# Response of Balady Mandarin Trees to Foliar Application of Some Biostimulants.

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## ABSTRACT

This investigation was conducted during (2021 and 2022) seasons to investigate the impact of individual or combination of three plant extracts termed: turmeric, onion and garlic extracts each at 0.05, 0.1 and 0.2% individually or in combination at each concentration on growth and yield of Balady mandarin trees grown in the Horticultural Research Station orchard at Mallawy district, El-Minia Governorate, Egypt. Trees were grown under surface irrigation system using water supply of the Nile River. Plant extracts were sprayed at the 1st week of: March, May, July & September, single and mixture applications 0.05, 0.1 and 0.2 percentages.

The results revealed that all plant extracts proved to be a tool used to manipulate vegetative and reproductive growth, yielding and fruit quality characteristics and maximize yield and thus grown profit. Furthermore, garlic extract was better than the onion or turmeric extracts as a single applications. In spite of, plant extracts mixture applications provided the best possible values for tree growth and productivity and quality of fruit. Increased mixing concentrations have a positive return with insignificant differences with the 0.1% concentration. Generally, results indicated that mixture of the three plant extract at 0.1 and 0.2% gave the highest values for tree growth, yield and fruit quality and leaf nutrient content of Balady mandarin trees under this study.

**Keywords:** plant extracts-turmeric extract- onion extract- garlic extract -fruit quality.

## INTRODUCTION

Citrus fruiting acreage in Egypt amounted to approximately 440210 feddans, yielding 4503226 tons of citrus. The Balady mandarin crop covered approximately 99546 feddans, representing 22.6% of the entire citrus fruiting region. Its total production is about 951396 tons (Yearly of Statistical and Agricultural Economic Dept. Ministry of Agriculture and Reclamation Egypt, 2021). Additionally, the citrus industry ranks the 1st first among Egypt's horticultural crop exports with a production reaching about 1845989 tons (E.A.Q.A., 2023). Under the middle Egypt conditions, the most of Balady mandarin orchards suffer from poor tree yield and economic return, which mainly could be related to flower abscission and inadequate fruit setting percentage.

Previous studies have reported that many factors could be involved, comprising environmental influences (air temperature, relative humidity, soil moisture…etc.) and malnutrition. Recently, biostimulants as natural plant extracts are safe agents for humans and environmental preservation. New alternative compounds such botanical extracts which can be recognized by having a greater concentration of organic sulphur-based compounds, fats, volatile components, proteins, tannins, certain nutrients, vitamins, and antioxidants (Peter, 1999) may help improve tree production and fruit quality. Additionally, such extracts have the largest concentrations of antioxidants and certain nutrients that enhance plant health by averting reactive oxygen species (Kirtikar and Basu, 1984; Botelho et al., 2007 and Bhanu et al., 2013). The objective of this study was to elucidate the impacts of certain plant extracts such as those from turmeric, garlic, and onion extracts on a few aspects of the vegetative growth, leaf chemical composition, yield, and fruit quality of Balady mandarin trees planted in El-Minia district.

## MATERIALS AND METHODS

This investigation was executed in the course of two consecutive trial seasons (2021 & 2022) on 39 uniform and similar in-vigor 18-year-old Balady mandarin trees (*Citrus reticulate* Blanco) budded on sour orange rootstock and cultivated in the orchard of Horticultural Research Station situated in the Mallawy district of the El-Minia Governorate, Egypt. Trees are planted according to the square arrangement method at a spacing of 4.0 x 4.0 M apart (262tree/ fed.). Orchard soil has a well-drained loamy soil texture subjected to a surface irrigation system thus using a Nile water supply, and a water table that is at least two meters deep. Physical and chemical analyses of the soil were conducted in accordance with the guidelines provided by Wilde et al. (1985) in **Table (1)**.

**Table (1). Soil physical and chemical properties of the experimental orchard**

| Constituents | Values | Constituents | Values |
|---|---|---|---|
| Clay % | 81.5 | O.M. % | 2.15 |
| Silt % | 12.5 | $CaCO_3$% | 1.11 |
| Sand % | 6.0 | Ava. N % | 0.09 |
| Texture | Clay | Ava. P (Olsen , ppm) | 6.2 |
| pH (1: 2.5 extract) | 8.01 | Ava. K (ammonium acetateppm) | 440 |
| EC (1:2.5extract) (mhos/cm/25$^o$C) | 0.92 | | |

The chemical composition of plant extracts were analyzed and recorded in Tables (2, 3 & 4) as follows:

