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# Effect of foliar application with urea, benzyladenine and dry yeast on flowering and fruiting of Minneola Tangelo trees to reduce the severity of alternate bearing phenomena

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**ABSTRACT**

This investigation was conducted during three successive seasons (2016/2017, 2017/ 2018 and 2018/2019) on Tangelo Minneola (*Citrus paradisi* Macf x *Citrus reticulata* Blanco) twenty two years old budded on sour orange ( *Citrus aurantium* L.) rootsock at Giza experimental station, Agricultural Research center, Egypt. To study the effect of foliar application with urea 20g/ L ,dry Yeast at 4g/L, benzyladenine at 60ppm, a mixture of(urea 20g/L + dry yeast at 4g/L), a mixture of ( urea 20g/L + benzyladenine at 60 ppm) ,and a mixture of ( urea 20g/L + benzyladenine at 60 ppm + dry Yeast at 4g/L ) compared with control treatment (spray with water) on flowering and fruiting of Minneola Tangelo trees to reduce the severity of alternate bearing phenomena .The result showed that treatment with (urea 20g/L + benzyladenine at 60 ppm ) gave the highest values of number of shoots ,Shoot diameter (cm), average leaf area ($cm^2$), fruit set % , remaining fruits after June drop % ,Mature fruits %,yield increment (%) over the control, fruit weight (g) Yield/tree (kg), Yield/ weight feddan (ton), pulp weight (g), Juice volume $cm^3$, Fruit volume ($cm^3$) , Fruit diameter (cm), vitamin c (mg/100mljuice), sugars %, carotenoids ( mg/g fresh wt ) total carbohydrates (mg/g), Chlorophyll- a ,b (mg/g fresh wt), total chlorophyll (mg/g fresh wt),total indoles ( mg/100g F.W),TSS (%),TSS/acid ratio and recorded the lowest juice total acidity %, leaf mineral contents (N, P, Mg, Fe ,Mn and Cu) contents as compared with the control treatment and the other treatments in "off " years, "On" years and" off "years, respectively. Moreover, Foliar application with a combination of (urea 20g/L + dry yeast at 4g/L) gave the highest values of Shoot length (cm), number of leaf /shoot, average leaf dry weight(g), Specific leaf weight (SLW) (mg/$cm^2$), number of fruits/tree, peel weight (g), fruit length ( cm ), leaf mineral contents ( K, Ca, and Zn ) contents as compared with the control treatment and the other treatments in "off " years,"On" years and " off "years, respectively. Foliar spray with 60 ppm + dry Yeast at 4g/L+ urea 20g/L) gave significantly the highest peel thickness (cm) compared with other treatments including control trees. Foliar application with benzyladenine at 60 ppm) gave significantly the highest leaf Total phenols (mg/100g F.W) as compared with untreated (control trees) and the other treatments. Generally, Minneola tangelo trees treated in" off " years (2018/ 2019) gave a high positive effect in reducing biennial bearing severity than trees treated in "off "years (2016/ 2017) and "On" years (2017/ 2018) respectively.

***Keywords*:** alternate bearing phenomena, Tangelo Minneola (*Citrus paradisi* Macf x *Citrus reticulata* Blanco), urea, dry yeast, benzyladenine, C/N ratio.

## Introduction

Alternate bearing of fruit trees has been known since antiquity, and yet it remains a problem with numerous fruit tree crops even today. Alternate bearing genetic phenomena (also called biennial or uneven bearing) is the tendency of a fruit tree to produce a heavy crop in one year one (on-year) followed by every light crop or no crop (off-crop year). The phenomenon is widespread, occurring in deciduous and evergreen trees (Monselise and Goldschmildt,1982) causing direct losses that amount to 20 thousand million € a year for citrus. The phenomenon is due to competition for reserves among subsequent crops. These cropping patterns result in surpluses and deficits in production which affect many facets of crop management including: price, marketing, quality, demand for labor (Chung *et al*., 1995; Kallsen *et al*., 2007), nutrient uptake (Picchioni *et al*., 1997; Rosecrance *et al*., 1998).

Citrus is ranked the primary fruit crop in Egypt.It is the most economic fruit crop for local consumption and export. In citrus (*Citrus* spp.), alternate bearing is more common than irregular bearing and can occur on an individual shoot-level, on a branch or tree, or across entire production

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regions (Monselise and Goldschmidt, 1982). Some cultivars are prone to an absolute alternate bearing habit,which involves a total lack of flowering in the off- crop years following a heavy fruit load, rather than excessive flower abscission or poor fruit set. In certain citrus cultivars with a high tendency for alternate bearing the phenomenon first seemed to have conspicuous causal factors, a high seed count and a late time of harvest (Monselise and Goldschmidt, 1982). A whole-tree level, alternate bearing is most notably prevalent in easy-peeling mandarin cultivars (Monselise and Goldschmidt,1982; Wheaton, 1992). In mandarins and their hybrids, as well as mandarin hybrids with grapefruit (*C.reticulata* × *C. paradisi*, i.e.tangelos) alternate bearing is typically a rule, irrespective of their level of seediness (Monselise and Goldschmidt,1982).

The Minneola Tangelo is one of the finest citrus fruits for the Desert Garden, and probably not planted as often as it should be. A cross between a mandarin and a grapefruit, the Minneola is essentially a large mandarin that grows in clusters like grapefruit and has all of the fine flavor of the best tangerines, in a larger fruit with fewer seeds. The Minneola tree is reliably hardy and a strong producer, tending towards alternate bearing. The fruit is easily peeled and excellent eaten fresh, but also makes the best orange juice think fresh squeezed Tang, and very best candied citrus peel (Davies and Albring,1994).

Some growers in California use manual, pruning hedging, and topping to minimize alternate bearing in Minneola Tangelo and many mandarin varieties and to reduce crop loads of other citrus varieties in years with a heavy fruit set. Heavy fruit sets, caused by alternate bearing or a cool spring with fruit drop, can result a large proportion of the fruit being too small to be profitable (Cameron and Hodgson,1941;Tucker*et al*., 1991).

Studies on how fruit regulates the inhibition on flowering have produced two generalized theories of alternate bearing – the hormonal theory and the nutritional theory (Bangerth, 2009; Barnett and Mielke, 1981; Davenport, 2000; Goldschmidt, 1999). In the following review the general phenology of vegetative shoot flushing and flowering of a citrus tree will be discussed, as well as the roles of important factors considered within the two different models of alternate bearing - carbohydrates and mineral nutrients in the nutritional theory of alternate bearing, and the endogenous hormones, ABA, cytokinin, GA3 and IAA in the hormonal theory of alternate bearing (Dixon *et al.,* 1988; Dovis *et al.,* 2014). Plant hormones play an integral role in controlling the growth, development, metabolism and morphogenesis of higher plants (Taiz and Zeiger, 1991). Auxins, gibberellins, cytokinins, ethylene and abscisic acid are well known plant hormones. However, growth hormones differ considerably in their mode of actions (Najma and Aisha, 2006). Most of the research on relationships between the growth of vegetative shoots and other tree organs provides evidence for the involvement of carboydrates in the inhibition or upregulation of vegetative shoot development (Goldschmidt and Golomb, 1982; Monerri *et al*., 2011; Martínez-Alcántara *et al*., 2015; Smith, 1976). Verreynne (2005) showed that the lack summer vegetative shoot development and flowering in "on" 'Pixie' mandarin trees was attributed to a high IAA concentration combined with low cytokinin concentration in buds caused inhibitionof new vegetative shoots.However, in other studies(Bower *et al*., 1990; Goldschmidt, 1984; Jones *et al*., 1976; Shalom *et al*., 2014), an inhibitionof new vegetative shoots was related to high concentrations of ABA in leaves and buds.

Urea is an ideal N carrier for foliar application because it contains high percentage of N (46 %), uptake, metabolism and translocation is rapid following application. It was used by many fruit seedlings at solution in different concentration during the growing season and enhanced most of the growth parameters. Sheo and singh, (1999) used urea at 0.5% on sour orange and Cleopatra mandarin seedlings, (Pegah sayyad and Shahsavar, 2012). N deficiency, therefore, acts, to various extents, sugar metabolism and/or carbohydrate partitioning between source and sink tissues (Paul and Driscoll,1997; Scheible, *et al*.,2004). Low N availability causes reduction in leaf N, reduced number of flowers per inflorescence, low fruit set and yield (Erel *et al*., 2013). Several researchers have shown that applications of N to foliage (foliar N applications) have a higher recovery rate than soil applications (Rosecrance *et al.,* 1998). Applying urea in spring and/ or autumn to apple trees as a substitute or supplement to soil N dressing has been reported to increase the amount of shoot growth (Shim *et al.,* 1972). Application methods and practices can also affect tree N efficiency. Foliar N application, particularly using urea (Furuya and Umemiya, 2001), Nitrogen is a part of all living cells and is a necessary part of all proteins, enzymes and metabolic processes involved in the synthesis and transfer of energy. Nitrogen is a part of chlorophyll, the green pigment of the plant that is responsible for

photosynthesis. It assists plants with rapid growth, increasing seed and fruit production and improving the quality of leaf and forage crops (Smith and Reuther 1954). Excessive crop in the "on year" depletes the nutrients needed to form new fruit buds; however there is also evidence that seed-producing hormones exported from the developing ovules have a direct inhibitory effect on flower development. Application of N in the form of urea tends to increase tree N storage and regulate N distribution, results in healthy spurs and better flowering. Nitrogen is the most important element for plant growth and development. Consequently, application of N fertilizers had the most significant effect in increasing crop production (Mengal and Krikby, 1987). Urea is considered one of the most suitable forms of nitrogen for foliar application due to its rapid absorption, translocation and metabolism, non-polarity, low toxicity, high solubility as well as its high content of nitrogen (Bondada *et al*., 2001; El-Otmani *et al*., 2002).

Dry yeast is containing several nutrients including N, P, K, Mg, Ca, Na, Mn, Zn, Cu, B and Mo,total protein (5.3%), total carbohydrates (4.7%), and some hormones (IAA 0.5 ppm and $GA_3$ 0.3 ppm) (Tartoura 2001) The first possibility of using the active bread yeast for improving growth and fruit quality was published by Suriabananont (1992). However, the different positive effects of applying active bread yeast as a newly used bio-fertilizer were attributed to its own component from different nutrients,a higher percent of proteins, a natural source of many growth substances ( thiamine, riboflavin, niacin, pyridoxine and vitamins B1, B2, B3 and B12 ), cytokinins and many of the nutrient elements as well as organic compounds i.e., carbohydrates, nucleic acid and lipids, yeast extract was suggested to participate in a beneficial role during vegetative and reproductive growth through improving flower formation and their set in some plants due to its high auxin and cytokinins content and enhancement of carbohydrates accumulation (Barnett et al., 1990; Ferguson et al., 1987 ; Hashem et al.,2008).Today, bread yeast (*Saccharomyces cerevisiae*) as a natural bio-stimulant appeared to induce an astonished influence on growth and yield of many crops, recently, it became a positive alternative to chemical fertilizers safely used for human, animal and environment (Omran, 2000). A growing number of studies indicate that plant root growth may be directly or indirectly enhanced by yeasts in the rhizosphere (Nassar *et al*., 2005; El-Tarabily and Sivasithamparam, 2006; Cloete *et al*., 2009). Mohamed (2005) also found that active dry yeast as foliar application had a beneficial effect on growth, yield and chemical constituents of plants.

Benzyladenine (BA) is one of the cytokinins which improve quantitatively and /or qualitatively the yield of many plants (Gamal EI-Din and Talaat 1999; Reda *et al*., 2010). 6-Benzyladine is a safe and efficient synthetic cytokinin mainly used in crop production to promote non-meristem differentiation and lateral bud outgrowth (Sprent, 1967). 6-BA application directly promotes lateral bud growth. For example, Liu *et al*. (2009) reported that exogenous 6-BA application stimulates the outgrowth of wheat tiller buds. Foliar spraying of 6-BA significantly stimulates axillary buds outgrowth in young (Huang *et al*., 1999; Kender and Carpenter, 1972) and nursery (Elfving and Visser, 2006; Meng *et al*., 2012) apple trees. Exogenous cytokines can promote an accumulation of chlorophyll and promote the conversion of etioplasts into chloroplasts even in dark grown seedlings. This may appear as a greening effect on ornamental crops which may be perceived as an increase in quality in green leaved crops and a decrease in quality in crops with other leaf colors. (Nishijima *et al.,* 2006). Cook *et al*. (2001) found that repeated BA sprays improve the BA absorption in apple trees. BA plays permissive role in the regulation of various growth processes in the plants. (Skoog *et al*., 1967 and Ibrahim *et al*., 2010). The improvement of growth of plants in response to foliar application of the treatments may result in improving quality of pods such as increased protein, nitrogen, total soluble sugars and oil content. Cytokinin including (BA) could induce cell division of excised root tissue and accompanied by great changes in protein (Butcher*et al.,*1988 and Reynold, 1990). Mostafa *et al*. (1993) proved that (BA) treatment on soybean plants induced a highly significant increase in the oil percentage. El-Meleigy (1989).Recently, a synthetic cytokinin benzyladenine (BA) has been released in the U.S. as nfigure for use on ornamental plants (John Carey and Mark 2008). A combination of notching and BA application, or BA application alone (single or possibly multiple applications), may be the best options for improving branching in poorly branched trees (Clements *et al*., 2010). Repeated BA treatments induced more laterals compared with single treatment and it is in agreement with Buban (2000).The reduction in ABA level could be due to the shift of the common precursor isopentenyl pyrophosphate to biosynthesis of cytokinins and/or gibberellins instead of ABA (Hopkins and Huner, 2004).

C/N ratio leaf C/N ratio in November (flower bud initiation) is of great importance, since blossoms production favor high C/N ratio but vegetative growth favor low C/N ratio (Singh, 1980). Tree carbohydrate status has been suggested as playing a dominant role in flower bud formation of fruit crops (Monselise and Goldschmidt, 1982). Carbohydrate plays an essential role in pollen tube growth (Negi *et al*, 2009). Deficiency carbohydrate metabolism in the anther leads to abnormal pollen development in many plants (Bhadula and Sawhnev1989). Reed and MacDougal (1938) reported that for sweet orange, the first vegetative shoot flush in spring is maintained by carbohydrate reserves that accumulated in permanent structural tree organs during the previous season. Carbohydrates (specifically starch) have an important role in the regulation and severity of alternate bearing in citrus trees (Jones *etal.,* 1975; Schaffer *et al.,* 1985). In contrast, early removal of fruit from "on" year „Owari" satsuma mandarin trees increased the carbohydrate levels in the leaves and increased flowering during the following "off" year (García-Luis et al., 1995a). El-Masry (1982) found that the trees in the "on year", generally showed greater percentage of nitrogen, total carbohydrate and C/N ratio compared to those in the "off year". It was reported by Childers (1961), Westwood (1978) and Ryugo (1988). This balance could be achieved by maintaining optimum nitrogen status in mango trees. Application of nitrogen fertilizer at proper rate and time may reduce irregular bearing in mango. In mango, tree carbohydrate reserves were directly correlated with flowering (Kalayanaruk *et al*., 1982; Chacko, 1972). It is clear that C/N ratio have a profound effect on alternate bearing habit in mangoes (El-Shamy *et al*., 1990). C:N ratio was higher in leaves than the terminal shoots at flower bud differentiation while during bud burst stage shoots showed decreasing trend than leaves may due to translocation of soluble carbohydrates towards flower buds during bud burst stage. C:N is considered as an important factor in regulation of flowering in fruit crops. A high ratio of C:N has been postulated to have promotory effect to reproductive growth (Corbesier *et al*., 2002) and increase in its ratio is ascribed as the consequence of increased carbohydrate availability (Ito *et al*., 2004), The C/N ratio plays an important role in determining the differentiation process of apical terminal into the vegetative or flowering phase (Lovatt *et al*., 1988).

