valencia orange in 2011/012 and 2012/013 seasons.**

Treat.	Fe (ppm)		Zn (ppm)		Mn (ppm)	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
M1	69.25 g	73.58 h	62.52 efg	63.37 cd	22.75 d	23.45 e
M2	72.92 fg	78.00 fg	67.80 cdef	64.02 cd	23.89 d	24.81 de
M3	75.33 ef	81.22 ef	65.14 defg	65.99 cd	23.37 d	23.83 e
H1	61.83 hi	63.92 j	61.82 fg	63.72 cd	22.88 d	23.27 e
H2	62.59 hi	66.58 ij	64.47 defg	65.52 cd	22.85 d	24.72 de
H3	64.08 h	67.43 i	75.20 abc	75.59 b	23.06 d	23.41 e
M1H1	70.73 g	75.00 gh	70.98 bcde	71.26 bc	24.39 d	24.77 de
M1H2	78.08 e	79.42 ef	72.96 bcd	74.13 b	24.18 d	25.86 bcde
M1H3	85.50 d	88.00 d	83.50 a	78.95 ab	28.91 a	29.54 abc
M2H1	78.83 e	80.17 ef	75.75 abc	75.22 b	24.68 cd	25.68 cde
M2H2	78.85 e	82.58 e	76.40 abc	77.67 ab	25.42 bcd	26.07 bcde
M2H3	90.42 bc	92.75 c	77.54 ab	78.68 ab	27.86 abc	30.29 ab
M3H1	88.58 cd	90.50 cd	75.35 abc	76.19 b	28.06 ab	28.72 abcd
M3H2	92.42 ab	97.00 b	77.63 ab	80.70 ab	29.19 a	30.60 a
M3H3	95.58 a	100.42 a	79.18 ab	85.75 a	29.51 a	29.78abc
Control	59.60 i	57.58 k	59.04 g	60.37 d	22.43 d	22.75 e