**Table (2). Chemical compositions of turmeric extract (100 g D.W.) (According to Li et al., 2011).**

| Compounds | Values | Compounds | Values |
|---|---|---|---|
| ß- bisabolene % | 1.3 | α-pinene % | 0.1 |
| 1, 8 – cineol % | 2.4 | Terpinolene % | 0.3 |
| P- cyemen % | 3.0 | Tr-turmerone % | 31.1 |
| P- cyemen 8-ol % | 0.3 | Turmerone % | 10.0 |
| Tr- curcumin % | 6.3 | Ascorbic acid (mg.) | 50.0 |
| Curloen % | 10.6 | ASH (g.) | 6.8 |
| Dehydrocurcumin % | 2.2 | Calcium (g.) | 0.2 |
| Myrecen % | 0.1 | Carbohydrate (g.) | 69.9 |
| α- Phellanmdrene % | 0.1 | Fat (g) | 8.9 |

**Table (3). Chemical composition of garlic extracts (mg/ 100 g D.W.) (According to Dehekney, 2016).**

| Compounds | Values (mg/100g D.W.) | Compounds | Values (mg/ 100 gD.W.) |
|---|---|---|---|
| Dipropyl disulfide | 0.25 | Bis- (1-propenyl)-sulfide | 0.08 |
| Diallyl disulfide | 37.90 | Diallyl sulfide | 6.59 |
| Dimethyl trisulfide | 0.33 | Dimethyl disulfide | 0.15 |
| Dimethyl thiophene | 0.08 | Allyl methyl tetrasulfide | 1.07 |
| Allyl methyl disulfide | 3.69 | Allyl propyl trisulfide | 0.23 |
| Methyl propyl disulfide | 0.25 | Diallyl suflide | 28.06 |
| Methyl 1- propenyl disulfide | 0.46 | Eugenol | 0.23 |
| Allyl propyl sulfide | 0.09 | | |

**Table (4). Chemical composition of onion extract (according to Mnayer *et al.*, 2015).**

| Compounds | Values (mg/ 100g D.W.) | Compounds | Values ng/ 100 gD.W.) |
|---|---|---|---|
| 1-propenyl propyl disulfide | 7.26 | 2-Methyl-3,4- dithiaheptane | 6.48 |
| Methyl propyl trisulfide | 5.2 | Dipropyl tetrasulfide | 0.55 |
| Mentone | 0.34 | Dipropyl disulfide | 3.92 |
| Dimethyl tetrasulfide | 0.15 | Allyl propyl sulfide | 0.42 |
| dipropyl trisulfide | 17.10 | Dimethyl trisulfide | 0.30 |
| Eugenol | 3.07 | | |

Selected trees received the common horticultural practices already applied in the orchard without spraying any materials inconsistent with thisstudy.

**The experiment included thirteen treatments as follows:**

$T_1$: Control trees (sprayed with tap water).
$T_2$: Turmeric extract at 0.05%.
$T_3$: ,, ,, at 0.1 %.
$T_4$: ,, ,, at 0.2 %.
$T_5$: Garlic extract at 0.05 %.
$T_6$: ,, ,, at 0.1 %.
$T_7$: ,, ,, at 0.2 %.
$T_8$: Onion extract at 0.05%.
$T_9$: ,, ,, at 0.1 %.
$T_{10}$: ,, ,, at 0.2 %.
$T_{11}$: Mixed extracts each at 0.05%.
$T_{12}$: ,, ,, ,, at 0.1 %.
$T_{13}$: ,, ,, ,, at 0.2 %..

Three replications of each treatment, each involving one tree, were conducted. In the early morning hours of the first week of March, May, July, and September, plant extracts were sprayed and for each treatment plant extract. The three plant extracts namely (turmeric, garlic and onion) were dried in the shade and washed with distilled water. They were finely grinded to powder. Fifty grams of each plant material of powder form was homogenized by laboratory blender in 200 ml of methanol (96%) and distilled water (20:80 v/v) for 10 min, and then left in dark glass bottles for 72 h for complete extraction. The extracts were filtered through thin cheesecloth sheets. The final extracts were collected separately in other dark glass bottles and exposed to 600C in water bath for 30 min for methanol evaporation. The collected extracts were then stored in a refrigerator at 50C until needed (Ezz-Thanaa et al., 2015). Triton B at 0.5 m/L as a witting agent was added to all plant extracts before application. Each extract solution was sprayed on trees until it ran off.

**Experimental design:** The study employed a Randomized Complete Block Design (RCBD) with 13 treatments and three replications, with one tree for each replication. (according to Rangaswamy, 1995).