**Material and Methods**

The present study was carried out during three successive seasons of 2016/2017, 2017/2018 and 2018/2019 on forty two trees (22- years old) of Minneola tangelo (*Citrus paradisi* Macf x *Citrus reticulata* Blanco) budded on sour orange (*Citrus aurantium* L.) rootstock and grown in clay soil and spaced of 5x5 meters a part under flood irrigation system at Giza Experimental station, Citriculture Division, Horticulture Research Institute, Agricultural Researches center, Egypt. All the chosen trees healthy.

The foliar application were as follow:
1- Control (sprayed with water only).
2- Spraying trees with urea at 20g/ L.
3- Spraying trees with dry yeast at 4g/ L.
4- Spraying trees with Benzyladenine at 60 ppm.
5- Spraying trees with urea at 20g/L + dry yeast at 4g/L.
6- Spraying trees with urea at 20g/ L + Benzyladenine at 60 ppm.
7- Spraying trees with urea at 20g/ L + dry yeast at 4g/L+ Benzyladenine at 60 ppm.

Therefore,the present study aimed mainly to evaluate the influence of foliar sprays of urea ,dry yeast extracts and benzyladenine either alone or combinations on vegetative growth parameters, leaf chemical compositions , fruiting behaviour and fruit quality of Minneola tangelo trees to reduce the severity of alternate bearing phenomena.

The all spraying treatment and their combinations were spared three times of three experimental seasons, the first spray applied at the mid of March, the second spray was applied at early bloom (1$^{st}$of April), the third spray after fruit set (2$^{nd}$ week of May) of each season("off " year,"on"year and"off" year). Each spray treatment and their combinations was replicated three time with two tree for each replicate. Triton B was used with all treatments were applied to run off by using compression sprayers (6L solution /tree) at the previously mentioned times.

**1. Vegetative growth:**

Number of shoots, shoot length (cm), shoot diameter(cm), number of leaves/shoot, average leaf dry weight(g), average leaf area ($cm^2$) and specific leaf weight (SLW) $mg/cm^2$ = leaf dry weight (g) x 1000 per unit leaf area ($cm^2$) according to Barden,(1974 **).** To measure average leaf area**,** twenty five mature leaf sample of each replicate were taken at the middle portion of shoots non fruiting to determine leaf area ($cm^2$) by using the equation Leaf area ($cm^2$) = 2/3( leaf length cm x leaf width cm), according to Chou *et al*. (1966) .

**2. Productivity measurements:**

**2.1. Fruit set percentage:**

At full bloom during each experimental season, the number of perfect flowers per each initial was counted. After 75% of petal fall fruit set as a percentage of perfect flowers were estimated according to the following equation used by Fouad *et al*. (1992).

$$\textit{Fruit set (\%)} = \frac{\textit{Number of set Fruitlets}}{\textit{Number of perfect flowers at full bloom}} \times 100$$

**2.2. Fruit retained percentage:** remaining fruits percentage after June drop was determined by counting the number of set fruitles up to the first week of July. Remaining fruits (%) was calculated as follows**:**

$$\textit{Remaining Fruit percentage after June drop} = \frac{\textit{Number of remaining Fruits in July}}{\textit{Number of treated flowers}} \times 100$$

**2.3. Mature fruits:** mature fruits was calculated as follows**:**

$$\textit{Mature fruits (\%)} = \frac{\textit{Number of Mature fruits at harvest}}{\textit{Number of treated flowers}} \times 100$$

**2.4. Fruit number and yield:**

At the harvest time of each season the remained fruits as the average number of fruits per tree were recorded to determine yield as kg /tree and ton /feddan by multiplication number of fruits per tree with an average fruit weight and yield per tree .

**2.5. Yield increment:**

Harvesting was achieved on December15$^{th}$ for each season, yield kg /tree was recorded. Fruit yield increment or reduction percentage is compared with the control was estimated according to Kabeel and El-Saadany (2004) as follows**:**

$$\textit{Fruit yield increment (\%)} = \frac{\textit{fruit yield(kg/tree)/ treatment - fruit yield(kg/tree)/ control}}{\textit{fruit yield(kg/tree)/ control}} \times 100$$

**2.6. Fruit physical characteristis:**

At harvest, samples of twelve fruits of each tree replicated two times were devoted to determine the following fruit characteristics : Fruit weight (g) , fruit volume ($cm^3$) , fruit diameter (cm), fruit length (cm) , Fruit pulp weight(g), Fruit peel weight (g), Juice volume ($cm^3$), peel thickness (cm).

**2.7. Fruit chemical characteristics**:

Another sample of twelve fruits for each replicate was randomly chosen in both seasons to determine the following chemical characteristics: Total soluble solids (TSS) using Carl Zeiss hand referactometer, total acidity % of unhydrous citric acid, TSS/acid ratio and vitamin C as mg ascorbic

acid were determined using 2.6 - dichlorophenol indophenols titration dye and estimated per mg /100 ml juice, according to A.O.A.C. (2015).

**3. Chemical analysis of leaves**

**3.1. Total carbohydrates (%)** in the leaves of spring cycle (Smith *et al*., 1986).

**3.2. C/N ratio** .

**3.3. Total chlorophylls, chlorophylls a &b and carotenoids** in the fresh leaves of spring growth cycle as mg /g F.W. Total chlorophylls were recorded by summation of chlorophylls a & b. A conventional method using dichromatic equations for the simultaneous spectrophotometric determination of chlorophylls a & b in plant using the optical densities at 664 and 647 nm for chlorophylls a & b, respectively. Actually using a pair of equations with two unknown (i.e. chlorophylls a&b concentrations) and carotenoids dates back to the Arnon, (1949).Vernon (1960) modified the existing spectrophotemetric procedure for total chlorophylls assay.

**3.4. Total sugars percentage (%):**

Ethanol extract of leaves was used for the determined calorimetrically of total sugar **%** as (g/100 g fresh weight) by Dubois *et al*., (1956).

**3.5. Indoles:**

1ml of the methanolic extract and 4 ml of PDAB reagent (paradimethylamino benzoic acid 1g dissolve in 50ml Hcl, 50ml of ethanol 95 %) were taken and left for 60 min in 30 - 40. The developing colour was spectrophotometrically measured at aWave length of 530 nm, as described by Larsen *et al*., (1962).

**3.6. Total phenolics:**

Total phenolics were determined by Folin-Ciocalteu method of Singleton *et al*. (1999).

**4. Nutrient status:**

To determine the leaf nutrient content (N, P, K, Ca, Mg, Fe, Mn,Cu and Zn ),sixty mature leaves of a seven months age from the non fruiting and non - flashing terminal shoots of the Spring flush were randomly taken from each replicate in July of each season leaf samples. At this time, most leaves are fully developed and their nutrient concentration is stable. washed with tap water then with distilled water, dried at 70°C for 48 hours until constant weight, A portion of 0.5g powdery oven - dried leaves material was wet- digested with $H_2SO_4$- $H_2O_2$ and allowed to stand still for about four hours till all the initial reaction subsided .It was heated gently until the solid material disappeared, then heated vigorously till a clear colorless solution formed, ground and finally digested by using method of (Lowther, 1980). The digested solution was used to determine N, P and K percentage in leaves, which estimated by standard procedure according to Chapman and Parker 1961. Calcium, Magnesium, Fe, Zinc and Manganese: were determined Spectrophotometricaly by an atomic absorption spectrophotometer as described by Brand and Spiner, (1965).

**Statistical analysis:**

The differences between the treatments and control were analyzed in completely randomized block design (RCBD) with three replicates for each treatment and each replicate was represented by two trees. Thus the total number of trees experiment was 42 ( 7 treatment x 3 replicate x 2 tree ) in each replicate and least significant difference test LSD at 5% level was used to differentiate means according to Snedecor and Cochran (1995) **.**

**Results and Discussions**

**1. Effect of foliar application with urea, dry yeast ,benzyladenine and their combinations on Vegetative growth( No.of shoots, Shoot length (cm),Shoot diameter (cm), No. of leaf /shoot) and alternate bearing phenomena of Minneola tangelo trees .**

**1.1. Number of Shoots:**

Results in Table (1) shows that the highest number of shoots was obtained from spraying trees with (Urea at 20g /L + Benzyladenine at 60 ppm) in the three season compared with the other

treatments and control. Number of shoots was higher values in "on" year compared to two" off " year. While control gave the lowest values of all three seasons of the study. However, the combined treatments of (Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60 ppm) gave the lowest number of shoots compared with the other spraying treatments. Ibrahim *et al*. (2010)found that foliar application of benzyladenine (BA) at (50,100 and150 ppm) were significantly affected on croton number of branches. This result agree with foliar application of *Adhatoda zeylanica* with a mixture of (0.2% urea + 100 ppm Benzyladenine ) was significantly higher No. of Branches /plant than other treatments Madhuri *et al*.,(2018).Who reported that benzyladenine application to pepper plants induced significant increase in number of branches (Abdel -Hamid,1997).

**1.2. Shoot length (cm):**

Results in table (1) obviously reveal that, (Urea at 20g/L+ Dry yeast at 4g/L)treatment significantly increased shoot length when compared to the control and all other treatments in the three seasons.Shoot length was higher in "on" year than two "off" years in all the used treatments. The increase in shoot length is due to nitrogen stimulation of growth (Marschner, 1995). In regard to the effect of active dry yeast on shoot length and leaf area. The stimulation effect on growth might be attributed to its own higher content of amino acid and cytokinen and minerals as well as its positive action on enhancing the biosynthesis of carbohydrates (N.R.P., 1977). The results of urea on vine growth are in agreement with those obtained by Darwish and Ahmed (1993). This result agree with Fawzi *et al*., (2014) reported that application of active dry yeast at 0.2% gave the highest significant shoot length (cm) (163.33 and 169.11) of "superior" grapevines. They added the combined treatments of urea 1.0% plus boric acid at 0.2% at plus 0.2% yeast gave a significant increase in shoot length than all other treatments and the control of "superior" grapevines Morever foliar spray Washington navel orange trees with Yeast extract 50 -100 ml/l significant increases in shoot length as compared with other two treatments Khamis *et al.*(2017).

**1.3. Shoot diameter (cm):**

Results in Table (1) obviously indicate that Minneola tangelo shoot diameter was significantly affected by all the used treatments when compared to control in three seasons**.** foliar sprays with a mixture of ( Urea at 20g /L + Benzyladenine at 60 ppm ) had the highest shoot diameter as compared with control and all other treatments. Shoot diameter was higher in" off "years (2018/ 2019 ) than " off "years (2016/ 2017). Meanwhile, (Urea at 20g /L + Benzyladenine at 60 ppm) treatment was higher in "on" years than two"off" years. The greater in the rate of increase of stem diameter in transplants of olive cvs were obtained with sprayed weekly with Urea + $GA_3$ (0.329 & 0.338 mm) respectively, compared with other treatments by Shereen and Aly (2011). Showed significant increase in berry diameter by using yeast 0.2% either alone or combined with urea 1.0% and boric acid 0.2%(Fawzi *et al*.,2014). As for the effect of foliar spraying with urea in increasing stem diameter it may be because it contains a high percentage of nitrogen which is involved in building amino acids such as tryptophan.Hopkins (2006). These results agree with Muralidhara *et al*., (2014) where their results showed a significant increase in stem diameter when the mango seedlings were sprayed with Benzyladenine.

**1.4. No.of leaf /shoot:**

Results in Table (1) clearly indicated that all treatments increased number of leaf /shoot than the control. The application of (Urea at 20g /L+ Dry yeast at 4g /L) possessed higher number of leaf /shoot as compared with all other treatments. Number of leaf /shoot was higher in "on" years than two" off "years in all the spraying treatments. (Urea at 20g /L+ Dry yeast at 4g /L) of the lower number of leaf /shoot in " off "years compared with "on" years trees. These results agree with Khamis *et al*., (2017) who found that the number of leaf /shoot of Washington navel orange was significantly increased with yeast extract ,its maximize existed with yeast extract (25.66& 27.33 and 26.33& 29.66) with 50 and 100 mg/l in 2013 and 2014 seasons. These results also agree with Kannan *et al*. (2002) where the number of leaves increased significantly when rough lemon seedlings were sprayed with urea at a concentration of 1.5%. Application of benzyl adenine at 50 and 100 ppm created significant stimulative effects on growth parameters; number of leaves/plant of sunflower (Emad *et al.* 2013). Our results of nitrogen increasing the vegetative growth parameters in the "on year" agree with

Nakhlla *et al*., (1998), Aly (2001), Shaheen *et al*. (2003) and El-Sonbaty *et al*. (2012). Role of nitrogen a constituent of amino-acids and proteins as well as its important role in encouraging cell. The division and the development of meristematic tissues. El-Badawy and Abd El- Aal (2013) which showed that the foliar spraying for the mango seedlings with kinetin (cytokinins) at a concentration of 75 mg.L-1 had the significant effect in increasing the number of leaves. Benzyladenine application to pepper plants induced significant increase in number of leaves/plant (Abdel - Hamid, 1997). The lack of vegetative shoot development is a major cause of poor flowering following an "on" year (García-Luís *et al*., 1995; Lenz, 1967; Martínez-Alcántara *et al*., 2015; Monselise and Goldschmidt, 1982). Foliar application of olive transplants with GA3 (200 ppm) and urea (1%) and their combination increased stem length, leaf number, shoot number, stem diameter, and fresh weights compared to untreated plants as reported by Shereen and Aly (2011).

**2. Effect of foliar application with urea, dry yeast, benzyladenine and their combinations on Vegetative growth (average leaf dry weight (g), average leaf area ($cm^2$), Specific leaf weight (SLW) ($mg/cm^2$) ) +and alternate bearing phenomena of Minneola tangelo.**

**2.1. Average leaf dry weight (g).**

Results in Table (2) show significant increase in the average leaf dry weight (g) in response to (Urea at 20g /L+ Dry yeast at 4g /L) application compared to the control and all other treatments. Foliar spray at (Urea at 20g /L+ Dry yeast at 4g /L) higher values of average leaf dry weight in "On" years (2017/ 2018) than two"Off" years. Moreover, treated trees gave a high positive effect on average leaf dry weight in "off" years (2018/ 2019). Generally, trees treated in "Off" years (2018/ 2019) produced higher average leaf dry weight than those treated in "Off" years (2016 /2017). Foliar applications of "Manzanillo" olive with dry yeast extract at 40g/ L exhibited the highest leaf dry weight (2.47 and 2.56 g ) in comparison with control. Mahmoud *et al*. (2015). El-Bassiony *et al.* (2014) showed that the values of dry weight of Kohlrabi plants was increased with foliar spray of bread yeast. Foliar application of olive transplants with GA3 (200 ppm) and urea (1%) and their combination increased dry weights compared to the control (Shereen and Aly 2011).