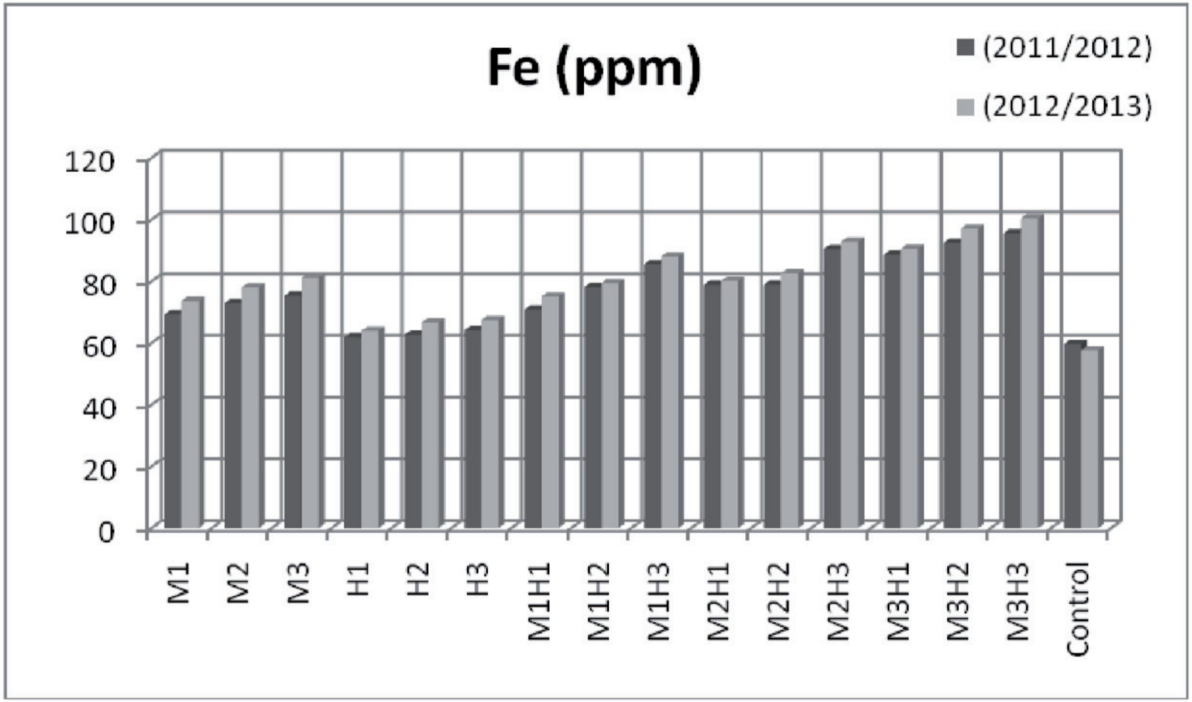


Fig. (27): Effect of Magnetite and K-humate and their combinations on Fe (ppm) leaf content of Valencia orange trees.

7.2.3. Manganese (ppm):

Regarding to Leaf Mn content **Table (16)** indicated that high doses of Magnetite and K-humate combinations treatments significantly improved Valencia orange leaves Mn content during both studied seasons (2011-012& 2012-13) respectively. Whereas, M_3H_3 treatment (29.51ppm) in the 1st season and M_3H_2 treatment (30.60ppm) in the 2nd season respectively, were the highest values in compared to other Magnetite; K-humate and its combinations treatments and the control which was the lowest leaf Mn (22.43 & 22.75) ppm content in both seasons.

These results are agreement with those obtained by, **Gregor and Powerll (1988); Fernández-Escobar *et al*., (1996); El-Seginy (2006); Dhawi and Al-Khayri (2009[b]); Mohammed *et al*., (2010) and Sarwar *et al*., (2012)** whom illustrated that Protonation reaction of humic acid caused a reduction of Fe^{3+} to Fe^{2+} and made iron chelated, which are readily available to the plants, enhanced solubilisation and increased extractability of iron and reduction of non-available higher oxide forms to available forms by humic acid may account for its increased availability and enhancing of Zn content. Also, Iron contained in magnetite may promote plant cell processes such as respiration, nitrification and catalyses activity; uptake of iron to the possibility humic acid can chelated Fe^{3+} to change its form to be absorbed through root system. Moreover, Magnetic field and nano iron oxides treatments increased plant concentration of Zn and Static magnetic field increased amount of Mn in date palm.

7.2.4. Boron (ppm):

Data in hand **Table (17)** showed that high doses of Magnetite and K-humate treatments were significantly kept the Boron element at the safe level in Valencia orange leaves, whereas, M_2H_3 treatment was the optimum concentration (86.67 ppm) in compared to the control treatment(105.00 ppm) in the 1st season (2011-012). In the contrary, Magnetite; K-humate and their combinations treatments were significantly improved leaf B content at optimum concentration.

Whereas, M3H3 was the best (83.33ppm) treatment in compared to the control treatment (108.00 ppm) during the 2nd season.

Table (17): Effect of magnetite and K-humate treatments on on Valencia orange leaf B; Na and Cl content in 2011/012 and 2012/013 seasons:

Treat.	B (ppm)		Na%		Cl %	
	2011/2012	2012/2013	2011/2012	2012/2	2011/201	2012/2
M1	99.67 ab	95.00 bc	0.31 a	0.30 b	0.69 ab	0.62 b
M2	99.00 ab	93.67 bcd	0.30 ab	0.30 b	0.69 ab	0.67 b
M3	94.00 ab	92.33 bcde	0.30 ab	0.30 b	0.60 ab	0.58 b
H1	99.33 ab	95.67 b	0.31 a	0.31 b	0.70 ab	0.68 b
H2	98.00 sb	94.33 bcd	0.30 ab	0.29 b	0.68 ab	0.67 b
H3	95.33 ab	88.33 cdefg	0.29 ab	0.28 b	0.62 ab	0.59 b
M1H1	95.00 ab	91.67 bcde	0.30 ab	0.29 b	0.66 ab	0.64 b
M1H2	94.00 ab	91.33 bcde	0.30 ab	0.30 b	0.70 ab	0.65 b
M1H3	89.00 b	87.67 defg	0.28 ab	0.25 bc	0.63 ab	0.57 b
M2H1	92.33 b	92.00 bcde	0.29 ab	0.30 b	0.69 ab	0.62 b
M2H2	94.00 ab	91.00 bcde	0.30 ab	0.28 b	0.66 ab	0.63 b
M2H3	86.67 b	84.00 fg	0.27 ab	0.26 b	0.62 ab	0.58 b
M3H1	92.67 b	89.67 bcdef	0.29 ab	0.27 b	0.62 ab	0.60 b
M3H2	90.00 b	86.33 efg	0.23 b	0.22 c	0.58 ab	0.58 b
M3H3	89.333 b	83.33 g	0.25 ab	0.25 bc	0.55 b	0.54 b
Control	105.000 a	108.00 a	0.34 a	0.36 a	0.72 a	0.79 a

7.2.5. Sodium %:

Data in **Table (17)** and **Fig (28)** reveled that M_3H_2 treatment significantly reduced leaf Na content (0.234%) when compared to control treatment (0.339%). Whereas, most of Magnetite; K-humate and their combinations treatments were no significant effect on Na leaf content during the 1st season (2011-012). In contrast, all Magnetite; K-humate and there combinations treatments were significantly reduced leaf Na percentage and M_3H_2 treatment was the highest effect with the lowest value (0.22 %) in compared to the control treatment which was the highest value(0.35%) during the 2nd season (2012-013) of this study.

The beneficial effect of magnetite is mainly attributed to reduction in the accumulation of Na^+ below the toxicity levels in leaves 0.4%.

7.2.6. Chlorine (%):

Concerning the effect of Magnetite, K-humate and combinations treatments present data in **Table (17)** and **Fig (29)** cleared that all the experimental treatments had the trend of their effect on leaf Na content. Whereas, M3H3 treatment was significantly reduced leaf Cl content (0.550 %) in compared to the control treatment (0.717%) during the 1st season (2011-012), with insignificant effect with other treatments under this study. Whereas, all Magnetite, K-humate and combinations treatments were significantly reduced leaf Na content and M3H3 treatment was the highest effect with the lowest value (0.54 %) when compared to the control treatment which was the highest value (0.79 %) during the 2nd season (2012-013).