Balady mandarin tree parameters were studied as follows:

**I. Vegetative spring growth parameters** were measured in accordance with Ahmed and Morsy (1999) including shoot length (cm), leaf area $(cm)^2$ and number of leaves at mid-September,

**II. Leaf pigments:** as chlorophylls a, b, and total carotenoids (mg/1.0 g F.W.) were determined at mid-September, according to Von –Wettstein (1957).

**III. Leaf mineral contents as:** N, P & K (%) and Fe, Zn & Mn (ppm) were determined on a dry weight basis according to Peach

and Tracey (1968), Summer (1985) and Wilde et al. (1985).

**IV. Tree yield and fruit quality:**

a. Tree production (number of fruit/tree, yield kg/tree and average fruit weight).

b. Several fruit physical and chemical attributes such as fruit weight (g), peel %, pulp and juice, peel thickness (cm.), TSS %, total acidity %,TSS/acid ratioand juice ascorbic acid content as (mg/ 100 ml Juice) were determined according to A.O.A.C., (2000); total sugars and reducing sugars % according to Lane and Eynan (1965).

**Statistical analysis:**

The collected data were statistically examined in accordance with Snedecor and Cochran (1990) and means were compared by using new L.S.D. multiple test at 5%. (Mead et al., 1993).

## RESULTS

### I. Some vegetative growth characteristics:

As for spring shoot length, as shown in **Table (5)**, the results indicated that throughout the two seasons under investigation, all applied treatments (individual or combination) considerably increased shoot length relative to the control. However, both plant extract mixtures 0.1% or 0.2% significantly resulted in the most noteworthy values with insignificant differences between them. Concerning the impact of individual plant extract, data in **Table (5)** also showed that Garlic extract at different concentrations under study significantly expanded shoot length compared to the control and the other treatments. When it came to leaf area, the data showed that using plant extract in combination or individually at moderate or high concentrations substantially enhanced the leaf area when compared to the control. Furthermore, throughout the both seasons, the combination of plant extract outperformed the others. According to the data provided in **Table (5)**, the mixture of plant extract at high and moderate concentrations had the greatest number of leaves/shoot across the two seasons in comparison to the control. Garlic extract at all concentrations was next in line.

### II. Leaf pigment contents:

Data presented in **Table (5)** clearly show that, all experimental treatments had a favorable effect on leaf contents of carotenoids and chlorophyll a and b in Balady mandarin. Nevertheless, the effects of the mixed treatments on leaf chlorophyll a & b and carotenoids were negligible at both high (0.2%) and moderate (0.1%) concentrations. But when compared to other treatments, they recorded the highest levels, with insignificant differences amongst them. Moreover, during the two seasons under investigation, the lowest response was seen in the control treatment.

**Table (5). Effect of spraying some plant extracts on some growth characteristics and leaf pigments of Balady mandarin trees during 2021 and 2022 seasons.**

| Treatment | Shoot length (cm.) | | Leaf area $(cm)^2$ | | Number of leaves/ shoot | | Chlorophyll a (mg/1.0 g F.W.) | | Chlorophyll b (mg/1.0 g F.W.) | | Total carotenoids (mg/1.0 g F.W.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| **Control (sprayed with tap water)** | 31.5 g | 31.6 f | 6.8 d | 6.9 d | 24.0 f | 25.0 g | 3.5 e | 3.6 e | 1.3 e | 1.4 g | 1.1 g | 1.1 f |
| **Turmeric extract at 0.05 %** | 33.2 f | 33.5 e | 7.1 cd | 7.2 c | 27.0 e | 27.0 f | 3.9 de | 4.0 c | 1.5 e | 1.6 fg | 1.3 f | 1.4 e |
| **„ „ at 0.1 %** | 35.0 e | 35.6 d | 7.6 c | 7.7 c | 28.0 d | 29.0 e | 4.2 d | 4.4 c | 1.8 d | 1.9 ef | 1.6 e | 1.7 d |
| **„ „ at 0.2 %** | 35.6 e | 36.0 d | 7.8 bc | 7.9 bc | 29.0 d | 29.0 e | 4.3 cd | 4.5 c | 1.9 d | 2.0 e | 1.7 e | 1.8 d |
| **Onion extract at 0.05 %** | 35.2 e | 35.8 d | 7.7 bc | 7.9 bc | 29.0 d | 29.0 e | 4.2 d | 4.4 c | 1.8 d | 1.9 ef | 1.6 e | 1.7 d |
| **„ „ at 0.1 %** | 36.6 d | 37 cd | 8.1 bc | 8.3 bc | 30.0 d | 31.0 d | 4.8 cd | 5 bc | 2.4 c | 2.5 d | 2.1 d | 2.2 c |
| **„ „ at 0.2 %** | 37.2 d | 38.2 c | 8.3 b | 8.5 b | 33.0 c | 34.0 bc | 5.1 bc | 5.3 b | 2.5 c | 2.6 d | 2.3 c | 2.4 c |
| **Garlic extract at 0.05 %** | 37.0 d | 38.0 c | 8.2 bc | 8.4 bc | 33.0 c | 33.0 c | 5 bc | 5.2 b | 2.4 c | 2.5 d | 2.2 cd | 2.3 c |
| **„ „ at 0.1 %** | 39.9 c | 40.8 b | 8.6 ab | 8.7 ab | 35.0 b | 35.0 b | 5.4 b | 5.6 b | 2.8 b | 2.9 cd | 2.5 b | 2.6 bc |
| **„ „ at 0.2 %** | 41.8 b | 42.0 b | 8.7 ab | 8.9 ab | 36.0 b | 36.0 b | 5.5 b | 5.7 ab | 2.9 b | 3.1 abc | 2.6 b | 2.7 b |
| **Mixture extract e a c h at 0.05%.** | 41.0 b | 41.4 b | 8.5 ab | 8.7 ab | 35.0 b | 36.0 b | 5.4 b | 5.6 b | 2.8 b | 3 bc | 2.5 b | 2.6 bc |
| **„ „ „ at 0.1%** | 44.2 a | 45.0 a | 8.9 ab | 9.0 ab | 37.0 ab | 38.0 a | 6.2 a | 6.3 ab | 3.1 ab | 3.3 ab | 2.8 a | 2.9 ab |
| **„ „ „ at 0.2 %** | 45.0 a | 45.6 a | 9.1 a | 9.3 a | 38.0 a | 39.0 a | 6.4 a | 6.5 a | 3.2 a | 3.5 a | 2.9 a | 3.0 a |
| **New L.S.D. at 5%** | 1.20 | 1.30 | 0.70 | 0.80 | 2.00 | 2.00 | 0.60 | 0.70 | 0.30 | 0.40 | 0.20 | 0.30 |