**2.2. Average leaf area ($cm^2$)**

Results in Table (2) show significant increase in leaf area in response to (Urea at 20g /L + Benzyladenine at 60 ppm) application compared to the control and all other treatments. The highest leaf area (31.28 and 33.42$cm^2$) was observed that (Urea at 20g /L + Benzyladenine at 60 ppm) application from" off "years (2016/ 2017) and" off "years (2018/ 2019) of Minneola Tangelo trees. All treatments caused (average of three seasons) increase in leaf area relative to the control. Meanwhile, the lowest leaf area was existed by control (22, 00, 23.60 and 22.35 $cm^2$ ) in" off "years, "On" years and "off" years respectively. These results also agree with Mahmoud *et al*. (2015) who found that the spraying of olive trees (*Olea europaea* L.) with benzyladenine (BA) at a concentration of 60 mg.L-1 led to the significant increase in the leaf area for two seasons of the study. The highest rate of nitrogen supply increased the leaf area; this is due to nitrogen role in stimulation of growth (Marschner, 1995). It also agrees with Badshah and Ayub (2013) who indicated a significant increase in the leaves area for pecan nut seedlings (*Carya illinoinensis*) when spraying with urea at a concentration of 5%**.**

**2.3. Specific leaf weight (SLW) ($mg/cm^2$)**

Results in Table (2) In this respect, specific leaf weight of the treatment( Urea at 20g /L+ Dry yeast at 4g /L) gave the highest significant values (7.50, 8.40 and 7.78 $mg/cm^2$ ) in" off "years, "On" years and " off "years respectively, while control treatment gave the lowest value (5.00, 5.50 and 5.36 $mg/cm^2$) in" off "years, "On" years and " off "years respectively. However, trees treated in "On" years showed high positive response in specific leaf weight than those treated in two"Off" year. Specific leaf weight was higher in" off "years(2018/2019) than "off "years(2016/ 2017). Foliar applications with dry yeast extract at 40g/L/tree leads to increase specific leaf weight dry of Manzanillo olive Mahmoud *et al*. (2015). The beneficial effect of amino acids or yeast on crop growth characters was reported Mohamed (2006) and Zaki *et al*. (2007). The improvement in apparent leaf attributes and related photosynthesis was recorded in soybean with proportionate increase in specific leaf weight (Thompson *et al.* 1996). The application of active dry yeast is very effective in releasing CO2 which improves net photosynthesis (Idso *et al*., 1995).

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**Table 1:** Effect of foliar application with urea, dry yeast ,benzyladenine and their combinations on No. of shoots, Shoot length (cm),Shoot diameter (mm), No.of leaf /shoot and alternate bearing phenomena of minneola tangelo trees during 2016/2017, 2017/2018 and 2018/2019 seasons .

| Treatments | No. of shoots | | | Shoot length (cm) | | | Shoot diameter (mm) | | | No. of leaf /shoot | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 |
| **Control (spray water only)** | 13.20 f | 14.57 f | 13.34 g | 26.30 e | 27.00 f | 26.65 e | 2.27 g | 2.56g | 2.36 f | 20.30 e | 21.63 g | 20.97f |
| **Urea at 20g /L** | 23.30 b | 26.60 b | 24.32 b | 34.25 b | 38.54 b | 35.89 b | 3.52 b | 3.89 c | 3.55b | 33.35 a | 35.56 b | 33.85b |
| **Dry yeast at 4g /L** | 20.00c | 23.55d | 21.75 c | 31.45 c | 36.70 c | 32.22 c | 2.65 c | 2.92b | 2.78 c | 27.00 c | 28.70 d | 27.86c |
| **Benzyladenine at 60ppm** | 19.85 d | 22.35 d | 20.00 e | 27.05 e | 33.15 d | 27.85 e | 2.54 d | 2.88 d | 2.63 d | 26.22 c | 27.56 e | 26.89d |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 21.20 c | 24.00 c | 22.33d | 36.10 a | 40.20 a | 37.65 a | 2.42 e | 2.78 e | 2.50 e | 34.25 a | 36.65 a | 35.95 a |
| **Urea at 20g /L+ Benzyladenine at 60ppm** | 24.25a | 27.30a | 25.95a | 29.22 d | 34.50 d | 29.82 d | 3.62 a | 3.97 a | 3.72 a | 30.12 b | 32.75 c | 30.93c |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60ppm** | 17.22 e | 20.33 e | 18.65 f | 26.14 e | 31.33 e | 25.36 ef | 2.35 f | 2.77 f | 2.46 e | 25.10d | 26.54 f | 25.82e |

Means in the same column followed by the same letter(s) are not significantly different at 5% probability

**Table 2:** Effect of foliar application with urea, dry yeast, benzyladenine and their combinations on average leaf dry weight (g), average leaf area ($cm^2$), Specific leaf weight (SLW)($mg/cm^2$) and alternate bearing phenomena of minneola tangelo trees during 2016/2017,2017/2018 and 2018/2019 seasons.

| Treatments | Average leaf dry weight (g) | | | Average leaf area ($cm^2$) | | | Specific leaf weight (SLW) ($mg/cm^2$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 |
| **Control (spray water only)** | 0.11 g | 0.13g | 0.12g | 22.00f | 23.60g | 22.35g | 5.00d | 5.50e | 5.36 d |
| **Urea at 20g /L** | 0.21b | 0.26b | 0.23b | 30.96a | 34.97b | 32.46b | 6.78b | 7.43d | 7.08b |
| **Dry yeast at 4g /L** | 0.19c | 0.24c | 0.21c | 25.53d | 30.00e | 27.26e | 7.44a | 8.00a | 7.70a |
| **Benzyladenine at 60 ppm** | 0.17e | 0.22e | 0.18e | 27.66 c | 32.40d | 29.03d | 6.14c | 6.79b | 6.20c |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 0.22a | 0.28a | 0.24a | 29.32b | 33.32c | 30.82c | 7.50a | 8.40a | 7.78a |
| **Urea at 20g /L + Benzyladenine at 60ppm** | 0.18d | 0.23d | 0.20d | 31.28a | 36.56a | 33.42a | 5.75c | 6.29bc | 5.98c |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60ppm** | 0.15f | 0.20f | 0.16f | 24.38e | 28.65f | 25.46f | 6.15c | 6.98b | 6.28c |

Means in the same column followed by the same letter(s) are not significantly different at 5% probability

**3. Effect of foliar application with urea, dry yeast , benzyladenine and their combinations on Productivity measurements (fruit set %, remaining fruits after June drop %, Mature fruits %, yield increment(%) over the control) and alternate bearing phenomena of Minneola tangelo trees.**

**3.1. Fruit set %:**

Results in Table (3) show that fruit set percentage significantly increased in response to (Urea at 20g /L + Benzyladenine at 60 ppm) foliar application compared to the control and other treatments. The lowest fruit set percentage was observed in the control treatment in" off "years, "On" years and "off "years respectively. Generally,( Urea at 20g /L + Benzyladenine at 60 ppm) treatment was the most efficient treatment in "Off" year (2018/ 2019) followed by ( Urea at 20g /L+ Dry yeast at 4g /L) treatment. failed to induce any positive effect on initial fruit set percentage of Minneola tangelo trees in "Off" years (2016/2017). On the other hand, the interaction between all tested factors showed that (Urea at 20g /L + Benzyladenine at 60 ppm) treatment improved initial fruit set percentage of Minneola tangelo trees as compared with the control treatment during "Off" years (2018 /2019). This result agree (Hellal *et al.*, 2011). Benzyl adenine (BA) is a first-generation synthetic cytokinin that elicits plant growth and development responses, setting blossoms and stimulating fruit richness. Foliar application combinations of urea and benzyladenine could be used to improve growth and biochemical yield and production of *Adhatoda zeylanica*. This result also agree Madhuri *et al.*, (2018). Foliar sprays of urea (1 and 1.6%) at flower initiation and differentiation stage was suggested to increase flowering and $GA_3$ (10ppm) applied during flowering to increase fruit set. Kommana *et al.* (2019). Moreover, nitrogen increases leaf chlorophyll levels and photosynthesis, thus promoting shoot growth and flowering (Marschner,1995). Application manzanillo olive trees with dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree recorded the highest significant values of percentage of fruit set (11.49 and 14.25%) during both seasons followed by dry yeast extract at 40g/ L/tree (9.14 and 11.37%) in both seasons respectively. Mahmoud *et al.* (2015). Nitrogen deficiency at the time of blooming is one of the most common causes of too much abscission of flowers, resulting in less fruit set (chandler,1958 ). Furthermore, Gilani *et al.* (1991), who reported a slight difference in fruit setting in Kinnow, when trees were supplied with ammonium sulphate (69.24%), calcium ammonium nitrate (68.10%) and urea (67.01%), as N source, which also supports our results (Thanaa *et al.*,2016). The positive effects of active dry yeast to increase fruit set compared with control trees could be explained as a result it is considered as a natural source of cytokinins and improving net photosynthesis (Hashem *et al.*, 2008). Moreover, Funckees-Shippy and Levine, (1985) reported that Cytokinins are important in the induction of greening and the initiation of the development of chloroplasts. BA has been shown to activate synthesis of two proteins of the chloroplasts. ). Foliar application of N at the highest rate gave the best results with regard to fruit set (71.7-73.8%), reduction in pre harvest fruit drop (9.07-9.81%) and yields ( 352-396 fruits/tree ) in sweet orange compared to control (Govind and Prasad, 1982 ).

**3.2. Remaining fruits after June drop %**

Results in Table (3) shows that (Urea at 20g /L + Benzyladenine at 60 ppm) foliar spray enhanced remaining fruits after June drop (%) as compared with the control treatment in "Off" years (2018 and 2019). Generally, all treatment was the most efficient treatment in 2018 and 2019 seasons followed by (Urea at 20g /L+ Dry yeast at 4g /L). Showed that (Urea at 20g /L + Benzyladenine at 60 ppm) treatment in "On" years (2017/ 2018) gave high values of remaining fruits after June drop (%).Whereas control treatments recorded the lowest percentage of remaining fruits after June drop in this respect; since it gave (5.62, 13.56 and 8.46%) in" off "years, "On" years and " off "years, respectively and it was the most efficient combination in this concern. Moreover, treated trees in "Off" years (2018 /2019). showed high remaining fruits percentage than those treated in "Off" years (2016/2017). This result agree with Khamis *et al.*, ( 2017) found that percentages of remained fruits of Washington navel completed during June reached their maximum with yeast extract100 ml/l treatments (21.85& 22.00 %) with the high concentration of yeast extract during (2013 and 2014) seasons, respectively .The fruit drop was effectively decreased by urea applications . The lowest values of fruit drop were observed with 5 and 2 per cent urea applied at 10 per cent leaf fall (Mohd *et al.*, 2017). Furthermore, hormones are most likely responsible for these differences since endogenous levels of hormones do differ between cultivars at certain critical times such as flowering and

physiological fruit drop (Goldschmidt and Koch, 1996; Schaffer *et al*., 1985). This result also agree with Abd El-Motty *et al.* (2010) with Keitte mango trees and Abd El Hamied (2014) with Sukkary Mango trees reported that 0.2 % and 0.3 % yeast extract was very effective in improving fruit set and fruit retention as well as decreasing fruit drop percentage. (Stewart and Hield, 1950) reported that reduction in fruit drop percentage may be due to the action of auxin in strengthening the cells in the abscission zone which is localized at the peduncle. While Al-Qurashi and Awad (2011b) found that spraying date palms with BA 40 and 70 days after pollination significantly decreased fruit drop.

**3.3. Mature fruits %**

Results in Table (3) show that mature fruits percentage significantly increased in response to (Urea at 20g /L + Benzyladenine at 60 ppm) foliar application compared to the control and other treatment. Illustrates that ( Urea at 20g /L+ Benzyladenine at 60 ppm) foliar spray gave higher values of mature fruits percentage as compared with the control treatment in "On" years (2017 and 2018).Moreover,( Urea at 20g /L + Benzyladenine at 60 ppm) gave high positive effect on mature fruits percentage as compared with the control treatment in "Off" years (2018 and 2019)**.**The other treatments increased this mature fruits percentage compared with the control but to less extent. All treatments" off "years (2016/ 2017) gave the lowest mature fruits percentage in this respect. This result agree with Lee and Kader (2000) reported that stage of maturity is considered more important, as it determines storage-life and final fruit quality. Immature fruits are extra subject to mechanical damage and of inferior flavor quality. Over mature fruits become mealy with insipid flavor. harvesting of fruits at proper stage of maturity is of principal importance for attaining desirable quality and to attain its proper nutritive benefits . This result also agree with Busling (1970). While studying the oranges found that in the season acid contents decreased with increasing maturity. Moreover, At the start of maturity this deterioration was accelerated by a net loss of total acid contents (Sinclair and Ramsey1944; Bain, 1958) and (Ting and Deszyck 1959).

**3.4. Yield increment (%) over the control**

Results of Table (3) show significant increase in yield increment ( %) in response to ( Urea at 20g /L + Benzyladenine at 60 ppm) application compared with other treatments including control in " off "years, "On" years and " off "years, respectively**.** Recorded high yield increment percentage values of Minneola Tangelo trees as compared with the control treatment in "On" years (2017/ 2018).Moreover, trees treated in" off "years (2018/ 2019) gave a high positive effect on yield increment percentage than trees treated in "off "years (2016/ 2017). On the other hand, showed that (Urea at 20g /L + Benzyladenine at 60 ppm) treatment improved yield increment percentage of trees Minneola Tangelo as compared with the control treatment and the other treatments during "Off" years (2018/2019) and it was the most efficient combination in this concern. These results agree with Kassem *et al.* ( 2010) Found that foliar sprays “Costata” persimmon trees with activated dry yeast at 4.20 g/L recorded the highest values of yield increment percentage in comparison with the control in both seasons and stated that spraying “Costata” persimmon trees with Urea at 2.5 g/L increased yield increment percentage in both seasons as compared with the control. These results also agree with El-Tanany and Shaimaa (2016) reported that Valencia orange trees sprayed with at benzyladenine treatments at 40 ppm, in both seasons, gave the highest values in an average fruit weight, number of fruit/trees and fruit yield expressed as kilogram/tree or ton/Fed. when compared with the control treatment and other treatments.

**4. Effect of foliar application with urea , dry yeast ,benzyladenine and their combinations on Productivity measurements (number of fruit/ tree , average fruit weight (g), Yield/ weight feddan ( ton) ) and alternate bearing phenomena of Minneola tangelo trees .**

**4.1. Number of fruit/tree**

Results of Table (4). Foliar application with a combination of(Urea at 20g /L + Dry yeast at 4g /L) gave significantly higher number of fruit/tree as compared with the control treatment and the other treatments in"off " years, "On" years and " off "years, respectively.