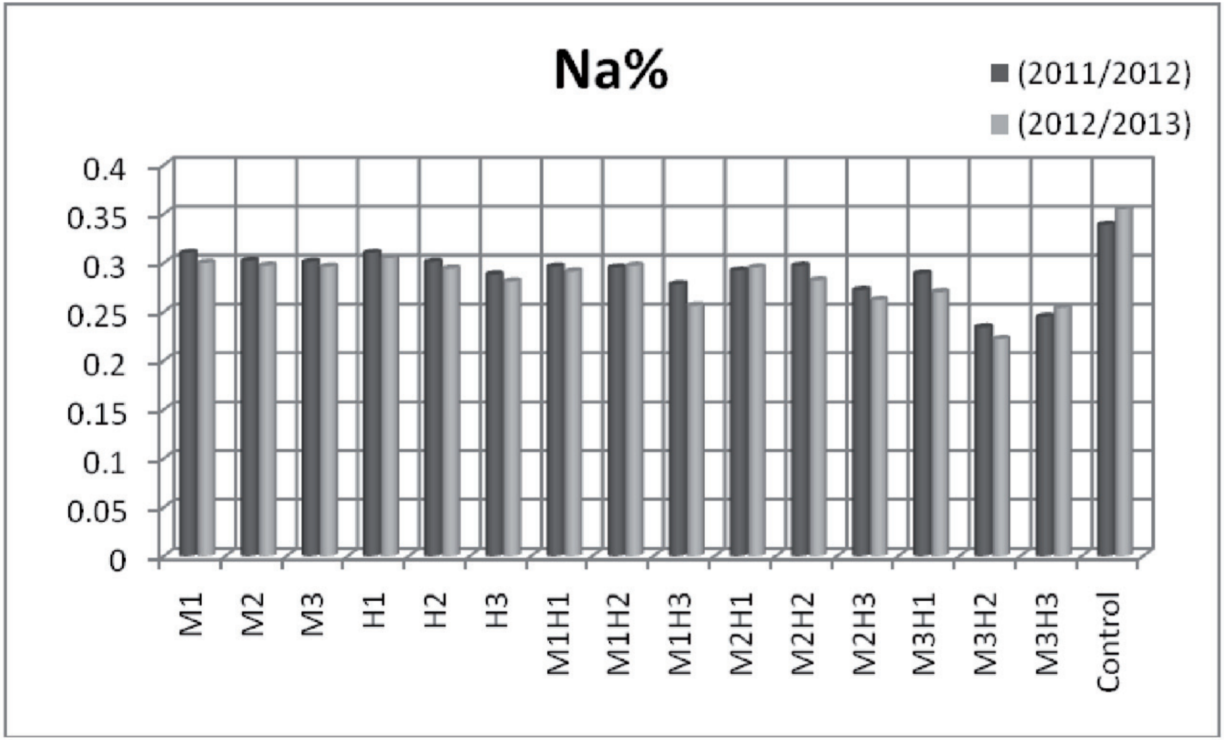


Fig. (28): Effect of Magnetite and K-humate and their combinations on Na % leaf content of Valencia orange trees.

It is well known that both Na and Cl were undesirable elements in the root absorption area .No doubt, Magnetite, K-humate applications will be significantly reduced its injury effect on plants and other nutrient elements uptake.

These results are in line with those obtained by, **Alva and Syvertsen (1991)**; **Munns (2002)**; **Garcia-Sanchez *et al*., (2006); Eissa *et al*., (2007[a &b])**; **Ameen and Kassim (2009)** and **Mehanna *et al*., (2010)** whom indicated that Magnetite may be assisting to reduce the Na toxicity at cell level by detoxification of Na, either by restricting the entry of Na at membrane level or by reduced absorption of Na by plant roots. High Na concentration is a limiting factor for plant growth in most crops; also, Salinity not only increased soil ECe, Na+ and Cl-, but also decreased elements conc. It is also interesting to note that the apparently reduced accumulation of Na in plants with magnetite and humate treatments may have helped the trees to continue their growth with less detrimental effects on total yield.

Also, Accumulation of leaf Cl^- can be a passive process which depends on transpirational water flow **.**This might attribute to increasing in osmotic pressure, thereby, reducing uptake of water and nutrients by Valencia orange trees. Moreover, Humic substances decreased Cl leaf content in pear, peach, apricot and grapevine.