Letter/s was used for distinguishing between values of treatments. Whereas means followed by the same letter/s of each column are not significantly different at the 5% level.

**III. Leaf mineral contents**:

Data in Table (6) results generally demonstrate that, regarding both studied seasons, foliar applications of plant extract treatments under investigation had a positive impact on leaf contents of macro-" N, P & K" or micro-" Fe, Zn & Mn" nutrients of Balady mandarin. In contrast, when contrasted with the mixed experimental treatments in both seasons under study, showed that the highest concentrations scored the highest values without significant differences among them.

**IV. Tree yield and fruit quality:**

**a. Tree yield (fruit number /tree, kg/tree & average fruit weight).**

Results presented in **Table (7)** clearly show the impact of plant extracts on the number of fruits/tree, yield and fruit weight of Balady mandarins. It is quite evident that applying the plant extracts under investigation as a single or combination of foliar applications has a positive impact on improving Balady mandarin tree yield (number & weight). However, in contrast to the other treatments, combination extract at 0.2% inclined to get the highest tree yield (number and weight) and was the best, this trend held true in both seasons of the study. Conversely, the control treatment experienced the lowest values during the course of the two seasons. Concerning fruit weight, the highest values were recorded by garlic extract at 0.2% and all mixture treatments.

**b. Some physical and chemical characteristics of fruits:**

**1) Physical characteristics of fruits:**

It is clear from **Tables (7) and (8)** that, when compared to other experimental treatments, both garlic extract at 0.1 or 0.2 % concentrations and the mixture of plant extracts under study have significantly increased Balady mandarin fruit weight with insignificant differences among them. On the other hand, the lowest fruit weight were obtained by the control and the turmeric extract at 0.05 percent. Additionally, Data in **Table (8)** disclosed that mixed applications at 0.1 or 0.2 % have significantly decreased both peel percentage and peel thickness. In contrast, the control and the turmeric extract, both at 0.05 %, had the greatest values. The mixture of plant extract at 0.2% and all mixture treatments resulted in the highest fruit pulp and juice percentage, meanwhile, either the control or turmeric extract at 0.05%, was the lowest.

**2) Chemical characteristics of fruits:**

The chemical characteristics of Balady mandarin fruit *i.e.* fruit juice, total soluble solids "TSS" %; total acidity %; TSS/Acid Ratio, total and reducing sugars, and vitamin C contents, were examined in this regard. Data displayed in **Table (9)** demonstrated that plant mixture extract at 0.1 and 0.2% treatments increased juice total soluble solids (TSS%) and TSS/acid ratio, with insignificant difference between the two concentrations of plant mixture extract in the second season only. These values were significantly greater than those of the other experimental treatments under this study, with the control treatment exhibiting the lowest values. Also, it could be noticed that the lowest significant juice acidity was recorded by both mixture treatments at 0.1 and 0.2% in both seasons. Furthermore, plant mixture extract at 0.2% concentration significantly increased juice total and reduced sugar values **(Table 9)**, whereas the lowest values in this concern were obtained by the control, turmeric extract, and onion extract at 0.05 or 0.1% conc. At last, for both analyzed seasons, fruit juice Vitamin C contents were significantly higher with the plant extract mixture at 0.1 or 0.2 % than with other experimental treatments.