On the other hand, control treatment gave the lowest values in the respect. Furthermore, all treatments improved number of fruit/tree in "Off" years (2018/ 2019). (Urea at 20g /L+Dry yeast at 4g /L ) foliar spray induced higher positive effect on number of fruit per tree as compared with the

**Table 3:** Effect of foliar application with urea, dry yeast ,benzyladenine and their combinations on fruit set % , remaining fruits after June drop % , Mature fruits %, Yield increment ( %) over the control and alternate bearing phenomena of minneola tangelo trees during 2016/2017 , 2017/2018 and 2018/2019 seasons .

| Treatments | Fruit set % | | | Remain fruit after June drop % | | | Mature fruits % | | | Yield increment (%) over the control | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 |
| **Control (spray water only)** | 7. 82e | 18.43g | 10.56g | 5.62f | 13.56g | 8.46f | 4.42 e | 11.63g | 7.36 e | 000.00 | 000.00 | 000.00 |
| **Urea at 20g /L** | 10.50 cd | 32.63f | 22.73ef | 7.60e | 28.45f | 18.73e | 5.85d | 26.52f | 17.65d | 44.08f | 81.82cd | 57.16f |
| **Dry yeast at 4g /L** | 12.02c | 34.10e | 23.02e | 8.25d | 31.00d | 21.08b | 6.12d | 28.23e | 18.20d | 63.67d | 115.00b | 86.10d |
| **Benzyladenine at 60ppm** | 11.63c | 35.03d | 24.08d | 8.00d | 30.11e | 19.12d | 6.35d | 29.12d | 19.21c | 58.25e | 100.00e | 79.20e |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 13.00a | 37.04b | 25.35b | 10.18b | 33.24b | 21.45b | 8.23b | 31.35b | 20.36b | 90.47b | 124.52a | 103.17 b |
| **Urea at 20g /L + Benzyladenine at 60ppm** | 13.11a | 38.54a | 26.29a | 10.25a | 35.45a | 22.29a | 8.30a | 33.55a | 22.54a | 91.16a | 126.80a | 110.31a |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60ppm** | 12.35b | 36.33c | 24.41bc | 9.45c | 32.25c | 20.50c | 7.54c | 30.33c | 21.34a | 66.47c | 108.07c | 83.99 c |

Means in the same column followed by the same letter(s) are not significantly different at 5% probability

**Table 4:** Effect of foliar application with urea , dry yeast, benzyladenine and their combinations on number of fruit/tree , average fruit weight (g), Yield/tree, (kg),Yield/ weight feddan (ton) and alternate bearing phenomena of minneola tangelo trees during 2016/2017,2017/2018 and 2018/2019 seasons .

| Treatments | Number of fruit/tree | | | Average fruit weight (g) | | | Yield/tree( kg) | | | Yield/ weight feddan ( ton) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017 / 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2017/ 2018 |
| **Control ( spray water only)** | 89. 85 e | 276.34f | 160.23g | 289.87f | 175.63e | 247.99g | 26.04.e | 48.53g | 39.73g | 4.29f | 8.00g | 6.55e |
| **Urea at 20g /L** | 105.30e | 370.30e | 235.30f | 356.35e | 238.30cd | 265.39f | 37.52d | 88.24f | 62.44f | 6.19e | 14.55e | 10.30 d |
| **Dry yeast at 4g /L** | 115.12d | 400.35c | 258.20d | 370.30c | 242.45c | 286.38d | 42.62b | 97.06c | 73.94d | 7.03bc | 16.01ab | 12.20d |
| **Benzyladenine at 60 ppm** | 110.40d | 385.32d | 244.86e | 373.30c | 248.24b | 290.78f | 41.21c | 95.65e | 71.20c | 6.79d | 15.78c | 11.74c |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 130.37a | 435.50a | 275.28a | 380.50a | 250.20b | 293.26b | 49.60d | 108.96c | 80.72e | 8.18c | 17.97d | 13.31b |
| **Urea at 20g /L + Benzyladenine at 60 ppm** | 128.43b | 428.32a | 270.50b | 387.65a | 258.54a | 308.92a | 49.78a | 110.07b | 83.56b | 8.21b | 18.16c | 13.78a |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60 ppm** | 120.35c | 420.35b | 260.87c | 360.20d | 240.23c | 280.22e | 43.35b | 100.98d | 73.10d | 7.15c | 16.66b | 12.06c |

Means in the same column followed by the same letter(s) are not significantly different at 5% probability

control treatment in an expected "Off" years (2018/ 2019). However, trees treated in"Off" years (2016/2017) showed lower in number of fruit per tree than those treated in "Off" year (2018 /2019). All treatment induced the highest as number of fruit/tree compared with control in "On" years (2017 /2018). These results agree with Khamis *et al.*(2017) reported that the foliar spray washington navel orange with yeast extract at the two rates (100 and 50 ml/L) gave the highest values of fruit/tree in comparison with the other foliar treatments in both seasons. Moreover, foliar application of Urea at 2.5 g/L increased number of fruit per tree of "Costata" persimmon trees over control. Kassem *et al.*(2010). Foliage of washington' navel orange trees at a final concentration of 1.3 % N treatment significantly increased both kg and number of fruit per tree in the"on" year ($P \leq 0.10$) Lovatt *et al.* (1999). Foliar application of urea during buds well, increased fruit numbers of Satsuma mandarin in "off years"(Asadi and Akhlaghi, 2008).

**4.2. Average fruit weight (g)**

Results of Table (4) showed that all treatments significantly increased average fruit weight "Off" years (2016 and 2017) compared with control treatment. Foliar application with a combination of (Urea at 20g /L + Benzyladenine at 60 ppm) gave the highest values of average fruit weight as compared to control and other treatments under study in" off "years, "On" years and " off "years, respectively. Average fruit weight was lower in"On" than two" off " in all the used treatments . Foliar spray with (Urea at 20g /L + Benzyladenine at 60 ppm) gave higher positive effect on average fruit weight of Minneola Tangelo trees in "Off " years (2018 and 2019). followed by (Urea at 20g /L+ Dry yeast at 4g /L) treatments increased average fruit weight as compared to control. These results agree with Khamis *et al.*(2017) reported that weight of fruit was significantly increased with different treatments, yet, its maximize existed with yeast extract (290.2 & 295.9 g/fruit and 306.5 & 310.4 g/fruit with 50 and 100 mg/l in 2013 and 2014 seasons respectively. Furthermore, foliar sprays with benzyladenine treatments at 40 ppm, in both seasons, gave the highest values in an average fruit weight of Valencia orange treesas compared with other treatments (El-Tanany and Shaimaa,2016). Yeast application alone or combined with urea and (boric acid) gave the heaviest values in berry weight in both seasons (Fawzi *et al.,* 2014). Highest weight of fruit significantly was observed in foliar application with Benzyladenine at100 ppm compared with control treatment (Abdel-Mohsenand Kamel,2015). Moreover, Umesh *et al*., (2010) who found that foliar application of urea at 2.5% to mango trees cv. Amrapali acquired more fruit weight compared to the control. Foliar spray navel orange trees with yeast at 10000 mg L-1 recorded 289.11 g and 310.32 g in the first and second seasons respectively (Elham and Salwa, 2013).

**4.2. Yield/tree (kg), Yield/weight feddan (ton)**

Results in Table (4) show that of Minneola Tangelo fruit yield as well as yield per faddan significantly increased in response to (Urea at 20g /L + Benzyladenine at 60 ppm) application as compared to the control and other treatments under study in " off "years, "On" years and " off "years, respectively . Foliar spray at ( Urea at 20g /L + Benzyladenine at 60 ppm) treatments gave a higher positive effect in reducing biennial bearing of minneola tangelo yield/tree (kg) and yield per faddan as compared with the control treatment and other treatments in " off "years(2018/ 2019). Generally, trees treated in "off " (2018/ 2019) years produced higher tree yield and yield per faddan than those treated " off "years (2016/ 2017) all treatments significantly increased (yield (kg) /tree, yield per faddan) than the control in "On" years. All treatment gave the lowest yield/tree (kg) and yield per faddan in "off" years (2016/ 2017)**.** These results agree with El-Kobbia *et al*., (2011) reported that spraying urea (2%) alone significantly increased the yield/tree (kg) when compared to the control. Each foliar urea application provided 25 to 33 % of the annual N required by sweet oranges for maximum yield (Embleton and Jones, 1974). Combining the full bloom application of urea with an application of cytokinin (proprietary material) at full bloom and 30 days later significantly increased kg fruit per tree both years of the study (Lovatt,1999). While Schuman *et al.* (2003), who reported that a significant increase in fruit number and fruit yield/tree were noticed when 'Hamlin' orange trees were treated with different doses of N as compared with those of control**.** Al-Obeed *et al*. (2017) studied the effect of urea, zinc (Zn) and boron (B) foliar sprays either alone or in combinations on fruit yield, yield per faddan and quality of "Kinnow" mandarin. Moreover, spraying of LBU 1% significant increase in tree yield,yield per faddan of Valencia orange trees compared with the control

in both seasons. Abdel-Aziz and El-Azazy (2016). Furthermore, Roversi and Ughini (2006) found that yield losses in Hazelnut between on and off bearing years are greater than 70% and 60% for the two orchards they studied. However, Smith (1969) reported an increase of 12% in yield of Marsh grapefruit with increasing rate of nitrogen from 0.5-0.7 Kg per tree. Oland (1963) reported significantly yield increases in both "on" and "off "years of Gravestien" trees growing in sod that had received post-harvest sprays of urea. Khamis *et al.* (2017) who found that foliar sprays Washington navel orange trees with 50 & 100 mg/l of yeast extract gave the highest weight (kg) /tree as compared with the control treatment and other treatments. Furthermore, Abd El-Rhman and Shadia (2012) investigate the effects of foliar sprays on jujube by urea (1 and 2%) observed better result on increased yield/tree (kg). These results also agree with El-Tanany and Shaimaa (2016). Foliar application of benzyladenine at 60 ppm/tree increased yield/tree compared with the control treatment in the 1st and 2nd seasons. Foliar applications *Adhatoda zeylanica* with 0.2% urea + 100 ppm benzyladenine had the highest fresh leaf yield/plant (g) compared with the control and other treatments. Madhuri *et al.* (2018). Foliar application of urea during buds well, in addition to increasing the average yield of trees, reduced the alternate bearing (Asadi and Akhlaghi, 2007 b). Application spistachio with urea and BA combined average yield and yield per CSA was high at BA 25 ppm and 0.25% urea in off-year (*Izzet et al.*, 2006). Lovatt and Ferguson (2002) reported that urea combined with 6-BA significantly increased kg split nuts compared to the control.

**5. Effect of foliar application with urea, dry yeast, benzyladenine and their combinations on some fruit physical characteristics(Peel thickness (cm), peel weight (g) , pulp weight (g)) and alternate bearing phenomena of Minneola tangelo trees**.

**5.1. Peel thickness (cm)**

The results shown in Table (5) trees sprayed with a combination of (Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at60ppm) significantly increased peel thickness as compared with other treatments and the control in "off" years, "On" years and " off "years, respectively. Moreover, sprayed with Urea at 20g /L gave lower peel thickness rate than other treatments on most measuring dates in three seasons, All foliar spray treatments in "off "year (2016/ 2017) gave higher peel thickness than those treated in "off "year (2018/ 2019) compared with control. While, trees treated in"off "year (2016/ 2017) produced higher peel thickness than those treated in "On" year (2017/ 2018). Showed that all treatment in "Off " years (2018/ 2019) improved peel thickness of minneola tangelo trees as compared with the control treatment. Whereas, control treatment recorded the lowest peel thickness in this respect. (Khamis *et al*. 2017) reported that foliar spray with (yeast extract 50-100 ml/l) the highest significant increased peel thickness of Washington navel orange trees as compared with other two treatments and control in the two seasons of this study. These results also agree with (Ye *et al*., 2002) When the citrus fruit peel is thicker, the possibility that it will be stretched and deformed is lower and the crack resistance is also stronger. (Malik *et al*., 2000) who pointed that Minimum peel thickness were recorded with the application of 1900 g urea +2730 g superphosphate per tree in Kinnow

**5.2. Peel weight (g)**

Data in Tables (5) clearly indicate that the peel weight (g) was significantly increased with different treatments in " off "years, "On" years and " off "years, respectively. Foliar application with a combination of ( Urea at 20g /L+ Dry yeast at 4g /L) gave significantly the highest peel weight (g)compared with other treatments including control. its maximize existed with ( Urea at 20g /L + Dry yeast at 4g /L) treatments ( 66,26 & 56.20 and 60.38 g) peel weight (g) in " Off "years, "On" years and " off "years. All treatments foliar spray gave higher values of peel weight (g) in "Off " years (2016 /2017). Moreover, trees treated in "On" years gave lower peel weight (g) than those treated in two "Off" year. Control treatment gave the lowest value of peel weight (g) in "off " years "On" years and " off " years. followed by (Urea at 20g /L + Benzyladenine at 60ppm) gave a high values of peel weight (g).These results agree with El-Tanany and Shaimaa (2016) reported that spraying valencia orange trees with dry yeast extract at 0.2% in first season, gave the highest values in peel weight (g) compared with control treatment. Followed by benzyladenine at 40 ppm gave the highest values in peel weight (g) (69.06, 43.13g) compared with control treatment. Furthermore, The application of 1500 mg N with1000 BA ppm resulted in the highest *Aloevera* peel weight compared to control treatments (64.49 and 47.51%) respectively, Saeid Hazrati *et al.* (2012). These results also agree with

Kashyap *et al*., (2012) in pomegranate. Nitrogen leads to increased peel weight of Kinnow mandarin fruits. Mohammed *et al.*, (2010) who found that increasing concentration of yeast caused a gradual increase in fruit peel weight.

**5.3. Pulp weight (g)**

Results in Table (5) show that, all foliar spraying treatments significantly increased pulp weight (g) compared with control treatment .In addition, the statistical analysis showed that ( Urea at 20g /L+ Benzyladenine at 60 ppm) treatments gave the best results as for pulp weight (g) in "off " years, "On" years and "off " years, respectively. Moreover, trees treated in" off "years ( 2016 / 2017) showed higher response of pulp/fruit weight percentage than other trees treated in " off "years ( 2018/ 2019). Moreover, all treatment gave the lowest values of pulp/ fruit weight in "On" years compared with two" off "years. All treatments gave a higher positive effect in reducing biennial bearing minneola tangelo trees in" off "years (2018/2019) in pulp/fruit weight as compared with the control. These results agree with Jagirdar and Sheikh (1970) found an increase in the pulp percentage of Bombay Alphonso fruit through fertilization with nitrogen. Sprayed with yeast at 0.2%, treatments significantly increased fruit pulp/fruit % than the control in the two seasons (Elham *et al*.,2010). However, Valencia orange trees sprayed with at Benzyladenine 40 ppm in both seasons, gave highest pulp weight compared with control treatment (El-Tanany and Shaimaa, 2016). These results also agree with Kassem *et al.*(2010) found that trees Spraying Washington Navel orange with Urea (2%) at pea and marble stages increased Pulp weight (g) compared to the control. (Abdou, 2010) reported that the fruit pulp of Navel orange and Le. Conte pear increased by the treatment with higher concentration of yeast

**6. Effect of foliar application with urea, dry yeast ,benzyladenine and their combinations on some fruit physical characteristics (Juice volume cm$^3$, Fruit volume (cm$^3$), Fruit diameter (cm), Fruit length (cm)) and alternate bearing phenomena of Minneola tangelo trees.**

**6.1. Juice volume cm$^3$**

Results in Table (6) show that (Urea at 20g /L + Benzyladenine at 60 ppm) treatments caused a higher and significant increasing in Juice volume cm$^3$ in " off " years, "On" years and " off " years . On the other hand, minneola tangelo trees treated in" off "years (2016/ 2017).gave a high in Juice volume cm$^3$ than those trees treated in "Off" year (2018/ 2019). Foliar application with a combination of (Urea at 20g /L+ Benzyladenine at 60 ppm) gave the highest values (187.50 and184.25 cm$^3$) in "off " years (2016/ 2017) and "Off" year (2018/ 2019). Meanwhile, the control gave the lowest Juice volume cm$^3$ (125 and 120 cm$^3$) in both seasons. These results agree with (Malik *et al*., 2000) maximum juice volume content in Kinnow fruits, obtained in fruits of the trees sprayed with 1.0 and 0.8 per cent urea and zinc sulphate, respectively. Moreover, Abd El-Migeed *et al.* (2007) and Al-Ashkar *et al*., (2007)on grand naine banana, they found that juice volume was gradually increased by treatments of zinc sulphate and yeast at the highest concentration. Elham andSalwa (2013). reported that fruit juice volume of Navel orange trees was recorded trees treated with yeast at 10000 mg/ litre ( 99.41, 107.25 ml ) in treatment of yeast but the control gave the least fruit volume (66.80, 74 ml) in the two seasons. El-Tanany and Shaimaa (2016). who pointed that Benzyladenine spraying treatment at 20 ppm, dry yeast extract 0.4 % alone and a mixture of (BA 20 ppm + yeast 0.2% + K0.2%) spray treatment, in both seasons, caused significantly increases in juice volume of Valencia orange fruits, as compared with the control .While, Hifny *et al.*(2013), who found that application of N to Valencia orange trees increased fruit juice volume and decreased rag percent of Valencia orange in comparison to the control.

