RESPONSE OF "ZAGHLOUL" DATE YIELD AND FRUIT CHARACTERISTICS TO VARIOUS ORGANIC AND INORGANIC FERTILIZATION TYPES AS WELL AS FRUIT-THINNING MODELS IN A RICH CARBONTE SOIL

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ABSTRACT

This study was conducted during 2002 and 2003 seasons at Nobaria Horticulture Research Station to investigate the response of "Zaghloul" date palm yield to various organic and inorganic fertilization types as factor (A), fruit-thinning models as factor (B) as well as interaction among their levels.

Factor (A) levels were: (a1) no animal manure + 5 kg NH_3SO_4, (a2) 25 kg animal manure + 4 kg NH_3SO_4, (a3) 50 kg animal manure + 2 kg NH_3SO_4 and (a4) 100 kg animal manure + no NH_3SO_4 levels. Factor (B) levels were: (b1) non-thinned fruits (the basic bunch number was 8 bunches per palm), (b2) removing of 25% from total bunches number, (b3) thinning of 25% from total stalks in each bunch, (b4) removing of 50% from total bunches number and (b5) thinning of 50% from total stalks in each bunch. The possible combinations among these levels were represented as field experimental reatments.

The results indicated that studied yield as well as fruits characteristics were significantly affected by both A and B factor levels as well as the experimental treatments except pit diameter trait. Regarding the fertilization types factor, the results declared that a3 and a4 levels lead to the best significant values of bunch weight, fruit weight and dimensions, flesh thickness as well as other fruit quality traits. Differences betweenconducted values were not significant.

Viewing the fruit-thinning models factor, the results illustrated that the b4 level produced the highest bunch weight value. Level b5 caused the statistical better fruit weight and dimensions; fruit flesh thickness; pit weight and length criteria. As well as b3 and b4 levels for fruit diameter, flesh thickness and pit weight criteria in both study seasons. For fruit quality traits, thinning models lead to the highest TSS (%) values comparing with non thinned palms in both study seasons. Acidity (%) and total protein traits did not statisticaly affected by fruit-thinning levels. Total sugers (%) was increased while soluble tannins was decreased as responses to b5 level.

Concerning the action of field treatments, a4b4 treatment was statisticaly superior regarding the bunch weight criterion in both study seasons. Also, a3b5 treatment produced the significant highest fruit weight. Highest pit length value was recorded by a1b3 and a1b5 treatments for the 1st and 2nd seasons, respectively. Also, results observed that a4b5, a4b4, a4b3, a4b2, a3b5, a3b4, a3b3 and a3b2 treatments were related with best significant values of fruit quality traits.

INTRODUCTION

The date palm (*Phoenix dactylifera* L.) is one of the most important fruit crops not only in Egypt but also in the Middle Eastern countries, which produce more than 80% of world production. Egypt is the leading date producing country in the world, with an annual production of 1,113,270 tons in 2002 that accounts for 17.78% of world wide date production (FAO Statistics, 2003). Zaghloul cultivar is leading one in the Northern Delta region and the area devoted for its cultivation is about 4241 Fedans (Ibrahim & Kholif, 2004). Date palm trees can grow successfully in multifarious soils including rich carbonate soil such those in the North Tahrier region, including Nobaria Horticulture Research Station farm. Hence, the present work aims to study the influence of organic and inorganic fertilizers and their level combinations as well as the effect of fruit-thinning models and various experimental treatments on both yield and fruit characteristics of 'Zaghloul' cultivar date palm.

MATERIALS AND METHODS

The present study was carried out during the 2002 and 2003 experimental seasons in the Nobaria Horticulture Research Station farm, North Tahrier region where the soils are rich carbonate (25.5% CaCO3). The study utilized trees of the 'Zaghloul' palms were 15-20 years old. Two main factors were investigated: fertilization types (factor A) and fruit-thinning (factor B). Also, all interactions among factor levels were analyzed. Fertilization types included (1) Zero animal manure + 5 kg NH_3SO_4, (2) 25 kg animal manure + 4 kg NH_3SO_4, (3) 50 kg animal manure + 2 kg NH_3SO_4, and (4) 100 kg animal manure + zero NH_3SO_4 levels. Fruits were thinned by reducing the number of bunches per palm (bunch removal) or reducing the number of stalks (strands) per bunch (bunch thinning). Each pattern being carried out at two levels (25% and 50%). Fruit-thinning models were (1) non-thinned fruits (the basic bunch number was 8 bunches per palm), (2) removing of 25% from total bunches number, (3) thinning of 25% from total stalks in each bunch, (4) removing of 50% from total bunches number, and (5) thinning of 50% from total stalks in each bunch. Fruit-thinning treatments were done after fruit-set.