**Table (6). Effect of spraying some plant extracts on N, P, K (%), Fe, Zn, and Mn (ppm) leaf content of Balady mandarin trees during 2021 and 2022 seasons.**

| Treatment | N% | | P% | | K% | | Fe (ppm) | | Zn (ppm) | | Mn (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| Control (sprayed with tap water) | 1.62 f | 1.65 f | 0.16 h | 0.17 h | 1.21 g | 1.22 h | 51.22 g | 51.30 f | 58.20 f | 59.30 f | 47.60 e | 47.30 f |
| Turmeric extract at 0.05 % | 1.71 e | 1.73 e | 0.19 g | 0.21 g | 1.26 f | 1.28 g | 53.5 f | 53.88 e | 61.00 e | 62.20 e | 49.20 e | 50.00 e |
| „ „ at 0.1 % | 1.77 de | 1.79 de | 0.21 f | 0.22 g | 1.30 e | 1.32 fg | 55.62 e | 56.00 de | 63.20 de | 64.50 de | 51.30 d | 52.00 de |
| „ „ at 0.2 % | 1.81 d | 1.82 d | 0.22 f | 0.24 f | 1.32 e | 1.34 f | 56.10 de | 56.30 d | 64.50 d | 66.00 cd | 52.50 d | 53.10 d |
| Onion extract at 0.05 % | 1.80 d | 1.81 d | 0.21 f | 0.23 fg | 1.31 e | 1.33 f | 55.90 de | 56.00 de | 64.00 d | 65.10 d | 52.00 d | 52.50 d |
| „ „ at 0.1 % | 1.88 c | 1.90 c | 0.26 e | 0.28 e | 1.36 d | 1.38 ef | 58.00 cd | 58.60 c | 66.33 c | 67.50 c | 55.10 c | 55.80 c |
| „ „ at 0.2 % | 1.91 c | 1.93 c | 0.29 d | 0.30 d | 1.38 d | 1.40 de | 59.30 c | 60.00 c | 67.20 c | 68.10 c | 56.60 c | 57.20 c |
| Garlic extract at 0.05 % | 1.90 c | 1.92 c | 0.28 d | 0.29 de | 1.37 d | 1.39 e | 59.00 c | 59.50 c | 67.00 c | 68.00 c | 56.00 c | 57.30 c |
| „ „ at 0.1 % | 1.99 b | 2.01 b | 0.33 c | 0.35 bc | 1.42 c | 1.44 cd | 61.20 b | 62.00 bc | 69.10 bc | 70.00 bc | 58.40 b | 59.10 bc |
| „ „ at 0.2 % | 2.05 b | 2.08 b | 0.35 b | 0.36 b | 1.45 c | 1.47 c | 62.30 b | 63.00 b | 70.20 b | 71.10 b | 59.50 b | 60.10 b |
| Mixture extract e a c h at 0.05%. | 2.00 b | 2.03 b | 0.33 c | 0.34 c | 1.44 c | 1.46 c | 62.00 b | 63.00 b | 70.00 b | 71.00 b | 59.00 b | 60.00 a |
| „ „ „ at 0.1% | 2.11 ab | 2.14 ab | 0.38 a | 0.40 a | 1.51a | 1.52a | 64.00 ab | 65.22 a | 73.40 a | 74.50 a | 61.30 a | 62.30 a |
| „ „ „ at 0.2 % | 2.16 a | 2.19 a | 0.39 a | 0.41 a | 1.55 a | 1.57 a | 65.10 a | 66.30 a | 75.20 a | 76.10 a | 62.50 a | 62.30 a |
| New L.S.D. at 5% | 0.07 | 0.08 | 0.02 | 0.02 | 0.04 | 0.05 | 2.11 | 2.19 | 2.33 | 2.36 | 2.05 | 2.06 |

Letter/s was used for distinguishing between values of treatments. Whereas means followed by the same letter/s of each column are not significantly different at the 5% level.