**6.2. Fruit volume (cm$^3$)**

Data in Table (6) show clearly that, foliar spray with (Urea at 20g /L + Benzyladenine at 60 ppm) treatment recorded the highest significant values of fruit volume (cm$^3$) compared with other treatments including control, lowest fruit volume (cm$^3$) was for spraying Urea at 20g /L and Benzyladenine at 60ppm alone compared withcombinations. Results cleared that, all treatments increased fruit volume (cm$^3$) compared with the control treatment in " off "years (2016/ 2017). On the other hand, minneola tangelo trees treated in" off "years (2018/ 2019) gave a high positive effect in reducing biennial bearing in fruit volume (cm$^3$) than trees treated in " off "years (2016/ 2017) and

"On" years (2017/ 2018) respectively. Moreover, all treatment gave the lowest values of fruit volume ($cm^3$) in "On" years compared with two" off "years. However, The control gave the lowest fruit volume ($cm^3$) in " off "years, "On" years and " off "years, respectively. These results agree with Umesh *et al*. (2010) who found that foliar application of urea at 2.5% to mango trees cv. Amrapali acquired more fruit volume compared to the control.(Abdel-Mohsen and Kamel,2015) reported that fruit volume ($cm^3$) of Canino was significantly increased due to applications of Yeast 0.2% (28.83), BA 50 ppm (29.83) compared with control trees. (Khamis *et al.,* 2017) who pointed that foliar sprays Washington navel orange with yeast extract 100 ml/l highest significant increased fruit volume ($cm^3$) (102.51, 100.52) in 2013 and 2014 seasons, respectively as compared with the control.

**6.3. Fruit diameter (cm)**

Data in Table (6). Minneola tangelo fruit trees sprayed with a mixture of (Urea at 20g /L + Benzyladenine at 60 ppm) gave significantly the highest fruit diameter (cm) compared with other treatments including control trees.Generally, in "On"years, all foliar spraying treatments increased fruit diameter (cm) compared with the control. While, lowest fruit diameter (cm) was for, spraying trees with dry yeast at 4g /L and benzyladenine at 60 ppm alone compared with combination with (Urea at 20g /L + Benzyladenine at 60 ppm). Meanwhile, foliar application of dry yeast at 4g /L and benzyladenine at 60g/L alone treatments increased fruit diameter as compared with control treatment. On the other hand, trees treated in" off "years (2016/ 2017) produced higher fruit diameter (cm) than those treated in "On" year (2017/ 2018). All treatment gave high positive effect on fruit diameter (cm) as compared with the control treatment in "off" years (2018/ 2019). These results agree with Thanaa *et al.* (2015) who pointed that foliar application Manzanello olive trees of benzyladenine at 60 ppm/tree gave highest fruit diameter (cm) (1.87and1.85 cm) in the first season and second season respectively, Qin et *al.* (2008) on Katy apricot variety. They showed that, fruit growth was promoted after applied with 50 mg/L GA3 and 50 mg/L 6-BA: fruit diameter were all higher than control′s. Abdel-Mohsen and Kamel (2015) reported that fruit width(cm) of Canino apricot trees was significantly increased due to applications of benzyladenine (100 ppm) with that of control. Moreover, Gattass *et al.* (2018) found that spraying keitt mango with BA (40 ppm) increased significantly fruit width (cm) as compared with the control. Kashyap *et al*.(2012) in pomegranate. Nitrogen leads to increased Fruit diameter (cm) of Kinnow mandarin fruits. This is due to the fact that nitrogen increases the efficiency of metabolic process of the plants;and thus encourages the growth of the plant and consequently increases the size of the fruit . (Elham and Salwa, 2013) reported that foliar sprays Navel orange trees recorded 9.12, 9.77 cm in fruit diameter followed by treatments of yeast at 5000, 10000 mg $L^{-1}$.

**6.4. Fruit length (cm)**

Data in Table (6).cleared that, all treatments increased fruit length as compared with control treatment in "off " years, "On" years and " off "years, respectively, and this increasing in fruit length are significant for all foliar applications as compared with control. foliar application with a mixture of (Urea at 20g /L+ Dry yeast at 4g /L )gave the highest values of fruit length( cm ) in during the three seasons of study and these values were significant as compared with control. All foliar spray treatments gave high positive effect on fruit length (cm) as compared with the control treatment in " off "years (2018/ 2019). The lowest value of fruit length (cm) as compared with control treatment in "On" years compared with two "off "years. Moreover, trees treated in "off "years (2016/ 2017). Showed high values of fruit length (cm) than other trees treated in" off "years (2018/ 2019). These results agree with Thanaa *et al.* (2015) found that foliar application Manzanello olive trees of dry yeast extract at 40g / Lgave highest fruit length (cm) ( 2.63 and 2.63 cm ) in during 2013 and 2014 season respectively. Abdel-Mohsenand Kamel (2015) reported that fruit length (cm) of Canino was increased due to applications of Yeast 0.1% (3.58) compared with control trees. Also (Fawzi *et al*.,2014). who pointed that the combined treatment of urea 1.0% plus boric acid at 0.2% at plus 0.2% yeast gave a significant increased fruit length (cm) of"superior" than all other treatments. Moreover, Meena *et al*. (2005) has conducted an experiment on Guava cv. Sardar under HDP with 4 levels of Urea (0, 2.0, 2.5 and 3.0% as foliar), Zinc sulp each and their combinations reported that Double foliar sprays of urea at 3 per hatecent gave the maximum fruit length (5.744 cm). Furthrmore, (Gattass *et al*., 2018) Spraying keitt mango tree with BA(40 ppm) increased significantly fruit length as

**Table 5:** Effect of foliar application with urea, dry yeast ,benzyladenine and their combinations on some fruit physical characteristics( peel thickness (cm) , peel weight (g), pulp weight (g)) and alternate bearing phenomena of minneola tangelo trees during 2016/2017, 2017/2018 and 2018/2019 seasons .

| Treatments | Peel thickness (cm) | | | Peel weight (g) | | | Plup weight (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Off year 2018/ 2019 | Off year 2018/ 2019 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 |
| **Control (spray water only)** | 0.30f | 0.28e | 0.24g | 35.20 f | 30.25e | 32.30g | 203.80 f | 110 .38f | 162.19g |
| **Urea at 20g /L** | 0.35e | 0.32d | 0.30f | 54.60e | 45.20d | 48.85f | 306.40 e | 195.03e | 254.37e |
| **Dry yeast at 4g /L** | 0.39d | 0.36c | 0.33d | 64.35b | 51.30b | 58.28b | 308.70c | 198.65b | 252.52f |
| **Benzyladenine at 60ppm** | 0.43b | 0.42b | 0.38b | 56.20d | 46.25d | 50.87e | 311.80 c | 196.20d | 255.49d |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 0.38d | 0.34d | 0.32e | 66.26a | 56.20a | 60.38a | 314.65b | 199.00a | 257.10c |
| **Urea at 20g /L + Benzyladenine at 60ppm** | 0.41 c | 0.37c | 0.36c | 63.30b | 50.20b | 57.80c | 316.74a | 200.13 | 262.54a |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60ppm** | 0.44 a | 0.43a | 0.39a | 58.22c | 49.60bc | 53.50d | 312.13c | 197.80c | 259.82b |

Means in the same column followed by the same letter(s)are not significantly different at 5% probability

**Table 6:** Effect of foliar application with urea , dry yeast ,benzyladenine and their combinations on some fruit physical characteristics( Juice volume($cm^3$),Fruit volume ($cm^3$), Fruit diameter (cm) , Fruit length( cm )) and alternate bearing phenomena of minneola tangelo trees during 2016/2017, 2017/2018 and 2018/2019 seasons .

| Treatments | Juice volume ( $cm^3$) | | | Fruit volume ($cm^3$) | | | Fruit diameter (cm) | | | Fruit length (cm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016 /2017 | On year 2017 /2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 |
| **Control (spray water only)** | 125.00f | 116.75g | 120.00 g | 200.50f | 160.33g | 184.23f | 6.86 f | 5.67e | 6.78d | 6.15g | 5.41g | 6.05g |
| **Urea at 20g /L** | 172.00e | 156.50f | 167.50f | 365.22e | 278.24f | 305.27e | 8.77b | 7.84b | 8.32b | 8.94b | 7.76b | 8.35b |
| **Dry yeast at 4g /L** | 175.00d | 168.75e | 171.75e | 378.33b | 288.32c | 315.28b | 8.64d | 7.72b | 8.20b | 8.87c | 7.60d | 8.28c |
| **Benzyladenine at 60ppm** | 178.75c | 172.25c | 177.50b | 375.55d | 282.45e | 312.44d | 8.46de | 7.44d | 7.95c | 8.52f | 7.44f | 7.96f |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 181.50b | 175.00b | 176.25bc | 390.35b | 290.15b | 316.23b | 8.56d | 7.65bc | 8.01c | 9.48a | 7.86a | 8.67 a |
| **Urea at 20g /L + Benzyladenine at 60ppm** | 187.50a | 180.25a | 184.25a | 402.50a | 295.23a | 318.32a | 8.97a | 7.96a | 8.47a | 8.63e | 7.54e | 8.14e |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60ppm** | 176.00d | 170.75d | 174.00d | 376.25bc | 285.26d | 314.26bc | 8.75c | 7.82b | 8.28b | 8.75d | 7.68c | 8.16d |

Means in the same column followed by the same letter(s)are not significantly different at 5% probability.

compared with the control. Elham andSalwa (2013) who found that foliar sprays Navel orange trees recorded 9.43, 9.92 length cm in fruit diameter followed by treatments of yeast at 5000, 10000 mg $L^{-1}$. (Ennab *et al.,*2017) Stated that In this respect, 1000 g N/tree recorded the highest fruit length (cm) of Chinese mandarin trees ( 5.71and 6.22 ) as compared with Control treatment in both seasons .

**Photo 1:** Illustrates the effect of foliar application with urea, dry yeast and benzyladenine and their combinations on fruit set of "minneola tangelo" trees in"off" years, "On" years and "off "years


**Photo 2:** Shows the effect of foliar application with urea, dry yeast and benzyladenine and their combinations on Fruit diameter (cm), Fruit length(cm ), peel weight (g) , pulp weight (g), Juice volume $cm^3$ on alternate bearing phenomena of minneola tangelo in "off " years,(2018 / 2019)

**7. Effect of foliar application with urea, dry yeast, benzyladenine and their combinations on fruit chemical characteristis (sugars %, carotenoids ( mg/g fresh wt),Total carbohrydrates (mg/g),C/N ratio)and alternate bearing phenomena of Minneola tangelo trees .**

**7.1. Sugars%**

Data presented in Table (7) clearly indicated that, in both seasons, trees sprayed with combination of (Urea at 20g /L + Benzyladenine at 60 ppm) gave significantly the highest Sugars%, compared with other treatments including control. Trees treaded in" off "years (2018/ 2019) gave a pronounced positive effect in reducing biennial bearing .Showed that(Urea at 20g /L + Benzyladenine at 60 ppm) treatment done in "Off" years(2016/ 2017 ) recorded high Sugars % values of Minneola tangelo trees as compared with the control treatment in "Off" years (2016/2017). All foliar spray treatments achieved significantly increased in Sugars % as compared with control treatments. However, trees treated in "Off" year (2016/ 2017) produced higher Sugars%, than other treated in "Off" year (2018/ 2019). Generally, trees treated in "On" years produced lower tree Sugars % than those treated in two "Off " years. These results agree with Banik *et al*.,(1997) found an increase in mango cv. Fazli fruits total sugars content after the application of 0.4% B+ 1% urea. Nitrogen treatments significantly increased flower percentage compared to the control. Kassem *et al*., (2010) reported that foliar sprays activated dry yeast at 4.20 g/L. recorded the highest values of total sugars of Costata persimmon trees compared to the control in both seasons. Mohamed *et al*., (2017) who pointed that spraying BA at 100ppm gave the highest significant increase of sugars percentage of Asters compared to control in both season. El-Boray *et al*., (2015) found that Washington Navel orange tress sprayed with1500 ppm yeast extract gave highest percentage in both season. While EL- Shazly and Mustafa (2013) stated that Washington Navel orange who reported that active dry yeast caused a significantly increase in total sugars of fruits. (Miller and Rice Evans, 1997) reported that in previous study on total sugars of citrus, it is observed that this level increased with fruit maturity. Moreover, in addition to the use of sugars from current photosynthesis supply, sugars are also available from stored carbohydrate reserves (Dovis *et al.,* 2014; Monerri *et al*., 2011; Ruiz *et al*., 2001). Furthermore, Lewis *et al.* (1964), It seems that although leaf total sugar levels remain much more constant than starch levels it will decrease with an increase in demand by developing fruit.The total sugars(6.30%) increased significantly by the application of 500 g nitrogen per plant .The highest mean values for sugars with the application of nitrogen could be attributed to the involvement of nitrogen in various energy sources Garhwal *et al*.,(2014).Foliar spray Washington Navel orange trees with yeast extract (100 and 50 ml/L) increased total sugars percentages in the two seasons of this study (Khamis *et al*.,2017). Also Samina *et al*. (2012) reported that tree sprayed with 30mg L- 1 BA at Fs stage produced fruit with significantly higher total sugars (7.33- 7.56 %) in comparison to control.