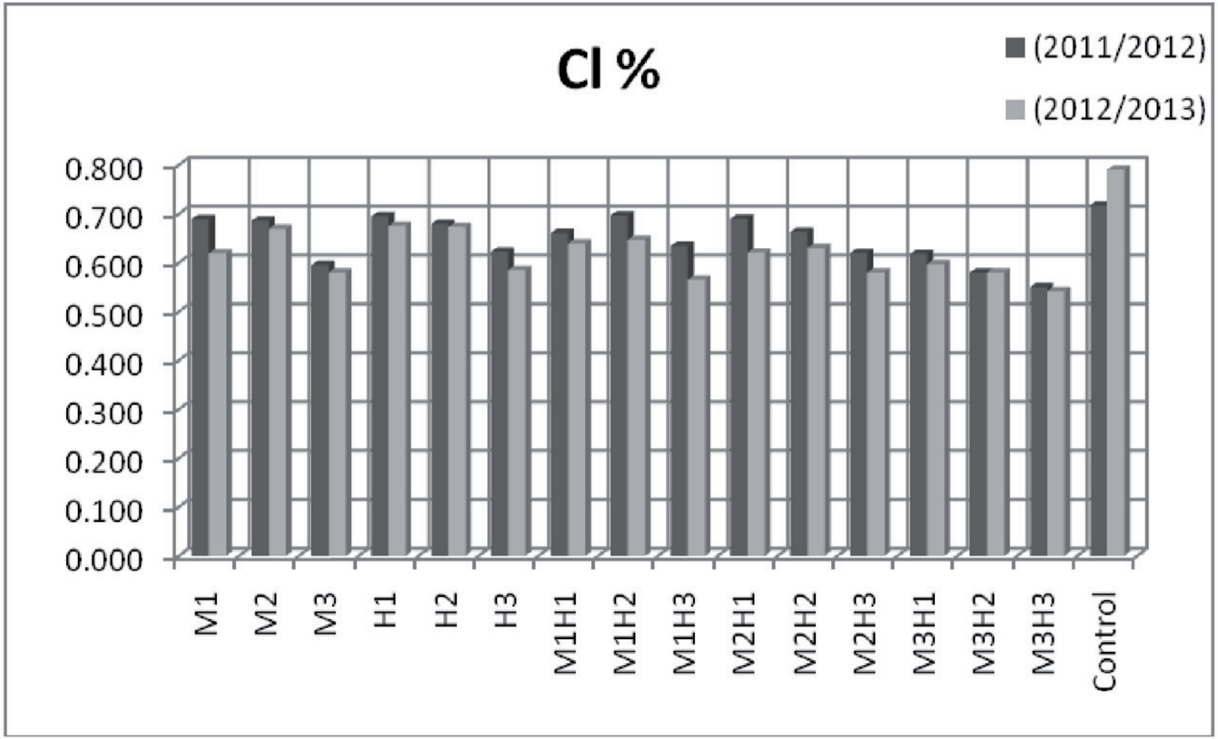


Fig. (29): Effect of Magnetite and K-humate and their combinations on Cl % leaf content of Valencia orange trees.

8. Expect net profit for the suggested treatment when applied in one feddan contained 160 Valencia orange trees:

It clear from the data in **Table (18)** that total costs of production if the suggested treatments (application of M_3H_2) were applied in one feddan cultivated with 160 Valencia orange trees reached 5540 and 6040 L. E. comparing with the total costs that that reached 4500 and 5000 L.E. of the control treatment.

Yield per feddan reached 8.160 and 9.920 ton fruits in the recommended treatment, while was 6.080 and 6.720 ton in the check treatment during both seasons, respectively. Net profit per feddan with application of the recommended treatment reached 12240 L.E and 17360 while, reached 9120L.E and 11760 L.E in the check treatment during both seasons, respectively.

Subtracting net profit of the check treatment for the recommended treatment produced the increase of the recommended treatment over the check treatment that reached 2080 L.E and 4560L.E. during 2011-012 and 2012-013 seasons, respectively.

Table (18): Economical study of the recommended treatment if was applied in one feddan containing 160 trees during both seasons over the check treatment.

a	The recommended practices	1st season (2011-012)	2nd season (2012-013)
	Total Hort. Practices (L.E)	4500	5000
	Costs of recommended magnetite dose (L.E)	640	640
	Costs of recommended humic acid dose (L.E)	400	400
	Total costs (L.E)	5540	6040
	Yield/ feddan (tons)	8.160	9.920
	Price of yield/ feddan (L.E)	8.160*1.5=12240	9.920*1.75=17360
	Net profit (L.E)	6700	11320
b	Control treatment	1st season	2nd season
	Total Hort. Practices (L.E)	4500	5000
	Yield/ feddan (tons)	6.080	6.720
	Price of yield/ feddan (L.E)	6.080*1. 5= 9120	6.720*1.75= 11760
	Net profit (L.E)	4620	6760
c	The increase over the check	2080 (L.E)	4560 (L.E)

*Price of selling one ton of Valencia orange fruits reached (1500 L.E.) and (1750 L.E.) during 1st and 2nd seasons.