**Table (7). Effect of spraying some plant extracts on yield and fruit weight and number of fruits/tree of Balady mandarin trees during 2021 and 2022 seasons.**

| Treatment | Number of fruits/tree | | Yield/tree (kg.) | | Fruit weight (g.) | |
|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| Control (sprayed with tap water) | 255.00 g | 260.00 g | 29.33 i | 30.81 h | 115.00 c | 118.50 c |
| Turmeric extract at 0.05 % | 262.00 g | 256.00 g | 31.83 h | 32.33 h | 121.50 c | 122.00 c |
| „ „ at 0.1 % | 280.00 f | 285.00 f | 34.72 g | 35.77 g | 124.00 b | 125.50 b |
| „ „ at 0.2 % | 285.00 f | 290.00 f | 35.63 g | 36.69 g | 125.00 b | 126.50 b |
| Onion extract at 0.05 % | 282.00 f | 295.00 ef | 35.11 g | 37.17 g | 124.50 b | 126.00 b |
| „ „ at 0.1 % | 299.00 e | 305.00 e | 38.87 f | 40.26 f | 130.00 b | 132.00 b |
| „ „ at 0.2 % | 305.00 de | 310.00 de | 40.57 ef | 41.85 ef | 133.60 b | 135.00 b |
| Garlic extract at 0.05 % | 315.00 d | 320.00 d | 41.58 e | 43.04 e | 132.00 b | 134.50 b |
| „ „ at 0.1 % | 330.00 c | 333.00 cd | 45.54 d | 46.35 d | 138.00 a | 139.20 ab |
| „ „ at 0.2 % | 335.00 bc | 340.00 bc | 47.74 c | 48.45 c | 142.50 a | 143.00 ab |
| Mixture extract e a c h at 0.05%. | 330.00 c | 335.00 c | 46.20 cd | 47.40 c | 140.00 a | 141.50 ab |
| „ „ „ at 0.1% | 345.00 b | 350.00 b | 50.20 b | 51.28 b | 145.50 a | 146.50 a |
| „ „ „ at 0.2 % | 360.00 a | 370.00 a | 53.28 a | 55.50 a | 148.00 a | 150.00 a |
| New L.S.D. at 5% | 13.00 | 15.00 | 1.80 | 1.90 | 10.10 | 11.00 |

Letter/s was used for distinguishing between values of treatments. Whereas means followed by the same letter/s of each column are not significantly different at the 5% level.

**Table (8). Effect of spraying some plant extracts on several physical characteristics of Balady mandarin fruit during 2021 and 2022 seasons.**

| Treatment | Fruit peel weight % | | Pulp % | | Juice % | | Fruit peel thickness (cm) | |
|---|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| **Control (sprayed with tap water)** | 27.40 a | 27.00 a | 72.60 g | 73.00 g | 52.50 f | 53.00 f | 0.38 a | 0.37 a |
| **Turmeric extract at 0.05 %** | 26.80 a | 26.40 a | 73.20 g | 73.60 g | 53.80 e | 54.00 f | 0.35 ab | 0.34 ab |
| **„ „ at 0.1 %** | 25.50 b | 25.10 b | 74.50 f | 74.90 f | 55.20 d | 55.50 e | 0.33 a | 0.32 b |
| **„ „ at 0.2 %** | 25.00 b | 24.70 b | 75.00 f | 75.30 f | 55.60 d | 55.80 e | 0.31 bc | 0.30 bc |
| **Onion extract at 0.05 %** | 25.20 b | 25.00 b | 74.80 f | 75.00 f | 55.50 d | 55.70 e | 0.32 bc | 0.31 b |
| **„ „ at 0.1 %** | 23.00 c | 22.70 c | 77.00 e | 77.30 e | 58.40 c | 58.80 d | 0.29 c | 0.28 bc |
| **„ „ at 0.2 %** | 20.80 e | 20.10 d | 79.20 d | 79.90 c | 59.20 c | 60.00 c | 0.27 cd | 0.26 c |
| **Garlic extract at 0.05 %** | 22.00 d | 21.50 e | 78.00 e | 78.50 d | 59.00 c | 59.50 cd | 0.26 cd | 0.25 cd |
| **„ „ at 0.1 %** | 19.80 f | 19.00 f | 80.20 cd | 81.00 bc | 61.20 b | 61.60 b | 0.25 d | 0.24 cd |
| **„ „ at 0.2 %** | 18.60 g | 18.10 g | 81.40 b | 81.90 b | 61.80 b | 62.00 b | 0.23 de | 0.23 cd |
| **Mixture extract e a c h at 0.05%.** | 19.00 f | 18.50 g | 81.00 b | 81.50 b | 61.50 b | 61.80 b | 0.24 de | 0.23 cd |
| **„ „ „ at 0.1%** | 18.60 g | 17.00 h | 82.40 a | 83.00 a | 63.00 a | 63.40 a | 0.22 de | 0.21 de |
| **„ „ „ at 0.2 %** | 16.80 h | 16.00 i | 83.20 a | 84.00 a | 63.30 a | 63.80 a | 0.21 e | 0.20 e |
| **New L.S.D. at 5%** | 0.70 | 0.80 | 1.10 | 1.20 | 0.90 | 1.10 | 0.04 | 0.05 |

Letter/s was used for distinguishing between values of treatments. Whereas means followed by the same letter/s of each column are not significantly different at the 5% level.