The organic fertilizer was added in winter (December) as one dose while the mineral fertilizer was added in two doses (the 1st dose was mixed with organic fertilizer in the winter and the 2nd dose was added at the end of May (during fruit growth period). In general, each palm received 1000 gm rock phosphate and 500 gm mineral sulphur at the time of animal manure addition. Twenty field experimental treatments were arranged, as shown in Table (1). Each treatment is represented by 4 palms (as replicates).

Fruit samples were collected at ripening stage (October, 4 - 8 period). Weight of bunchs (kg / bunch) was determined by a field balance. Fruit weight (gm / fruit), fruit length & diameter (cm), pit weight (gm / pit), pit length (cm) and pit diameter(mm) were determined in the laboratory. Total soluble solids (TSS%) in fruit juice was measured using hand refactometer, juice acidity (as malic acid) percentage was titrated (A.O.A.C. 1980), soluble tannins (%) were evaluated by the method of Swain & Hillis (1959), total sugars (%) were determined in dried fruit samples at 56 C^o in an oven to a constant weight (Malik & Singh, 1980), and total protein as total nitrogen (ppm) was determined using the Kjeldahl method according to Jackson (1967).

All obtained data were tabulated and analyzed at the end of each season using a Completely Randomized Design (CRD) according to Steel & Torrie (1980).

RESULTS AND DISCUSSION

1 Yield characteristics:

1.1 Bunch weight (Kgm / bunch):

Both experimental factors and their interactions significantly affected bunch weight in both the study seasons. For the fertilizer types factor, data in Table (2) indicates that the superior significant value of bunch weight was related with the a4 level in both seasons (32.11 and 31.71 kg / bunch for the 1st and 2nd seasons, respectively). However, no significant difference appeared between value related with the a3 level in both study seasons. Always, the a1 level had the lowest significant bunch weight value (25.16 and 24.84 kg / bunch for the 1st and 2nd seasons, respectively). Hussein & Hussein (1983) and Shawky *et al*. (1999) obtained similar results.

Looking at the fruit-thinning factor effect, data tabulated in Table (2) indicates significant differences among values of such a trait. In two season, the b4 level had a significant superior value (32.38 and 32.27 kg / bunch for 1st and 2nd seasons, respectively) compared with values related to the b5, b1and b3 levels. However, no significant difference was apparent when comparing the value related to the b2 level (31.55 and 31.38 kg / bunch for 1st and 2nd seasons, respectively). Results from both seasons demonstrate the influence of leaf / bunch ratio on this criterion. On the other hand, the non thinned palms were statistically commensurate with the removal of 50 and 25% from total stalks from each bunch. These results are in line with those of Azzouz & Hamdy (1974), Badran (1999), and Hammam *et al*, (2002).

Regrading the effect of which experiments, data from the 1st season indicated that the a4b4, a3b4, and a4b2 treatments produced higher bunch weight values compared with most other treatments (34.77, 34.60, and 34.50 kg / bunch, respectively). No significant difference was found among these values. Likewise, a3b4, a4b4 and a4b2 treatments lead to higher bunch weight values compared with most other treatments in the 2nd season (34.73, 34.19 and 34.17 kg / bunch, respectively). No significant differences were found among the recorded values. Always, the lowest significant bunch weight value was related with a1b1 treatment (20.23 and 20.70 kg / bunch for the 1st and 2nd seasons, respectively). Various significant relationships were found in Table (2). These results are consistent with previous results of fertilization and thinning factors as well as agreeing with those of Azzouz & Hamdy (1974), Nixon & Carpenter (1978), and Godara *et al*. (1990).

2 Fruit physical characteristics:

2.1 Fruit weight (gm / fruit):

The statistical analysis of the data indicated that the fruit weight character was significantly affected by both A and B factors and interaction between their levels in both study seasons. Concerning the effect of A factor in the 1st season, data in Table (3) shows that the a3 level had a significantly higher fruit weight value (31.96 gm / fruit) followed by the a4 level (30.13 gm / fruit). The lowest fruit weight was obtained with the a1 level. In the 2nd season, the a3 level produced a significantly higher fruit weight (32.66 gm /

fruit) cmoparing the values related to the a2 and a1 levels, but no significant difference comparing the a4 related value. These results are in line with those observed with the bunch weight criterion. Nixon & Carpenter (1978) described the positive influence of fertilization on fruit weight. Contrarily, Bacha & Abo-Hassan (1983) and Shawky *et al*. (1999) reported that weight of date palm fruits was not significantly affected by nitrogen fertilization.