**7.2. Carotenoids (mg/g fresh wt)**

Data in Table (7) demonstrated that all treatments achieved significantly increased carotenoids (mg/g) as compared with control treatment in both seasons. Foliar application with a combination of (Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60 ppm) significantly increased carotenoids (mg/g) as compared with other treatments and the control. Trees treated in "On" years in showed high response of carotenoids( mg/g ) percentage than other trees treated in two "Off" year . Furthermore, all foliar spraying treatments improved carotenoids (mg/g) in "Off" years (2018 /2019). Moreover, trees treated in"Off" year (2016/ 2017) showed lower response of carotenoids (mg/g) than other trees treated in "On" years (2017/2018) and "Off" year (2018/ 2019). These results agree with Emad *et al.* (2013) reported that foliar spray of benzyladenine (50, 100 ppm) was more effective than other treatments in enhancing cartenoid content of sunflower. Fawzi *et al*., (2014) found that Spraying with 0.2% yeast application produced significant increase in cartenoid of "superior" than the control in both seasons. However, application of (urea at 1.0% plus boric acid at 0.2% plus active dry yeast at 0.2% )gave the highest values in cartenoid of "superior" than other treatment and the control (Salwa *et al.*,2014) who pointed that Spraying amino acids (D) or yeast(Y), significant increment in carotenoids of wheat leaves compared to untreated plants. El- Garhy (2002) showed that application of yeast significantly increased carotenoids concentration in faba bean plants grown under least water requirements foliar sprays of Urea at 2.5 g/L increased carotene contents of costata persimmon trees as compared with the control. However, spraying “Costata” persimmon trees with activated dry yeast at 4.20 g/L recorded the highest value of carotenoides content compared with the control. Kassem *et*

*al*, (2010). Foliar spray Washington Navel orange trees with yeast extract (100 and 50 ml/L) the highest increase of carotenoids in the two seasons of this study (Khamis *et al*.,2017).

**7.3. Total carbohrydrates (mg/g)**

Data in Table (7) indicated that spraying trees with (Urea at 20g /L + Benzyladenine at 60 ppm) in three seasons, significantly increased Total carbohrydrates (mg/g) compared with other treatments and the control. The maximum values (19.50,32.46 and 24.65mg/g) for the 1$^{st}$, 2$^{nd}$ and 3$^{th}$ season, respectively of total carbohydrates was observed at (Urea at 20g /L + Benzyladenine at 60 ppm).The minimum values (11.25,16.30 and13.70 mg/g )for the 1$^{st}$, 2$^{nd}$ and 3$^{th}$ season, respectively of total carbohydrates was (the control treatment). All foliar spraying treatments gave higher positive effect on total carbohydrates as compared with the control treatment in "Off" year (2018/2019). Trees treaded in"Off " years (2018 and 2019) gave a pronounced positive effect in reducing biennial bearing than those treaded in "Off " years and "On" years compared with the control treatment. Results show that (Urea at 20g /L + Benzyladenine at 60 ppm) has higher impact than other treatments on leaf total carbohydrates content. These results agree with (Dovis *et al*., 2014; Martínez-Alcántara *et al*., 2015; Monerri *et al*., 2011) reported that the current role for carbohydrates in the model for alternate bearing therefore appears to be that of a secondary role, with its positive effects being experienced in the absence of fruit and flowering inhibiting plant hormones. Mohamed (2017) who pointed that Sprayed with BA at 100 ppm gave the highest significant increase of total carbohrydrates percentage of Aster (*Symphyotrichum novi- belgii* L.) as compared to control in both season. (Emad *et al.,* 2013) Who started that foliar spray of benzyladenine (BA)100 ppm significantly increased carbohydrates of sunflower plants.El- Meleigy (1989) and Sun *et al*., (1996) reported that benzyladenine enhanced the accumulation of total carbohydrates in Roselle. Abou *et al.* (2010) on olive trees when sprayed it with benzyladenine at a concentration of 40 mg.L-1, which achieved a significant increase in percentage of carbohydrate in leaves. Iglesias *et al.* (2003) indicated that 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 periods. Iglesias *et al.* (2006) revealed that the carbohydrates content may be a biochemical signal involved in the mechanisms controlling fruit abscission. Fahmi (1958) showed changes in carbohydrate components in leaves of olive trees during bearing (ON) and non-bearing (OFF)-years and stated that sugars and starch are much higher at the beginning of a bearing than of a non-bearing years. (Cao and Shannon, 1997) indicated that cytokinins are known to activate enzymes which regulate carbohydrate metabolism. The increase in carbohydrate accumulation may be due to the decline in the carbohydrate degradation

**7.4. C/N ratio**

The results shown in Table (7) foliar spray with a mixture of ( Urea at 20g /L + Benzyladenine at 60 ppm) recorded the highest significant values of C/N ratio(8.02,12.62 and 9.98) in treatment in "off " years, "On" years and " off "years, respectively. While, lowest C/N ratio was for spraying trees with Urea at 20g /L and benzyladenine at 60 ppm alone compared with combination with (Urea at 20g /L + Benzyladenine at 60 ppm). Trees treated in "On" years produced higher C/N ratio than those treated in two" off "year. Trees treated in "off "year (2018/ 2019) gave positive effect in reducing biennial bearing as compared with the control treatment. All foliar spray treatments in "off "year (2016/ 2017) lower C/N ratio than those treated in "off "year (2018/ 2019) compared with control. Consequently, these changes in environmental factors and species composition have altered leaf C:N ratio and thereby affected nutrient cycling and primary productivity of the ecosystem. (Alongi 2018 ; Mizanur *et al.,* 2015; Rahman *et al.,* 2019). Moreover, Winkler *et al.,*(1974) observed that a disturbance of the C/N balance in grapevines would have negative effects on vine growth and productivity. Poor vegetative growth and limited fruit bud formation are often associated with vines showing high carbon and low nitrogen tissue content that is typically found when grown in soils with low nitrogen content, followed by high N and moderate C concentration tends to increase growth in grapevines. Saayman (1983) found that affected vines had significantly higher N contents in leaves and shoots. Vigorous lateral shoot growth is undesirable, because this may lead to dense canopies and an imbalance favouring vegetative growth versus fruit production (Smart, 1985) Monselise and Goldschmidt (1982) found that carbohydrate reserves in mango have a direct relationship with flower formation rather than hormonal factors. Nafees *et al*. (2013) found significant increase in blooming in

the "off " year and flushing in the "on year" when mango trees received 3% urea compared with the control. Followed by plant C/N ratio is associated with balance between reproductive and vegetative growth. Furthermore, Fertilizer with (2 Feldspar +200 Yeast) gave higher values C/N ratio in shoots of Balady mandarin trees compared with other treatments and the control. El-Salhy *et al*. (2017). Weinbaum *et al*. (1994) investigated the effect of nitrogen and boron fertilizer on alternate bearing cycle in Pistachio trees. Results showed that "on year" trees has greater reproductive demand for N and carbohydrate, reduced accumulation of C and N reserves and reduced recovery of applied labeled-N fertilizer than "off year" trees. They also observed that the increase in uptake of labeled nitrogen by tree entering an "off year" is associated with lower levels of carbohydrate and N reserves than "on year" trees.

**8. Effect of foliar application with urea, dry yeast, benzyladenine and their combinations on fruit chemical characteristics ( chlorophyll-a (mg/100g fresh wt), Chlorophyll- b (mg/100g fresh wt), Tolal chlorophyll (mg/100g fresh wt)) and alternate bearing phenomena Minneola of tangelo.**

**8.1. Chlorophyll (a) & (b) & (a+b) (mg/100g fresh wt)**.

Data in Table (8) explained the effect of spraying Urea at 20g /L, dry yeast at 4g /L and Benzyladenine at 60 ppm at low or high concentration alone or in combination on leaf content of chlorophyll (a) & (b) & (a+b).

All foliar spray treatments improved chlorophyll (a) & (b) & (a+b) compared with the control. Minneola tangelo trees sprayed with a mixture of ( Urea at 20g /L + Benzyladenine at 60 ppm) which recorded the highest leaf content chlorophyll (a) & (b) & (a+b) which was (5.30,7.41and 6.04 mg/ g FW) for the chlorophyll (a+b) compared with other treatments including control in " off "years, "On" years and " off "years, respectively, followed by foliar application with a combination of ( Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60 ppm) increased leaf content of chlorophyll (a) & (b) & (a+b) compared with control . However, trees treated in "Off" year (2018/ 2019) gave high positive response in chlorophyll (a) & (b) & (a+b) compared with control. Generally, trees treated in "On" years produced higher chlorophyll (a) & (b) & (a+b) than those treated in two "off "years. These results agree with **(**Emad *et al.,* 2013) indicated that foliar spray of benzyladenine at 50 ppm significantly increased of chlorophyll a; b; total chlorophyll (a+ b) of sunflower plants compared with control. Moreover, the reason for the increasing the leaves content of chlorophyll due to foliar spraying with urea is due to the role of nitrogen, which is considered the main constituent of the basic plant pigments, including chlorophyll (Marschner, 2015).Treatment with kinetin (cytokinin) and urea in addition to increasing the leaves content of chlorophyll and its reflection in increasing the efficiency of photosynthesis process and increase of manufactured carbohydrates (Jordan and Ogren, 1984). Sayyad-Amin and Shahsavar (2012) where their results showed that the leaves content of chlorophyll has significantly increased when spraying the olives trees with urea at a concentration of 0.75%. Sprayed with BA at 100 ppm gave the highest significant increase of total chlorophyll of Aster (*Symphyotrichum novi-belgii* L.) (210.0 212.2 mg/100g F.W) as compared to control in both season. Mohamed (2017). Spraying with 0.2% yeast at four times application produced significant increase in chlorophyll (a and b), (a+b) of "superior" than the control in both seasons. Fawzi *et al*.,(2014).Showed that application of N and interaction of Nwith BA treatments had a significant effect on chlorophyll "a","b" and tolal chlorophyll content in leaves of N *Alvera* plants. In this experiment, BA had significant effects on chlorophyll "a" and tolal chlorophyll content. The highest chlorophyll "a","b" tolal chlorophyll content were observed in the plant treated with 1500mg N without BA (40,66.6 and 50% respectively) that considerably were more than content plant **(**Saeid Hazrati *et al*.,2012).Exogenous cytokinin increased the chlorophyll content in the chloroplast (Davies,2004).Wanas (2002)reported that yeast enhanced the formation of chlorophyll and delayed its degradation and senescence of bean plants. Spraying amino acids (D) or yeast (Y), significant increment in total chlorophyll (chl. a+ b) of wheat leaves compared to untreated plants. Salwa *et al*,(2014).El-Maadawy *et al*. (2006a)working on *Calendula afficinalis* L. plants, observed that BA (100) had a favorable effect on chlorophyll synthesis and accumulation in the leaves. (Gollan and Wright 2006). This extracts contain Cytokinins as well in which induce the physiological activities and increase the total chlorophyll in the plant. Baninasab *et al.* (2007) who demonstrated that the

**Table 7:** Effect of foliar application with urea, dry yeast ,benzyladenine and their combinations on some fruit chemical characteristics sugars %, carotenoids (mg/g fresh wt), Total carbohrydrates (mg/g) ,C/N ratio and alternate bearing phenomena of minneola tangelo trees during 2016/2017, 2017/2018 and 2018/2019 seasons **.**

| Treatments | Sugars% | | | Carotenoids ( mg/g fresh wt) | | | Total carbohrydrates (mg/g) | | | C/N ratio | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 |
| **Control (spray water only)** | 5.26f | 4.62 f | 5.34f | 0.509g | 0.610f | 0.520 f | 11.25e | 16.30f | 13.70g | 6.04e | 7.30g | 6.85g |
| **Urea at 20g /L** | 7.05e | 6.96c | 7.00c | 0.644c | 0.865e | 0.712e | 15.85cd | 27.20e | 19.75f | 6.60cd | 10.00ef | 8.12f |
| **Dry yeast at 4g /L** | 7.10e | 6.42e | 6.67e | 0.662b | 1.009c | 0.806c | 16.50c | 28.10d | 20.50e | 6.73c | 10.25e | 8.23e |
| **Benzyladenine at 60ppm** | 7.25c | 7.09b | 7.10c | 0.606d | 0.984d | 0.730d | 17.50b | 29.10c | 22.50c | 7.44b | 11.78bc | 9.38b |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 7.74b | 7.11b | 7.43b | 0.569e | 0. 973d | 0.793c | 18.75b | 31.50b | 23.20b | 7.56b | 12.18b | 9.16bc |
| **Urea at 20g /L + Benzyladenine at 60ppm** | 8.00a | 7.54a | 7.85a | 0.705a | 1.186a | 0.883a | 19.50a | 32.46a | 24.65a | 8.02a | 12.62a | 9.98a |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60ppm** | 7.18d | 6.73d | 6.92d | 0.546f | 1.068b | 0.847b | 16.78c | 28.60d | 21.68d | 6.93c | 10.77d | 8.81d |

Means in the same column followed by the same letter(s) are not significantly different at 5% probability

**Table 8:** Effect of foliar application with urea, dry yeast, benzyladenine and their combinations on some fruit chemical characteristics chlorophyll-a (mg/g fresh wt),Chlorophyll- b (mg/g fresh wt ), Total chlorophyll (mg/g fresh wt ) ,and alternate bearing phenomena of minneola tangelo trees during 2016/2017,2017/2018and 2018/2019 seasons.

| Treatments | Chlorophyll-a (mg/g fresh wt) | | | Chlorophyll- b (mg/g fresh wt) | | | Total chlorophyll (mg/g fresh wt) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 |
| **Control (spray water only)** | 2.05f | 2.72g | 2.24f | 0.68e | 0.90g | 0.74f | 2.73f | 3.62g | 2.98f |
| **Urea at 20g /L** | 3.32c | 4.27c | 3.64d | 1.21c | 1.44e | 1.30d | 4.53b | 5.71c | 4.94c |
| **Dry yeast at 4g /L** | 3.28c | 4.06d | 3.56c | 1.16c | 1.51d | 1.22d | 4.44b | 5.58d | 4.78c |
| **Benzyladenine at 60ppm** | 3.67e | 4.79e | 3.84e | 1.26d | 1.69f | 1.41e | 4.94e | 6.48 f | 5.26e |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 3.46d | 4.32f | 3.78d | 1.24b | 1.55c | 1.32c | 4.70d | 5.88e | 5.10d |
| **Urea at 20g /L + Benzyladenine at 60ppm** | 3.90a | 5.48a | 4.53a | 1.40a | 1.92a | 1.51a | 5.30a | 7.41a | 6.04a |
| **Urea at 20g /L+ Dry yeast at 4g /L + Benzyladenine at 60ppm** | 3.80b | 4.82b | 4.21b | 1.37a | 1.74b | 1.43b | 5.17a | 6.56b | 5.64b |

Means in the same column followed by the same letter(s) are not significantly different at 5% probability

leaves content of chlorophyll in pistachio trees (*Pistacia vera* L.) had increased linearly by increasing the concentration of nitrogen by spraying urea at the concentration of 0.6%.