**Table (9). Effect of spraying some plant extracts on several chemical characteristics of Balady mandarin fruit during 2021 and 2022 seasons.**

| Treatment | TSS % | | Total acidity % | | TSS /acid ratio | | Total sugars % | | Reducingsugars % | | Vitamin C content (mg/100 g Juice) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| **Control (sprayed with tap water)** | 11.10 f | 11.1 e | 1.385 a | 1.380 a | 8.01 g | 8.04 g | 7.70 j | 7.75 j | 3.00 l | 3.05 j | 41.00 h | 41.00 g |
| **Turmeric extract at 0.05 %** | 11.60 e | 11.7 d | 1.370 ab | 1.365 ab | 8.47 f | 8.57 f | 7.95 i | 8.00 i | 3.10 k | 3.15 i | 44.50 g | 44.80 f |
| **„ „at 0.1 %** | 11.90 de | 12.0 cd | 1.360 b | 1.355 b | 8.75 ef | 8.86 ef | 8.20 h | 8.25 h | 3.25 j | 3.30 h | 46.30 f | 46.90 e |
| **„ „at 0.2 %** | 12.10 d | 12.2 c | 1.350 bc | 1.345 bc | 8.96 e | 9.07 e | 8.30 g | 8.35 g | 3.33 i | 3.35 g | 47.00 f | 47.50 e |
| **Onion extract at 0.05 %** | 12.00 d | 12.1 c | 1.355 b | 1.350 b | 8.86 e | 8.96 e | 8.25 gh | 8.30 gh | 3.30 i | 3.37 g | 46.00 f | 47.20 e |
| **„ „ at 0.1 %** | 12.40 cd | 12.5 bc | 1.330 c | 1.325 c | 9.32 d | 9.43 d | 8.45 f | 8.50 f | 3.50 h | 3.56 f | 48.20 e | 49.50 d |
| **„ „ at 0.2 %** | 12.60 c | 12.7 b | 1.300 d | 1.295 d | 9.69 c | 9.81 c | 8.69 e | 8.75 e | 3.75 f | 3.81 e | 49.50 d | 50.00 d |
| **Garlic extract at 0.05 %** | 12.50 c | 12.6 b | 1.290 de | 1.285 de | 9.68 c | 9.80 c | 8.65 e | 8.70 e | 3.70 g | 3.77 e | 49.00 de | 49.80 d |
| **„ „ at 0.1 %** | 12.80 bc | 12.9 ab | 1.270 e | 1.265 e | 10.08 b | 10.20 b | 8.85 d | 8.90 d | 3.82 e | 3.88 d | 51.50 c | 51.90 c |
| **„ „ at 0.2 %** | 12.90 bc | 13.0 ab | 1.260 e | 1.255 ef | 10.24 b | 10.36 b | 9.00 c | 9.05 c | 3.95 c | 3.99 c | 53.20 b | 53.60 b |
| **Mixture extract e a c h at 0.05%.** | 12.80 b | 12.9 ab | 1.260 e | 1.250 ef | 10.16 b | 10.32 b | 8.95 c | 9.00 c | 3.90 d | 3.95 c | 53.00 b | 53.50 b |
| **„ „ „ at 0.1%** | 13.00 ab | 13.1 a | 1.250 ef | 1.240 f | 10.40 ab | 10.56 ab | 9.20 b | 9.30 b | 4.20 b | 4.28 b | 54.60 a | 55.00 a |
| **„ „ „ at 0.2 %** | 13.20 a | 13.3 a | 1.235 f | 1.230 f | 10.69 a | 10.81 a | 9.35 a | 9.50 a | 4.30 a | 4.39 a | 55.80 a | 56.20 a |
| **New L.S.D. at 5%** | 0.400 | 0.500 | 0.022 | 0.025 | 0.330 | 0.350 | 0.080 | 0.090 | 0.040 | 0.050 | 1.300 | 1.400 |

Letter/s was used for distinguishing between values of treatments. Whereas means followed by the same letter/s of each column are not significantly different at the 5% level.