V. SUMMARY

Effect of humic compounds and magnetic iron on growth and fruiting of Valencia orange trees (Citrus sinensis L.*)*

This investigation was carried out during the two successive seasons (2011-012) and (2012-013) on Valencia orange trees, grown in a private orchard in El Salhia region - Sharkia governorate. The trees were grown in sandy-clay loamy soil and subjected to normal cultural practices. This experiment included 16 treatments, which were three levels of Magnetite (250, 500 and 1000g) and three rates of K-humate (25, 50 and 100g) and their combinations beside control treatment.

The experimental design was complete randomized blocks with 3 replicates.

Analysis of variance was made in order to test the significance of differences among the means of studied treatments.

The objective of this study was to add more information about the effect of different magnetite and K-humate treatments on vegetative growth, leaf mineral content, yield and fruit quality of the Valencia orange trees.

The obtained results could be summarized as follows:

- ***Vegetative growth:***

The combination of M_3+H_2 had significantly increased the shoot length, number of leaves per branch and canopy volume as compared with other treatments treatment, while, control treatment recorded the lowest values in both seasons. The combination of M_3+H_2 treatment had

significantly increased the shoot length, number of leaves per branch and canopy volume as compared with other Magnetite and K-humate treatments and control treatment which was the lowest values in both seasons.

Application of M_3+H_3 treatment was significantly increased leaf area in compared to control treatment during both seasons.

- ***Blooming behavior and fruit set:***

M_3+H_3 treatment was significantly increased Leafy inflorescences percentage during both seasons in compared to M_3H_1treatment in the 1st season and the control treatment in the 2nd season respectively, of this study.

M_3H_3 treatment was significantly reduced the woody inflorescences percentage when compared to M_1H_3 treatment in the in the 1st season and the control treatment in the 2nd season respect.

M_2H_3 treatment was the highest initial fruit set percentage in the 1st season and M_3+H_2 treatment in the 2nd season in this respect.

Generally, Valencia orange trees, final fruit set percentage were positively response to Magnetite and K-humate applications .Whereas, M_3H_2 treatment was the highest values in the 1st season and M_3H_3 treatment in the 2nd season respect, with this respect, when compared to the control treatment during both seasons.

- ***Leaf chlorophyll content:***

M_3H_3 application significantly enhanced leaf chl. a content, which was the highest values in both seasons.

H_3 treatment was the highest values of leaf chl. b content during both seasons; whereas, the control treatment was the lowest values of Chls. a and b in both seasons.

In the contrary, the control and M_3H_3 treatments were the highest values of leaf total carotenoids content in both seasons.

- ***Total Carbohydrate and Proline leaf contents:***

M_3H_3 treatment was the highest values of leaf carbohydrate content in compared to control treatment which was the lowest values in this concern, in both seasons.

The control treatment was the highest values of leaf proline content in compared to Magnetite and K-humate treatments which reduced proline leaf content. Also, M_3H_2 treatment was the lowest values in both seasons.

- ***Leaf Water relations:***

The highest values of relative water content were recorded with M_2H_3 treatment in the 1^{st} season and M_1H_3 treatment in the 2^{nd} season.

Application of M_1H_2 positively affected and was the highest values of specific leaf weight in both seasons.

The control treatment significantly recorded the highest values of saturated leaf weight in compared to all Magnetite and K-humate treatments .Whereas, M_3H_3 treatment was the lowest values during both seasons.

- ***Leaf mineral content:***

a) **Macro elements:**

M_3H_2 and M_3H_3 treatments were significantly increased leaf N content; in compared to the control treatment which was the lowest values in this concern, in both seasons.