For the effects of factor B, the data of the 1st season showed that the b5 level had a significantly higher value of this trait (31.79 gm / fruit) but there was no significant difference comparing the b3 related value. The lowest significant value was obtained with the b1 level (25.92 gm / fruit). Regarding the 2nd season, the data declared that the b5 level had the highest fruit weight value (34.65 gm / fruit) followed by the b3 level. Always, the lowest fruit weight value was observed with the b1 level (27.15 gm / fruit), Table (3). Godara *et al.* (1990), Badran (1999) and El-Hammady *et al*. (2002) reported similar findings. It is logical that the higher fruit weight resulted from palms that received 50 or 25% stalks-thinning treatments. On the contrary the lowest fruit weight resulted from non thinned palms.

Reviewing the field experimental treatments effect, data of the 1st season showed that the a3b5 treatment had a significantly higher fruit weight value (34.70 gm / fruit), followed by the a3b3 and a4b5 treatments (33.87 and 31.85 gm / fruit, respectively). In the 2nd season, the a3b5 treatment also had the highest value, but this value did not significantly differ comparing the values produced by the a4b5 and a2b5 treatments (36.13, 35.85, and 35.50 gm/fruit, respectively). Always, the lowest value was correlated with the a1b1 treatment (20.10 and 20.90 gm/fruit for the 1st and 2nd seasons, respectively). Other various significant relationships were presented in Table (3). Nixon & Carpenter (1978) reported the impact of fertilization and fruit-thinning operations on yield and fruit weight. The obtained results are compatible with the impact of factor level.

2.2 Fruit length (cm):

The obtained data indicated that fruit length was statistically affected by the two studied factors and the interaction between their levels. For the effect of fertilization factor, data of two study seasons indicated that the a3 level had a significantly better fruit length value (5.27 and 5.13 cm for the 1st and 2nd seasons, respectively). However, there was no significant difference comparing the values of a4 level in both seasons (5.09 and 4.95 cm for the 1st and 2nd seasons, respectively). The a1 level had the lowest significant value of this trait in both seasons (4.33 and 4.47 cm, for the 1st and 2nd seasons, respectively), Table (4). These results are in line with Hussein & Hussein (1983) and Nixon & Carpenter (1978).

Viewing the fruit-thinning factor, the significant superior fruit length was related with the b5 level (5.35 and 5.47 cm for the 1st and 2nd seasons, respectively). the lowest significant fruit length value was obtained with the b1 level in both experimental seasons (4.19 and 4.09 cm for the 1st and 2nd seasons, respectively), Table (4). El-Makhtoun *et al*.(1995), Hammam *et al*. (2002), and El-Hammady *et al*. (2002) reported that fruit-thinning had affected fruit dimensions, however Azzouz & Hamdy (1974) reported that the physical properties of the fruits were not affected by fruit-thinning. Likewise, Glazner (1993) reported that thinning fruits of ‘Barhi’ dates did not affect their size.

Viewing the impact of the interactions on this criterion, the results of two season indicated that the a3b5 treatment had a significantly higher length value comparing all other treatments (5.95 and 5.85 cm for 1st and 2nd seasons, respectively) but there was no significant difference with the value achieved with the a4b5 treatment (5.80 cm) only in the 2nd season. Always, the lowest significant value was related to the a1b1 treatment (3.61and 3.59 cm for 1st and 2nd seasons, respectively). Other statistically significant relationships were shown in Table (4). Nixon & Carpenter (1978) report similar effects.

2.3 Fruit diameter (cm):

The fruit diameter trait was significantly affected by the two studied factors and their interaction treatments in both study seasons. Concerning the factor A, the data of the two study seasons illustrated that the a3 level had a significantly higher fruit diameter value (2.83 and 2.85 cm for the1st and 2nd seasons, respectively). But the recorded values did not significantly differ from the value related to the a4 level in both study seasons (2.74 and 2.76 cm for the 1st and 2nd seasons, respectively). Always, the a1 level had the lowest significant value of fruit diameter cmoparing all other levels in both study seasons (2.23 and 2.27 cm for the1st and 2nd seasons, respectively), Table (5). These results are in line with the conspectus of Hussein & Hussein (1983) and commentary of Nixon & Carpenter (1978). Regarding the fruit dimension criteria, the results indicated that the applied amount of ammonium sulphate was not enough for obtaining a good fruit size.

Looking factor B, the fruit diameter value related to the b5 level was highest in both study seasons (2.85 and 2.87 cm for the 1st and 2nd seasons, respectively) but did not significantly differ comparing those produced by the b3 and b4 levels (2.73 and 2.71 cm, respectively in the 1st season and 2.79 and 2.76 cm, respectively, in the 2nd season). Always, the b1 level produced the lowest significant fruit diameter value in both seasons (2.21 and 2.20 cm, for the 1st and 2nd seasons, respectively), Table (5). El-Makhtoun *et al*.(1995), Hammam *et al*.(2002), and El-Hammady *et al*. (2002) reported that fruit-thinning affected fruit dimensions. On the contrary, Azzouz & Hamdy (1974) reported that the physical properties of the fruits were not affected by fruit-thinning.