**9. Effect of foliar application with urea, dry yeast, benzyladenine and their combinations on some fruit chemical characteristics( Total indoles (mg/100g F.W), Total phenols (mg/100g F.W), Vitamin C (mg/100mljuice)) and alternate bearing phenomena of M inneola tangelo trees.**

**9.1. Total indoles (mg/100g F.W).**

The results shown in Table (9) revealed that, generally, in three seasons, all foliar spray treatments increased Total indoles (mg/100g) as compared with the control. Minneola tangelo trees sprayed with ( Urea at 20g /L + Benzyladenine at 60 ppm) significantly increased total indoles (mg/100g) content compared with other treatments including control .All foliar spray treatments improved total indoles (mg/100g) of Minneola tangelo trees as compared with the control treatment in "Off " years (2018/2019). Meanwhile, trees treated in "Off" years (2018/2019) gave a high positive effect on total indoles (mg/100g) than trees treated in "Off" years (2016/2017). Trees treated in "On" years produced higher total indoles (mg/100g) than those treated in two "Off" years. (Mohamed *et al.*,2017) reported that foliar application of BA at (50,100 ppm) significantly increased total indoles of aster (*Symphyotrichum novibelgii* L.) compared with control in both seasons

**9.2. Total phenols (mg/100g F.W)**

The obtained data in Table (9). revealed that, all treatments increased total phenols (mg/100g F.W) in "off " years, "On" years and "off "years, respectively as compared with control treatment. Foliar spray with (Benzyladenine at 60 ppm) produced higher total phenols (mg/100g F.W) as compared with other treatment including control. All foliar spraying treatments in "On" years produced higher total phenols (mg/100g F.W) than those treated in two "off " years. Generally, trees treated in "off " years (2016/ 2017) produced lower total phenols (mg/100g F.W) than those treated in "off " years (2018/ 2019) and "On" year (2017/ 2018). All treatment in "off " years (2018/2019) gave high positive effect on total phenols (mg/100g F.W)compared with the control treatment . Whereas, the control treatment recorded the lowest phenols (mg/100g F.W) values. These results agree with Abdel-Al *et al*., (1988) who showed that cytokinins increased phenolic content in cotton plants. The increase in phenolic content may be attributed to the increase in carbohydrate synthesis. The effect of yeast on phenolic compounds was in significant in both seasons as reported by Ibrahim (2014). Moreover, Dawood and Sadak (2007) reported that spraying canola plant with benzyladenine caused significant increases in phenolic compounds. Effect of spraying benzyladenine at 40 ppm/L showed the highest increases in total phenolic compounds percentage in the yielded lupines seeds.(Hemdan *et al*., 2016). Furthermore, Mert *et al.*,(2013)found significant differences in phenolic compounds between ON and OFF trees of olive. While Dawood *et al*. (2013) reported that yeast extract at 3% and 4% showed the highest significant increases in phenolic content and the latter dose resulted in the highest significant content of the yielded soybean seeds.

**9.3. Vitamin C (mg/100mljuice)**

Data in Table (9). Sprayed with combination of (Urea at 20g /L+ Benzyladenine at 60 ppm) gave significantly the highest vitamin C (mg/100mljuice), compared with other treatments including control. Minneola tangelo trees as well as sprayed with combination of (Urea at 20g /L + Dry yeast at 4g /L) also increased vitamin C (mg/ 100 mljuice), in three seasons of study. Other treatments increased vitamin C (mg/100mljuice) as compared with control treatment. In "off" years (2018/ 2019) gave a higher positive effect on vitamin C (mg/100mljuice). Generally, trees treated in "Off" years (2018/ 2019) produced higher vitamin C (mg/100mljuice) than those treated in "On" year (2017/ 2018) and" off "years (2016/ 2017) while control trees gave the lowest vitamin C (mg/100mljuice), in the three seasons of the study. These results agree with El-Tanany and Shaimaa(2016) reported that Valencia orange trees sprayed with benzyladenine at 40 ppm alone or dry yeast extract at 0.4% alone increased vitamin C (mg/100 ml juice) as compared with the control in both seasons of study. Foliar spray of Costata persimmon trees with activated dry yeast at 4.20 g/L alone gave significantly higher vitamin“C” as compared with the other treatments. Moreover, foliar spray Urea at 2.5 g/L increased

vitamin C (mg/100mljuice) as compared with the control in both seasons (Kassem *et al.,* 2010). These results also agree with (Helail *et al.* 2003 ; Kabeel *et al*, 2005) on Washington Navel orange and Canino opricot that, ascorbic acid increased by increasing concentration of yeast treatment in the first and second seasons. EL-Shazly and Mustafa (2013) with Washington Navel orange who reported that active dry yeast caused a significantly increase in vitamin C contents of fruits.

**10. Effect of foliar application with urea, dry yeast, benzyladenine and their combinations on fruit chemical characteristics (TSS (%), Total acidity (%) , TSS/acid ratio) and alternate bearing phenomena of Minneola tangelo trees.**

**10.1. Total soluble solid percentage (TSS %) :**

The results shown in Table (10) foliar sprays with ( Urea at 20g /L + Benzyladenine at 60 ppm) recorded the highest value of total soluble solid as compared with other treatment including control in "off " years, "On" years and " off "years, respectively. All foliar sprays increased TSS % when compared with the control in three seasons. Spraying trees with Urea at 20g /L alone or Benzyladenine at 60 ppm alone in three seasons, recorded the lowest TSS % contents compared with combinations. Generally, trees treated in "On" years produced lower TSS % than those treated in two "off "years. However, all treatment in" off "years (2018/2019) gave higher positive effect on TSS % as compared with the control treatment. The control treatment recorded the lowest TSS % values. These results agree with Fawzi and Eman (2004) found that spraying bread yeast significantly increased TSS% of Flame Seedless Grapevines. Abdel-Mohsen and Kamel (2015) reported that foliar spraying with BA at 100 ppm and yeast at 0.1 and 0.2% increased SSC (%) to maximum value (15.45, 14.52 and 14.27, respectively). Kassem *et al*., (2010) who pointed that foliar sprays “Costata” persimmon trees with Urea at 2.5 g/L alone or activated dry yeast at 4.20 g/L alone increased TSS% contents as compared with the control. Tarraf (1999) found that spraying sugar beet plants with benzyladenine (BA) significantly increased TSS %. Mohamed (2008) and Bakry (2007) who found that spraying yeast extract increased TSS% of Balady mandarin and Jafa orange, respectively. Abd El-Motty and Orabi (2013) on Navel orange they showed that yeast treatments increased soluble solids content ( SSC %). Bread yeast application caused significant increase in total soluble solid (TSS %) of clusters "Thompson" seedless" grapevines compared with control. Shabaq *et al*., (2018). The result also agree with Banik *et al*. (1997) who found an increase in mango cv. Fazli fruits TSS% after the application of 0.4% B + 1% urea. Single application of urea 0.5 or 1.0% increased the TSS% in compared with control (Fawzi *et al*., 2014).

**10.2. Total acidity (%)**

The results shown in Table (10) demonstrated that all treatments achieved significantly increased total acidity (%) as compared with control treatment in "off" years, "On" years and "off" years, respectively. Foliar application with a combination of ( Urea at 20g /L + Benzyladenine at 60 ppm) recorded the lowest juice total acidity % contents compared with a high acidity content of the control and other treatment in three seasons. Trees treated in "off "years (2016/ 2017) gave higher total acidity (%) than those treated in" off " years (2018/ 2019). Moreover, trees treated in "On" years produced higher total acidity (%) than those treated in two " off " years. In this study, all treatments in" off "years (2018/2019) significantly decreased acidity (%) comparing with control and other treatment in "off" years (2016/ 2017) and "On" years (2017/ 2018). These results agree with (Gattass *et al*., 2018). Spraying BA40 ppm significantly decreased fruit aciditiyof Keitt mango trees in comparison with the control.(Abdel-Mohsenand Kamel, 2015) found that foliar spraying with BA at100 ppm as well as yeast at 0.1% significantly increased acidity ratio of Canino apricotcompared with control. (El-Boray *et al*.,2015) indicated that foliar applications of yeast extract reduced acidity of Washington Navel sweet orange contents in fruit juice as compared with control treatment Applications of 500g nitrogen per plant reduced acidity ratio of Washington navel orange Fawzi and Eman (2004) found that spraying yeast significantly reduced the total acidity in compared with control.

**10.3. TSS/acid ratio**

The results shown in Table (10) Minneola tangelo trees sprayed with a combination of (Urea at 20g /L+ Benzyladenine at 60 ppm) gave the highest values in TSS/acid ratio compared with other

**Table 9:** Effect of foliar application with urea , dry yeast ,benzyladenine and their combinations on some fruit chemical characteristics Total indoles (mg/100g F.W) , Total phenols (mg/100g F.W), vitaminc (mg/100 mljuice) and alternate bearing phenomena of minneola tangelo trees during 2016/2017 , 2017/2018 and 2018/2019 seasons .

| Peel Thickness (cm) | Total indoles (mg/100g F.W) | | | Total phenols (mg/100g F.W) | | | Vitaminc (mg/100 mljuice) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/ 2017 | Off year 2016/ 2017 | Off year 2018/ 2019 | Off year 2016/ 2017 | Off year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 |
| **Control ( spray water only)** | 85.20 f | 118.44g | 90.95e | 116.32e | 130.36f | 120.22f | 52.50g | 48.32f | 51.33e |
| **Urea at 20g /L** | 112.24e | 141.12f | 117.00d | 142.80b | 164.62c | 149.20bc | 74.12d | 71.16d | 76.34b |
| **Dry yeast at 4g /L** | 121.12c | 155.60d | 125.90c | 126.42d | 140.40e | 134.00e | 76.32c | 73.54c | 78.23b |
| **Benzyladenine at 60ppm** | 116.80d | 144.64e | 120.44d | 158.58a | 198.40a | 170.60a | 72.24e | 70.13d | 74.12c |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 147.40a | 185.20b | 152.80a | 136.20c | 152.00d | 142.23d | 82.00b | 78.30b | 83.31a |
| **Urea at 20g /L + Benzyladenine at 60ppm** | 150.70a | 193.90a | 156.50a | 146.60b | 176.80b | 157.80b | 84.64a | 80.25a | 85.25a |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60ppm** | 127.80 b | 177.40c | 132.60b | 143.00b | 173.80b | 156.80b | 70.23f | 68.45de | 71.58d |

Means in the same column followed by the same letter(s)are not significantly different at 5% probability

**Table 10:** Effect of foliar application with urea, dry yeast ,benzyladenine and their combinations on some fruit chemical characteristics TSS (%), Total acidity (%),TSS/acid ratio andalternate bearing phenomena of minneola tangelo trees during 2016/2017, 2017/2018 and 2018/2019 seasons

| Treatments | TSS (%) | | | Total acidity (%) | | | TSS/acid ratio | | |
|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 019 | Off year 2016/ 2017 | On year 2017/ 2018 | Off year 2018/ 2019 |
| **Control ( spray water only)** | 9.36f | 9.20f | 9.38f | 1.033a | 1.049a | 1.000a | 9.06f | 8.77f | 9.38f |
| **Urea at 20g /L** | 10.86 de | 10.35e | 11.16e | 1.026e | 1.032f | 0.992 e | 10.58de | 10.02 de | 11.25e |
| **Dry yeast at 4g /L** | 11.00d | 10.75d | 11.85bcd | 1.016d | 1.027d | 0.985 d | 10.82b | 10.46b | 12.03b |
| **Benzyladenine at 60ppm** | 11.54c | 11.12c | 12.15b | 0.995g | 1.010 g | 0.965g | 11.59c | 11.00 d | 12.59c |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 12.00b | 11.36b | 12.35b | 0.990b | 1.000b | 0.956b | 12.12a | 11.36a | 12.91a |
| **Urea at 20g /L + Benzyladenine at60ppm** | 12.66a | 12.05a | 13.11a | 0.983c | 0.997c | 0.945c | 12.87c | 12.08c | 13.87d |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60ppm** | 11.20d | 11.00c | 12.00bc | 0.998 f | 1.020e | 0.978f | 11.22d | 10.78c | 12.26d |

Means in the same column followed by the same letter(s)are not significantly different at 5% probability

treatments including control in "off " years, "On" years and " off " years, respectively. Meanwhile, trees treated in "off " years(2018/ 2019) produced higher TSS/acid ratio than those treated in "On" year (2017/ 2018 ). Furthermore, trees treated in "off " years (2018/ 2019) gave a high positive effect on TSS/acid ratiothan trees treated in " off " years (2016/ 2017) and "On" year ( 2017/ 2018 ). In this study, all treatments in "On" year (2017/2018) gave the lowest values TSS/acid ratio than trees treated in two "off "years. Control treatment recorded the lowest TSS/acid ratio in this respect. These results agree with (Gattass *et al*.,2018) reported that spraying BA (40 ppm) significantly higher TSS /acidity ratio than the control. (Abdel-Mohsen and Kamel,2015) who pointed that foliar sprays with BA at 100 as well as yeast at 0.1% significantly increased TSS/acidity ratio compared with control. Fawzi and Eman (2004) found that spraying yeast significantly increased T.S.S/acid ratio in berry juice of flame seedless grapevines. (Fawzi *et al*., 2014) indicated that single application of urea 0.5 or 1.0% increased the TSS/acid ratio in compared with control .

**11. Effect of foliar application with urea, dry yeast and benzyladenine and their combinations on leaf macro-elements on alternate bearing phenomena of minneola tangelo trees**

**11.1. Nitrogen*:***

The results in Table (11) showed that all foliar spraying treatments, generally resulted in increase leaf total nitrogen content compared with control in "off " years, "On" years and " off " years, respectively. Minneola tangelo trees sprayed with a combination of (Urea at 20g /L+ Benzyladenine at 60 ppm) gave significantly higher in leaf nitrogen content than that of other treatments including the control in three seasons. However, trees treated in "On" years produced higher leaf nitrogen content than those treated in two" off "years. These results agree with (Elham *et al*., 2013) reported that sprayed with yeast alone and recorded the higher values of leaf N content (1.17 and 1.27%) in the first and second seasons, respectively .Valencia Orange trees sprayed with a mixture of (BA 20ppm + yeast 0.2% + K0.2% ) gave higher in leaf nitrogen content than that of other treatments and control (El-Tanany and Shaimaa,2016). Foliar spraying "superior" with urea (alone) and yeast (alone) clearly improved N percentage in leaves compared with control (Fawzi *et al*., 2014). Moreover, Mahmoud *et al*. (2015) where the percentage of nitrogen in the leaves increased significantly when spraying olive trees with benzyladenine at a concentration of 60 $mg.L^{-1}$.These results are also agreed with Cheng *et al*. (2002) where their results showed increasing the leaves content of nitrogen when spraying apple trees with urea at the concentration of 3%. Rekha (2005), who indicated the increasing in the leaves content of nitrogen when spraying the rough lemon with urea at the concentration of 2%. Stan and David (2007) show that providing olive tree with additional doses of nitrogen increases the ability of the tree to utilize other nutrients. Nitrogen enables the absorption of other nutrients that led to balance the growth of plant. This in turn improves photosynthesis and dry matter accumulation leading to higher yield (Aly *et al*., 1996). Sprayed aster with benzyladenine (50 - 100 ppm) recorded the high values (2.42 and2.51),(2.53and 2.49) of leaf nitrogen contents respectively as compared to control. Mohamed *et al*. (2017). All BA solutions (1, 2 and 3 %) significantly increased leaf N % of papaya seedling Solo cv. during 2015 and 2016 experimental seasons (Abd El-Latif *et al*., 2018).

**11.2. Phosphorus:**

Data presented in table (11) indicated that, also, all spraying treatments increased leaf phosphorus content compared with the control in "off " years, "On" years and " off " years, respectively. Moreover, spraying trees with a combination of (Urea at 20g /L+ Benzyladenine at 60 ppm) in three seasons, significantly higher in leaf phosphorus content than their leaves in the other treatments and the control. In this study, all treatment done in "off " years ( 2018/2019) gave higher positive effect on leaf phosphorus content as compared with the control treatment. These results agree with(Thanaa *et al.,*2015) reported that foliar application of Manzanillo olive trees with 40g/L dry yeast extract alone or 60 ppm benzyladenine / tree alone gave the high significant phosphorus content in the leaves during seasons 2013 and 2014. Furthermore, the treatment of BA at 50- 100ppm recorded high significant increase in leaf phosphorus content of Aster when compared with control in both seasons. Mohamed (2017).The leaf phosphorus of Kinnow mandarin increased significantly by the application of 750 g nitrogen per plant, against that of control (Garhwal *et al.,* 2014).