M_3H_1 was the highest values of leaf P content were recorded in compared to the control treatment during both seasons.

M_3H_2 treatment was significantly increased leaf K content in compared to the control treatment which the lowest values in this concern in both seasons.

M_3H_2 was significantly increased leaf Ca content in compared to the control treatment which was the lowest values in both seasons.

M_3H_2 treatment was the highest values of leaf Mg content in the 1st season and M_3H_3 in the 2nd one. The lowest Mg values were recorded with control treatment during both seasons.

b) **Micro elements:**

Magnetite application alone or with K-humate combination was significantly increased leaf Fe content. Whereas, M_3H_3 application was the highest values of leaf Fe content in compared to control treatments in both seasons.

M_1H_3 treatment was the highest leaf Zn content in the 1st season and M_3H_3 in the 2nd season in compared to the control treatment.

M_3H_3 was the highest values of leaf Mn content in the 1st season and M_3H_2 in the 2nd one. Whereas, the control treatment was the lowest in both seasons.

Magnetite and K-humate treatments reduced leaf B content. Whereas, M_2H_3 treatment was significantly the lowest value in the 1st season and M_3H_3 in the 2nd one, in compared to the control treatment which was the highest leaf B content in both seasons.

M_3H_2 treatment was significantly reduced leaf Na content in compared to the control treatment which was significantly the highest values in both seasons.

Also, control treatment was significantly increased leaf Cl content and recorded the highest values in compared with other Magnetite and K-humate treatments in both seasons.

Magnetite and K-humate treatments were significantly improved the total yield of Valencia orange trees. M_3H_3 treatment was the highest values (kg/tree) in compared to the control treatment in both seasons.

Whereas, M_1H_3 treatment was significantly increased yield efficiency (kg/m^3 canopy volume) in both seasons in compared to M_2H_2 treatment in the 1^{st} season and the control treatment in the 2^{nd} season.

- ***Fruit quality:***

The highest values of fruit weight, fruit volume, Juice weight, juice volume and total sugars of Valencia orange fruits were obtained with M_1H_3 treatment when compared to the control treatment in both seasons.

M_3H_2 treatment was significantly increased Valencia orange fruit (number/tree) in compared with the control treatment during both seasons.

M_1H_2 was the highest peel thickness of Valencia orange fruit in the 1^{st} season and M_3H_3 treatment in 2^{nd} one. Whereas, the control treatment was significantly the lowest values in both seasons.

M_1H_2 treatment was the highest values of fruit juice (w/w) ratio of

Valencia orange fruit in the 1st season and M_3H_1 treatment in the 2nd season in compared to the control treatment in booth seasons.

The control treatment was the highest values of TSS% and acidity; M_1H_3 treatment was the lowest values of juice acidity and M_3H_3 treatment was the highest values of TSS in both seasons

M_1H_3 treatment was significantly increased TSS/ acid Ratio in Valencia orange fruit juice in compared to the control treatment in both seasons.

Application of M_3H_2 increased Valencia orange fruit juice Vit. C content in compared to the control treatment during both seasons.

- ***Fruit Juice Total and reducing sugars:***

Magnetite and K-humate treatments were significantly increased juice total sugars. Whereas, M_1H_3 treatment recorded the maximum total sugars values in booth seasons in compared to the control treatment.

H_1 treatment increased Valencia orange fruit juice reducing sugars content in the 1st season, while, the control treatment was significantly the highest value in the 2nd season in compared to the M_3H_2 treatment in both seasons.

Generally; Magnetite and k-humate have been utilized to reduce the effect of soil and water salinity on plant growth and enhancement different growth parameters, also, reduced negative effects of B, Na and Cl elements on trees performance.

Finally, it can be suggest that M_3H_2 treatment was the economically treatment which was the best results for the most parameters under this study which reflected to the yield production and the fruit quality.

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