Studying the field treatments effect, data showed that the a3b5 treatment produced a significantly higher fruit diameter value in both experimental seasons (3.05 and 3.04 cm for the 1st and 2nd seasons, respectively). Always, the lowest significant fruit diameter value was produced with the a1b1 treatment (1.88 and 1.90 cm for the 1st and 2nd seasons, respectively). More statistical significant relationships are shown in Table (5). Nixon & Carpenter (1978) support the derived results.

2.4 Flesh thickness (mm):

Flesh thickness criterion was affected by both experimental factors but did not affected by the interaction between their levels in both study seasons.

Data in Table (6) shows that factor A had a similar effect on this trait in both seasons. The highest significant value was obtained with the a3 level (4.12 and 4.39 mm for the 1st and 2nd seasons, respectively). However, this value did not significantly differ from the flesh thickness value resulted from the a4 level in both seasons (3.85 and 3.95 mm for the 1st and 2nd seasons, respectively).The lowest value was obtained with the a1 level. However it was not significantly different from the value related to the a2 level in both study seasons. Shawky *et al*. (1999) studied the effect of nitogen fertilization on the pulp weight of 'Sewy' fruits and found opposite results of those reported here.

For factor B (fruit-thinning), the b5 level lead to the highest value of this criterion in both study seasons (4.13 and 4.14 mm for the 1st and 2nd seasons, respectively). However, no significant difference appeared comparing the values related with the b3 and b4 levels (3.83 and 3.77 for the 1st and 4.02 and 3.89 mm for the 2nd season, respectively). The b1 level caused the lowest significant value in both seasons (2.93 and 3.04 mm, respectively), Table (6). Hammam *et al*. (2002) studied the effect of leaf / bunch ratio and reported that fruit-thinning significantly increased fruit weight, dimensions, and flesh thickness (%). Differences among flesh thickness values conducted from field treatments were not statistically significant in the experiments of Bacha & Abo-Hassan (1983) and Shawky *et al*. (1999).

3 Pit characteristics:

3.1 Pit weight (gm / pit):

Statistical analysis of the data showed that the pit weight was significantly affected by both the A and B factors but was not significantly affected by the interaction between their levels in both study seasons. Regarding the effect of fertilization, the data of 1st season showed that the a1 level lead to a significantly higher pit weight value (3.04 gm / pit) comparing all other levels. There were no significant differences among values produced by the other levels. Similar results were obtained in the 2nd season except the a3 level had the lowest significant value, Table (7). The results are in line with those of flesh thickness but inconsistent with those obtained by Bacha & Abo-Hassan (1983) and Shawky *et al*. (1999), who reported that nitrogen fertilization did not affect seed weight.

Studying the effect of fruit-thinning, the data of 1st season indicated that the b5, b3, and b4 levels had the highest pit weight values (2.95, 2.79 and 2.75 gm / pit, respectively) while the b2 and b1 levels had the lowest values (2.62 and 2.74 gm / pit, respectively). No significant differences were found among values of these two groups. Data from the 2nd season showed that the b5 level lead to the highest pit weight value (2.96 gm / pit), however there was no significant difference comparing the b4 level (2.87 gm/pit), Table (7). The obtained results are in harmony with those of El-Makhtoun *et al*. (1995), but differ from those of El-Hammady *et al*. (2002) and Hammam *et al*. (2002).

3.2 Pit length (cm):

Both studied factors and their interactions had significant influences on the pit length criterion in the two study seasons. Concerning the factor A effect, the a1 level lead to a highest pit length value (3.05 and 3.07 cm for the

2nd season, respectively), however it was not significantly different comparing that associated with the a2 value (3.01 cm) only in the 2nd season, Table (8). These results are harmonious with those previously obtained with the pit weight criterion.

As to the results of fruit-thinining, the data of two seasons showed that the b5 and b3 levels produced the highest pit length (3.07and 3.06 cm for 1st season and 3.09 and 3.06 cm for 2nd season, respectively). The difference between there values was not significant. Always, the lowest pit length produced by b1 level but it was not significantly different than the values related with b2 and b4, Table (8). El-Hammady *et al*. (2002) found that fruit–thinning did not significantly affect seed weight or seed dimensions.