**11.3. Potassium:**

Data presented in table (11) as for potassium percentage in leaves results in the same Table indicated that all treatments increased the percentage of potassium than control in "off " years, "On" years and " off " years, respectively. Meanwhile, spraying trees with a combination of (Urea at 20g /L + Dry yeast at 4g /L) in three seasons, significantly higher in leaf potassium content than their leaves in the other treatments and the control. However, trees treated in "off " years( 2018/2019) showed high positive response in leaf potassium than those treated in in "Off" year ( 2016/ 2017 ). These results agree with (Mohamed, 2017) reported that foliar application of BA at 50- 100 ppm recorded high significant increase in leaf potassium content of Aster when compared with control in both seasons .Thanaa *et al.* (2015). who found that foliar application of Manzanillo olive trees with 40 g/L dry yeast extract alone gave the high significant leaf potassium values (0.98and1.05 %) in the first and second seasons respectively. Fawzi *et al.*,(2014) indicated that application of active dry yeast 0.2% (alone) and urea (alone) significantly increased leaf potassium content of "superior" than the untreated. Salwa and Osama (2014) who found that Yeast extract showed the greatest significant increase of NPK% and uptakes compared to control.On faba bean. Such promoting effect of yeast may be attributed to increased absorption of different elements by roots and also their translocation and accumulation in leaves. The application of yeast under drought stress condition caused a significant increase in N%, P% and K% in pea leaves which could be attributed to its minerals, carbohydrates and hormonal contents (Hammad, 2008). Richard *et al.*, (1998) showed that heavy fruiting significantly reduced NPK at the end of the year.

**11.4. Magnesium:**

The results in Table (11) sprayed with a mixture of (Urea at 20g /L + Benzyladenine at 60 ppm)gave higher in leaf magnesium content their magnesium than the control in "off " years, "On" years and " off " years, respectively. However, all treatments increased the percentage ofmagnesium than control in three seasons. Generally, trees treated in "On" years gave higher magnesium than those treated in two "Off" year. These results agree with Merwad *et al*. (2014) who found that application of N in slow release forms was significantly preferable in increasing leaf Magnesium content of Valencia orange trees than those treated with the fast release one. Thanaa *et al.* (2015) reported that foliar application of Manzanillo olive trees with benzyladenine 60 ppm / tree gave the highest significant values leaf Magnesium content during seasons 2013 2014

**11.5. Calcium:**

Data presented in table (11) revealed that all foliar sprays increased leaf Calcium content when compared with the control in three seasons. Minneola tangelo trees sprayed with (Urea at 20g /L+ Dry yeast at 4g /L) had statistically the richest leaves Ca (%) content (4.86,6.80 and 5.82) in "off " years, "On" years and " off " years, respectively. Generally, trees treated in "off " years ( 2018/2019) improved on leaf Calcium content of Minneola tangelo trees as compared with the control treatment in "off " years (2016/ 2017) and "On" years ( 2017/ 2018 ) Meanwhile, trees treated in "On" years produced higher leaf Calcium than those treated in two "off " years. These results agree with (Thanaa *et al.,* 2016) reported that effect of foliar application with bread yeast suspend at 10 g/L alone or in combination. The highest significant leaf Calcium content of almond seedlings (1.25 and 1.30) as compared with the control. Amino acids and yeast extract may be increased absorption of different elements by roots and also their translocation and accumulation in leaves. Similar results were observed by Hammad (2008) and Mady (2009). Moreover, the increment in nutrient contents might be also due to the enhancement effect of yeast on some metabolic activities in the plants which lead to good accumulation of nutrient in seeds (Fruton and Simmonds, 1959).Furthermore, Brown *et al.,*(1995) reported that in an “on year”, the macronutrient demand by leaves plus fruit is more extended through out the season. Also, on trees have significant higher levels of Ca in the leaves, a feature which may linked with the disturbance in nitrate reduction (Dekock *et al*., 1978).

**12. Effect of foliar application with urea, dry yeast,benzyladenine and their combinations on leaf micro element and alternate bearing phenomena of Minneola tangelo trees**

**12.1. Leaf iron content (ppm)**:

The results in Table (12) revealed that all treatments resulted significantly increased Leaf iron content over control during 2016/2017,2017/2018 and 2018/2019 experimental seasons. Sprayed with (Urea at 20g /L+ Benzyladenine at 60 ppm) gave significantly higher level of leaf Fe content than that of other treatments including the control in "off " years, "On" years and " off " years, respectively. Showed that all treatment in "off " years ( 2018/2019) improved Leaf iron content of minneola tangelo trees compared with the control treatment in "Off" years (2016 /2017). These results agree with(Abd El-Latif *et al.*,2018) reported that BA at 2- 3 % increased leaf Fe content during two seasons compared with the control. (Thanaa *et al.,* 2015) found that foliar application of Manzanillo olive trees with 40 g/L dry yeast extract alone or 60 ppm benzyladenine/ tree alone gave the high significant iron content in the leaves during seasons 2013 and 2014. (Manal *et al.,* 2018) who pointed that foliar application wheat plants with yeast 5g/liter gave the highest values in Leaf iron content1676.32ppm of wheat plants compared with other treatments and control. Merwad *et al.,* (2014) who found that Valencia orange trees at high level scored higher leaf iron contents (48.0 %) for U( urea 46.5% N ) forms. (Sohrab *et al.,* 2013) indicated that Iron increases photosynthesis and carbohydrate synthesis and in reproductive growth of fruit in organs of the plant acts as a strong sink

**12.2. Leaf copper content (CU ppm)**:

Tabulated data in Table (12) show clearly that all investigated treatments significantly increased leaf cu content of minneola tangelo trees during three seasons of study. Sprayed with a combination of (Urea at 20g /L + Benzyladenine at 60 ppm) significantly increased leaf cu content as compared with other treatments and the control in "off " years, "On" years and " off " years, respectively. Generally, trees treated in "off " years ( 2018/2019) produced higher leaf cu content than those treated in "Off" year (2016/ 2017). These results agree with (Saeid Hazrati *et al.,*2012) reported that foliar spraying with active dry yeast at rates of 4 g $L^{-1}$ recorded highest values of Cu (mg kg-1) in cucumber fruits This extracts contain Cytokinins as well in which induce the physiological activities and increase the total chlorophyll in the plant. This will positively reflects on the activity of photosynthesis and the synthesized materials which will positively reflects on shoots characteristics (Thomas, 1996). And also might due to the minerals Zn and Cu content in the seaweed extracts, which have a great role in cell division and enlargement and induce the photosynthesis and then a great shoot growth. Fertilization with a lower dose of nitrogen (80 kg $ha^{-1}$) contributed to an increase in Cu concentration in wheat grains (Lopez *et al.,* 2008).

**12.3. Leaf manganese content (Mn ppm):**

Tabulated data in Table (12) reveals obviously that all treatments resulted increasing leaf Mn content than control (water spraying). Foliar application with a combination of (Urea at 20g /L + Benzyladenine at 60 ppm) as well as ( Urea at 20g /L+ Dry yeast at 4g /L) gave significantly higher leaf Mn content growth rates than that of the control in "off " years, "On" years and " off " years, respectively. However, trees treated in "off" years (2018/2019)a pronounced positive effect on leaf Mn content than those treated in"off " years ( 2016/2017) These results agree with (Abd El-Latif *et al.*,2018). treated with BA gave highest concentration at 3 % resulted in the highest leaf Mn content for papaya Solo cv. seedlings during 2015 and 2016 experimental seasons. Khamis *et al.,* (2017) who found that foliar spray with (yeast extract 50-100 ml/l) the highest significant increased leaf Mn content of Washington navel orange trees as compared with other treatments and control during both seasons of study .Treatments of U (urea 46.5% N)gave higher leaf manganese contents of Valencia orange trees Merwad *et al.,* (2014). Heerendra *et al*. (2017) it was found that leaf nutrient contents (N, P, K, Ca, Mg and Cu) were also recorded maximum in treated trees. The application of urea + $ZnSO_4$+ 2, 4-D**.**

**12.4. Leaf zinc content (Zn ppm)**:

Data presented in Table (12) reveals obviously that all treatments resulted increasing zinc content than control. Minneola tangelo trees sprayed with (Urea at 20g /L+ Dry yeast at 4g /L) recorded the highest significant values of (75.25, 87.92 and 76.58 ppm) in "off " years, "On" years

**Table 11:** Effect of foliar application with urea, dry yeast ,benzyladenine and their combinations on leaf macro-elements and alternate bearing phenomena of minneola tangelo trees during 2016/2017 , 2017/2018 and 2018/2019 seasons .

| Treatments | N % | | | P % | | | K% | | | Mg% | | | Ca% | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 |
| **Control (spray water only)** | 1.86g | 2.23g | 2.00g | 0.125f | 0.136g | 0.129g | 0.72f | 0.92g | 0.82 f | 0.42e | 0.53f | 0.48g | 2.90e | 3.50e | 3.15e |
| **Urea at 20g /L** | 2.20e | 2.61e | 2. 25e | 0.144e | 0.158f | 0.148f | 1.30e | 1.68f | 1.42e | 0.61b | 0.78b | 0.64b | 3.64cd | 4.25d | 3.95d |
| **Dry yeast at 4g /L** | 2.26c | 2.63c | 2.32c | 0.157b | 0.162d | 0.159cd | 1.34d | 1.70d | 1.45d | 0.63b | 0.83a | 0.65b | 3.70c | 5.79c | 5.62b |
| **Benzyladenine at 60ppm** | 2.24f | 2.54f | 2.27f | 0.146bcd | 0.160 e | 0.152e | 1.32e | 1.69e | 1.43e | 0.56c | 0.72d | 0.59cde | 3.56cd | 5.54c | 4.27c |
| **Urea at 20g /L+ Dry yeast at4g/L** | 2.30b | 2.64b | 2.38b | 0.160a | 0.170b | 0.165b | 1.40 a | 1.78a | 1.52 a | 0.58c | 0.75c | 0.60cd | 4.86a | 6. 80a | 5.82a |
| **Urea at 20g /L+ Benzyladenine at 60ppm** | 2.34a | 2.65a | 2.40a | 0.163a | 0.182a | 0.172a | 1.38 b | 1.75 b | 1.49 b | 0.67a | 0.85a | 0.68a | 4.00b | 6.08b | 5.72b |
| **Urea at 20g /L+ Dry yeast at 4g/L + Benzyladenine at 60ppm** | 2.23cd | 2.62d | 2.29cd | 0.156bc | 0.165c | 0.161c | 1.36c | 1.73c | 1.47c | 0.53d | 0.70de | 0.55f | 3.68cd | 5.62c | 4.55c |

Means in the same column followed by the same letter(s) are not significantly different at 5% probability

**Table 12:** Effect of foliar application with urea, dry yeast ,benzyladenine and their combinations on leaf micro element and alternate bearing phenomena of minneola tangelo trees during 2016/12017, 2017/2018 and 2018/2019 seasons.

| Treatments | Fe (ppm) | | | Cu(ppm) | | | Mn(ppm) | | | Zn(ppm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 | Off year 2016/2017 | On year 2017/2018 | Off year 2018/2019 |
| **Control (spray water only)** | 71.00g | 95.32g | 76.33f | 12.56g | 14.23g | 13.65g | 142.36f | 165.65f | 148.65e | 56.08g | 60.58f | 57.83c |
| **Urea at 20g /L** | 120.35f | 148.34f | 125.65e | 14.68f | 16.00f | 15.22f | 173.73d | 195.46cd | 184.59c | 60.36f | 76.33e | 63.83ab |
| **Dry yeast at 4g /L** | 142.25d | 165.22d | 150.64c | 15.65e | 17.22e | 16.85e | 186.33c | 200.66c | 192.49b | 65.58c | 80.32bc | 67.45ab |
| **Benzyladenine at 60ppm** | 139.45e | 158.60e | 143.45d | 16.86bcd | 18.00d | 17.33cd | 212.66a | 236.35ab | 224.50a | 62.08e | 78.75bcd | 65.75ab |
| **Urea at 20g /L+ Dry yeast at 4g /L** | 155.23b | 175.35b | 162.00b | 18.96a | 20.33b | 19.59b | 195.33b | 242.00a | 217.00a | 75.25a | 87.92a | 76.58a |
| **Urea at 20g /L+ Benzyladenine at60ppm** | 168.66a | 190.33a | 176.49a | 19.39a | 22.53a | 21.83a | 206.00a | 245.46a | 220.36a | 64.25c | 85.62a | 68.79ab |
| **Urea at 20g /L+ Dry yeast at 4g /L+ Benzyladenine at 60ppm** | 149.36c | 170.65c | 154.32c | 17.26bc | 19.06c | 18.25c | 168.56de | 190.35cde | 179.95cd | 70.42b | 82.92b | 71.67a |

Means in the same column followed by the same letter(s) are not significantly different at 5% probability

and " off " years, respectively, trees treated in "off " years ( 2018/2019) showed high positive response in leaf zinc than those treated in "Off" year (2016/ 2017). These results agree with(Khamis *et al.,*015) who found that foliar spray with (yeast extract 50-100 ml/l) the highest significant increased leaf zinc content of Washington navel orange trees as compared with other treatments and control during both seasons of study . (Abd El-Latif *et al.*, 2018) reported that treated with BA at 3% resulted in the highest leaf Zn content (43.29,52.62),(45.24,43.70) for papaya Solo cv. seedlings over the control during both seasons.(Manal *et al.,* 2018) who stated that foliar application wheat plants of Yeast 5g/liter gave the highest values in Leaf content zinc (1077.76) ppm of wheat plants compared with other treatments and control.

**Conclusions**

Alternate bearing is an economic problem for certain citrus cultivars growers (mandarins hybrids) and industry affecting fruit size and net economic return, causing a price fluctuation between „"on" and „"off"" year. It is controlled by an interaction between vegetative growth and fruit load. Factors have been attributed to cause alternate bearing carbon and nitrogen imbalance, namely exhaustion of carbohydrate supply carbohydrates and mineral nutrients in the nutritional theory of alternate bearing, and the endogenous hormones. Conclusively, From the obtained results on"Minneola" tangelo trees, it was clear that foliar application with (Urea at 20g /L + Benzyladenine at 60 ppm) gave a high positive effect on the studied number of shoots, Shoot diameter (cm) , average leaf area ($cm^2$), fruit set %, remaining fruits after June drop % , Mature fruits %, Yield increment ( %) over the control, Yield/tree (kg),Yield/ weight feddan (ton),Total carbohrydrates (mg/g),C/N ratio, Carotenoids, Chlorophyll- a , b (mg/g fresh wt), tolal chlorophyll ( mg/g fresh wt ), Total indoles (mg/100g F.W), Total phenols (mg/ 100g F.W), leaf mineral contents (N, P, Mg, Fe and Mn, Cu) and reduce juice total acidity %, in "off " years ( 2018/2019)**.** Also, it produced higher peel weight (g), pulp weight(g),Juice volume ($cm^3$), Average fruit weight (g),Fruit volume ($cm^3$),Fruit diameter (cm), Fruit length(cm), sugars %,TSS (%), TSS/acid ratio in "Off " years (2018/ 2019) than those treated in"On" years (2017/ 2018). Foliar spray with (Urea at 20g /L + Benzyladenine at 60 ppm) gave positive effect in reducing biennial bearing severity.

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