## DISCUSSION

Judging by the aforementioned results, it could be generally deduced from **Tables (2, 3 & 4)** that extracts contain various organic compounds *i.e.* free amino acids, carbohydrates, organic acids, vitamins, minerals, growth-stimulating and inhibiting substances…etc. play an important role in plant growth at different growth stages.

The advantageous impacts of the plant-based extracts on boosting the aspects of plant growth, biosynthesis *i.e*, pigments, nutrients uptake, yield, and fruit quality, and enhancing tree immune system against some disorders such as biotic or abiotic stresses, (Peter, 1998, Kitikar and Basu, 1984 and Koch and Lowsott, 1996). Additionally, some vitamins, some amino acids, and onion contain about 50% sulphur which is synthesized from non-protein amino acids which comprise the precursors of volatile flavor compounds (Fenwick and Hanley, 1990).The outstanding effects of turmeric extract on some growth characteristics, nutritional state, and fruiting of Balady mandarin trees might be the cause of its higher content of potassium oleoresin and oils and compounds termed (Curcumin, non-volatile fatty acids, and volatile oil) these compounds as antioxidants have a vital function in shielding the cells of plants against deterioration and were accountable for promoting the division within the cell and the biosynthesis of organic nourishment (El-Salhy et al. 2024 and Govinaerain, 1980). The stimulating effects of garlic extract on growth characteristics, trees' nutritional status, yield, and fruit quality may be related to its content of sulphur containing compounds and the amino acids allium which comprise the existence of the volatile flavoring substances (Koch and Lawson, 1996). The obtained results are in line with those reported by (Qaoud, 2019, Al-Mahmoudi et al., 2010, Abd El- Rahman and El-Masry, 2012, Al Wasfy *et al.*, 2013, Refaai, 2014, Abd El-Rahman, 2015; Shoug, 2015, Ahmed, 2016, Ahmed and Habasy- Randa, 2017 and El- Senosy, 2021).

**Conclusion:-**

Conclusively, it appears that vegetative growth stimulation and yield increase were obtained by four foliar sprays of equally effective 0.1% or 0.2% concentration mixture of turmeric, onion, and garlic extracts during the first week of March, May, July, and September of Balady mandarin trees as evidenced by more vegetative growth; leaf pigment & element contents and yield & the fruit quality grown under Minia region conditions. Yet, from the economical point of view that 0.1% of the mixture could be recommended for the best productivity.

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## استجابة أشجار اليوسفى البلدى للرش الورقى ببعض المنشطات الحيوية

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تم اجراء الدراسة ضمن الاطار الزمنى لموسمي (2021 و 2022) لدراسة مدى تأثير الاستخدام المنفرد والمختلط لثلاثة مستخلصات نباتية وهي مستخلص الكركم ومستخلص البصل ومستخلص الثوم بتركيزات 0.05 ، 0.1 ، 0.2 % لكل منهم على نمو واثمار اشجار اليوسفي البلدي النامية ببستان محطة بحوث البساتين بملوي محافظة المنيا - مصر " قوام تربة طميي"، وتحت نظام الري السطحي باستخدام مياه النيل كمصدر لمياه الري. تم رش المستخلصات النباتية في الاسبوع الاول من مارس، ومايو، ويوليو، وسبتمبر في صورة منفردة ومختلطة بتركيز 0.05 ، 0.1 ، 0.2 % لكل منهم.

أظهرت النتائج أن جميع المستخلصات النباتية كانت واعدة في تحسين نمو الشجرة والحالة الغذائية ، والمحصول وجودة الثمار خلال موسمي الدراسة. بالاضافة إلى أن مستخلص الثوم كان أفضل من مستخلصي البصل والكركم في الصورة المنفردة. على الرغم من أن اضافة المستخلصات في صورة مخلوطة أعطت أفضل القيم لمحصول الشجرة وجودة الثمار. وكان لزيادة تركيز المخلوط عائدا ايجابيا بفروق غير معنوية مع تركيز 0.1 %.

وبشكل عام، دللت النتائج أن مخلوط الثلاثة مستخلصات بتركيزى كل من 0.1 و 0.2 % حقق أفضل النتائج من حيث نمو الأشجار والمحصول وجودة الثمار والمحتوى المعدنى للأوراق.

**الخلاصة:**

لتحسين حالة النمو الخضري وزيادة محصول وجودة ثمار اليوسفي البلدي تحت ظروف محافظة المنيا ومن الوجهة الاقتصادية يوصي بالرش بمخلوط من مستخلص نباتي لكل من الكركم والبصل والثوم بتركيز 0.1 % أربعة مرات خلال الموسم في الأسبوع الأول من مارس ، مايو، يوليو وسبتمبر.