Statistical analysis of the 1st season's data showed that the a1b3 treatment produced a longer pit length value (3.21 cm), however it was not significantly different than the values produced by the a1b5, a4b5, and a3b3 treatments (3.13, 3.10 and 3.08 cm, respectively). The lowest significant value was obtained by the a3b1 and a4b1 treatments (2.84 and 2.85 cm, respectively). In the 2nd season, the a1b5 treatment lead to the highest significant length value (3.17 cm). However it was not significantly different from the values produced by the a1b3, a2b5, a2b3, a3b5, a1b2, and a3b3 treatments. On the other hand, the a3b1 treatment produced the lowest value, Table (8). These results are in harmony with those obtained regarding the fruit weight criterion.

3.3 Pit diameter (mm):

Regarding this criterion, the statistical analysis of the collected data indicated that fertilization types and fruit-thinning models factors as well as their interactions had no significant impact on pit diameter. This indicates that the changes in pit weight were due to changes in pit length rather than pit diameter. This concept is consistent with the results of El-Makhtoun *et al*. (1995), Shawky *et al*. (1999), and Hammam *et al*. (2002), who all reported that the flesh / seed ratio of thinned palms was significantly increased in comparis on with non-thinned palms.

4 Quality traits:

4.1 Total soluble solids (TSS %):

This quality trait was significantly affected by both studied factors and their interactions in both study seasons. For factor A, the data in Table (9) indicates that the a4 level lead to a high TSS (%) value in both study seasons (20.17 and 20.21 %, for the 1st and 2nd seasons, respectively). However, this recorded value did not significantly different from the value obtained with the a3 level (20.03 and 20.16 %, for the 1st and 2nd seasons, respectively). The lowest TSS (%) value was obtained by the a1 level in both study seasons (18.18 and 17.97 %, for the 1st and 2nd seasons, respectively). The obtained results are logical and in line with Nixon & Carpenter (1978) and Hussein & Hussein(1983).

Looking to fruit-thinning factor, the data of two seasons showed that the b1 level lead to the lowest significant TSS (%) value (19.9 and 19.08 %, for the 1st and 2nd seasons, respectively). There were no significant differences among TSS (%) values associated with all other levels (b2, b3, b4 and b5), Table (9). It can be seen that all fruit-thinning treatments increased the TSS content comparing with non-thinned palms (control treatment), as with the studies of El-Makhtoun *et al*. (1995) and El-Hammady *et al*. (2002).

Data of the 1^{st} season showed that high TSS (%) values were obtained with the a4b5, a3b5, a4b3, a4b4, a3b3, a4b2, and a3b4 treatments (20.25, 20.20, 20.20, 20.20, 20.15, 20.13 and 20.11 %, respectively). Statistically, these recorded values had no significant differences. In the 2^{nd} season, high TSS (%) values were associated with the a4b5, a4b3, a4b4, a3b4, a4b2, a3b3, a3b5, and a3b2 treatments (20.37, 20.33, 20.33, 20.27, 20.27, 20.25, 20.25,and 20.20 %, respectively). However, there were no significant differences among these recorded values. Always, the lowest TSS (%) value was related with the a1b1 treatment (17.73 and 17.83 % for 1^{st} and 2^{nd} seasons, respectively). This value was not significantly different than related a1b2 value only in the 2^{nd} season (17.90%). Other significant relationships are presented in Table (9). The highest values of TSS% were produced from field treatments which consisted of high amounts of organic fertilization plus any mode of fruit-thinning. Results of Azzouz & Hamdy (1974), Hussien & Hussien (1983) and Hussien *et al*.(1992) are in harmony with these results.

4.2 Acidity of fruit juice (%):

Fruit juice acidity (%) was statistically affected by fertilization type and by field experimental treatments but not by fruit-thinning in both study seasons. However, the results of El-Makhtoun *et al*. (1995) and Shawky *et al*. (1999) are different than these obtained results. El-Makhtoun *et al*. (1995) reported that acidity of ‘Zaghloul’ fruit was significantly decreased by bunch thinning treatments. Also, Shawky *et al*. (1999) reported that ‘Sewy’ fruit quality was not significantly affected by nitrogen fertilization treatments. Studying the fertilization effect, the data in Table (10) shows that a lower value was related to the a4 level (1.04 and 1.08 % for the 1^{st} and 2^{nd} seasons, respectively). Always, the high value of fruit acidity were associated with the a1 level (1.57 and 1.63 % for the 1^{st} and 2^{nd} seasons, respectively) followed by the a2 level. However, there was no siginficant difference between the two values in the 1^{st} season.

Regarding the experimental treatments effect, the data of 1^{st} season indicated that the highest value of fruit acidity was obtained with the a1b1 treatment (1.63 %), however there were no significant differences among values associated with most of the field treatments, Table (10). Low fruit juice acidity was associated with the a4b2 and a4b5 treatments (1.00 % for both), however there were no significant differences among the values associated with most of the field treatments. In the 2^{nd} season, the data was similar to that from the 1^{st}. The highest fruit juice acidity was obtained with the a1b1 and a1b2 treatments (1.67 % for both), however it was not significantly different from values associated with most of the field treatments. Lowest fruit juice acidity was produced by a4b5 (1.00 %), however no statistically significant differences were found comparing most of the tabulated values (Table10). These results of field treatments are in harmony with Hussien & Hussien (1983) and Hussien *et al*. (1992).

4.3 Total protein (%):

Total protein was significantly affected by fertilization and by the interaction between levels of both factors (experimental treatments). No statistical effect for fruit-thinning appeared in either study seasons. Concerning the influence of fertilization type, the a4 level produced a high value of total protein (%), however it was not statistically different from the value related to the a3 level (6.01 and 5.60 % for the 1st and 6.05 and 5.72 for the 2nd season , respectively). Always, the a1 level lead to a low value of total protein (%), but it was not statistically different from the value related to the a2 (Table 11). Auda et al. (1976) recorded similar values of protein content in Iraqi dates. Hussein *et al*. (1992) also reported similar results with 'Zaghloul' dates.

As for the effect of field treatments, the data of both seasons showed that the a4b5 treatment produced a high total protein (%) value (6.15 and 6.37 % for the 1st and 2nd seasons, respectively), but it was not statistically different from the remainder of the recorded values (Table 11). Always, the lowest value was related to the a1b1 treatment (3.40 and 3.55 % for the 1st and 2nd seasons, respectively). Similar total protrin (%) values were recorded byAuda*et al*. (1976) and Hussien *et al*. (1992).

4.4 Total sugars (%):

Total sugers (%) was significantly affected by fertilization types and fruit-thinning models factors as well as their level interaction treatments in both experimental seasons. Studying the effect of fertilization types factor, the data presented in Table (12) indicats that a statistical positive relationship occurred between the total sugers percentage values and the levels of (A) factor in both study seasons. The differences among all values were significant. Hussein *et al*. (1992) reported similar results on 'Zaghloul' dates. However Hussein & Hussein (1983) reported discrepant results on some dry dates grown a tAsswan.

Viewing the effect of (B) factor, the data observed that the b5 level produced the best significant value of total sugers (%) in both study seasons (79.20 and 79.29 % for 1st and 2nd seasons, respectively) but this recorded value did not statistically differ than the value related with the b4 level in both study seasons (79.05 and 78.88 % for 1st and 2nd seasons, respectively). Always, the b1 level lead to the lowest significant total sugers (%) in both study seasons (77.67 and 77.41 % for 1st and 2nd seasons, respectively). El-Makhtoun *et al*. (1995) found that the total sugars content significantly increased by all thinning treatments.

As for the field treatments, the data of Table (12) declared that the highest significant value of total sugers (%) was obtained by the a4b5 treatment in both study seasons (81.67 and 81.83 % for 1st and 2nd seasons, respectively) followed by the value obtained by the a4b4 treatment (81.23 and 81.37 % for 1st and 2nd seasons, respectively). Always, the a1b1 treatment produced the lowest significant total sugers (%) value in both study seasons. Various statistical differences were found among recorded values. The obtained results are going in line with those of Hussein *et al*. (1992) and El-Makhtoun *et al*. (1995).

4.5 Soluble tannins (%):

The percentage of soluble tannins was statistically affected by both studied factors and their levels interaction treatments in either experimental seasons. A negative relationship was occurred between the values of soluble tannins (%) values and the levels of factor (A) in both study seasons. All differences among the recorded values were statisticaly significant. It means, the lowest significant value (better fruit quality) was produced by the a4 level (0.129 and 0.126 % for 1st and 2nd seasons, respectively) and the highest signficant value (lower fruit quality) was conducted from the a1 level, Table (13). These results are logical and on line with those of Hussein & Hussein (1983) and Hussein *et al*. (1992).

Regarding to factor (B), the data indicated that the best significant value (low value) was conducted from the b5 level (0.210 and 0.201% for 1st and 2nd seasons, respectively). However, there was no significant difference was found with value conducted from the b4 level (0.209 and 0.202 % for 1st and 2nd seasons, respectively), Table (13). The highest significant value (least fruit qulity) of this trait was produced by the b1 level in both study seasons (0.241 and 0.242 % for 1st and 2nd seasons, respectively) but this value did not significantly differ than value related with the b2 level in the 1st season. Bacha & Shaheen (1986), Godara *et al*. (1990) and El-Makhtoun *et al*. (1995) studied the effect of thinning level and treatments and different leaf / bunch ratios on date fruits, they reported compatible results.

Studying the differences among soluble tannins (%) values which resulted from the field treatments, the data in Table (13) indicated that the highest significant value (low quality fruits) was obtained by the a1b1 treatment in both study seasons (0.323 and 0.322 % for 1st and 2nd seasons, respectively). On the other side, the lowest significant value (high quality fruits) was obtained by the a4b5 and a4b4 treatments in both study seasons (0.106 and 0.106 % for 1st season as well as 0.100 and 0.103 % for 2nd season, respectively). No significant difference was found between values of each season. Many statistical differences were presented among the values of each season. Findings of Hussein & Hussein (1983), Godara *et al.* (1990), Hussein *et al*. (1992) and Badran (1999) are compatible with previous results.

Conclusion

It can be conclude that the best farming practices of the fertilization types factor were the a3 (50 kg animal manure + 2 kg NH_3SO_4) and a4 (100 kg animal manure + zero NH_3SO_4) levels concerning the yield characteristics (bunch weight value), fruit physical characteristics (values of fruit weight, fruit dimensions and fruit flesh thickness) as well as fruit quality traits: TSS (%), acidity (%), total protein (%), total sugars (%) and soluble tannins(%). The best farming practices of the fruit-thinning models factor were the b4 (removing of 50% from total bunches number) level concerning the yield characteristics (bunch weight value). However, the b3 (thinning 25% of total stalks in each bunch) and b5 (thinning of 50% from total stalks in each bunch) levels were consentaneous for some fruit physical characteristics (values of fruit weight, fruit diameter and fruit flesh thickness). As well as the b3, b4 and b5 levels were appropriate for some fruit quality traits: TSS (%), acidity (%), total protein (%), total sugers (%) and soluble tannins (%). Likewise, the feild treatments which consisting of possible combinatios of these levels were commodious for these studied specifications.

Table (1) : Field experimental treatments:

Experimental Treatments	**Treat.**	**No.**
Zero animal manure + 5 kg NH_3SO_4 and non-thinned fruits.	a1b1	1
Zero animal manure + 5 kg NH_3SO_4 and removing 25% of total bunches number.	a1b2	2
Zero animal manure + 5 kg NH_3SO_4 and thinning 25% of total stalks in each bunch.	a1b3	3
Zero animal manure + 5 kg NH_3SO_4 and removing 50% of total bunches number.	a1b4	4
Zero animal manure + 5 kg NH_3SO_4 and thinning 50% of total stalks in each bunch.	a1b5	5
25 kg animal manure + 4 kg NH_3SO_4 and non-thinned fruits.	a2b1	6
25 kg animal manure + 4 kg NH_3SO_4 and removing 25% of total bunches number.	a2b2	7
25 kg animal manure + 4 kg NH_3SO_4 and thinning 25% of total stalks in each bunch.	a2 b3	8
25 kg animal manure + 4 kg NH_3SO_4 and removing 50% of total bunches number.	a2b4	9
25 kg animal manure + 4 kg NH_3SO_4 and thinning 50% of total stalks in each bunch.	a2b5	10
50 kg animal manure + 2 kg NH_3SO_4 and non-thinned fruits.	a3b1	11
50 kg animal manure + 2 kg NH_3SO_4 and removing 25% of total bunches number.	a3b2	12
50 kg animal manure + 2 kg NH_3SO_4 and thinning 25% of total stalks in each bunch.	a3b3	13
50 kg animal manure + 2 kg NH_3SO_4 and removing 50% of total bunches number.	a3b4	14
50 kg animal manure + 2 kg NH_3SO_4 and thinning 50% of total stalks in each bunch.	a3b5	15
100 kg animal manure + ZeroNH_3SO_4 and non-thinned fruits.	a4b1	16
100 kg animal manure + Zero NH_3SO_4 and removing of 25% from total bunches number.	a4b2	17
100 kg animal manure + ZeroNH_3SO_4 and thinning 25% of total stalks in each bunch.	a4b3	18
100 kg animal manure + Zero NH_3SO_4 and removing 50% of total bunches number.	a4b4	19
100 kg animal manure + Zero NH_3SO_4 and thinning 50% of total stalks in each bunch.	a4b5	20

Table (2): Effect of fertilization types (A) and fruit-thinning models (B) factors as well as field treatments (their levels interaction) on the bunch weight trait (kg / bunch).

LSD (0.05) : A = 1.23   A = 1.39
B = 1.42   B =1.72
AB = 0.71   AB = 0.74

Table (4): Effect of fertilization types (A) and fruit-thinning models (B) factors as well as field treatments (their levels interaction) on the fruit length trait (cm).

Fertilization types (levels)	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	3.61	4.13	4.44	4.57	4.85	4.33	3.59	4.21	4.86	4.70	4.97	4.47
a2	3.86	4.23	4.65	4.84	4.95	4.51	4.00	4.33	4.90	4.86	5.25	4.67
a3	4.63	4.85	5.35	5.55	5.95	5.27	4.37	5.45	5.55	5.45	5.85	5.13
a4	4.67	4.78	5.15	5.20	5.65	5.09	4.40	4.41	4.88	5.27	5.80	4.18
Mean	4.19	4.50	4.90	5.04	5.35	------	4.09	4.35	5.05	5.07	5.47	------

LSD (0.05) : A = 0.29   A = 0.26
B = 0.30   B = 0.35
AB = 0.16   AB = 0.18

(3): Effect of fertilization types (A) and fruit-thinning models (B) factors as well as field treatments

(their levels interaction) on the fruit weight trait (gm / fruit).

ertilization es (levels)	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	20.10	27.73	29.81	28.77	30.27	27.34	20.90	28.50	29.33	30.05	31.10	28.10
a2	25.13	27.85	29.95	30.10	30.33	28.68	28.03	29.95	31.15	30.19	35.50	30.96
												66
												18

Table (7): Effect of fertilization types (A) and fruit-thinning models (B) factors as well as field treatments (their levels interaction) on the pit weight trait (gm.pit).

Fertilization types (levels)	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	3.17	2.85	2.93	3.10	3.17	3.04	3.11	3.02	2.90	3.01	3.13	3.03
a2	2.85	2.77	2.54	2.73	2.87	2.75	2.80	2.80	2.75	2.74	2.98	2.81
a3	2.15	2.10	2.83	2.87	2.88	2.57	2.20	2.37	2.64	2.75	2.88	2.61
a4	2.85	2.75	2.87	2.85	2.88	2.84	2.79	2.66	2.75	2.98	2.85	2.81
Mean	2.74	2.62	2.79	2.75	2.95	------	2.73	2.71	2.76	2.87	2.96	------

Table (10): Effect of fertilization types (A) and fruit-thinning models (B)factors as well as field treatments (their levels interaction) on the acidity trait (%).

Fertilization types (levels)	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	1.63	1.57	1.60	1.53	1.53	1.57	1.67	1.67	1.60	1.60	1.60	1.63
a2	1.48	1.38	1.33	1.20	1.20	1.32	1.37	1.33	1.23	1.23	1.17	1.27
a3	1.17	1.13	1.17	1.10	1.17	1.15	1.17	1.13	1.13	1.07	1.10	1.12
a4	1.10	1.00	1.01	1.01	1.00	1.02	1.07	1.04	1.03	1.04	1.00	1.03

LSD (0.05) : A = 0.03   A = 0.03
B = NS   B = NA
AB = 0.02   AB = 0.02

s field

ason (2003)		
els (levels)		Mean
b4	b5	
2.96	3.17	3.07
2.94	3.08	3.01
2.94	3.10	2.99
3.00	3.00	2.97
2.96	3.09	------

AB = 0.15   AB = 0.15

Table (9): Effect of fertilization types (A) and fruit-thinning models (B) factors as well as field treatments (their levels interaction) on the TSS trait (%).

Fertilization types (levels)	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	17.83	18.00	17.87	18.60	18.67	18.18	17.73	17.90	18.12	18.03	18.07	17.97
a2	19.10	19.55	19.80	19.43	19.63	19.50	19.17	19.40	19.23	19.20	19.47	19.29
a3	19.03	20.05	20.15	20.11	20.20	20.03	19.57	20.20	20.25	20.27	20.25	20.16
a4	19.80	20.13	20.20	20.20	20.25	20.17	19.83	20.27	20.33	20.33	20.37	20.21
Mean	19.09	19.43	19.51	19.58	19.66	------	19.08	19.44	19.51	19.46	19.57	------

LSD (0.05) : A = 0.22   A = 0.07

Table (11): Effect of fertilization types (A) and fruit-thinning models (B) factors as well as field treatments (their levels interaction) on the total protein trait (%).

Fertilization types (levels)	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	3.40	4.00	4.48	4.48	4.48	4.17	3.55	3.95	4.40	4.40	4.67	4.19
a2	4.71	4.67	4.62	5.08	5.10	4.82	4.52	4.48	4.87	4.80	5.20	4.77
a3	5.32	5.43	5.55	5.83	5.86	5.60	5.39	5.57	5.88	5.85	5.93	5.72
a4	5.90	5.95	5.65	6.07	6.15	6.01	5.87	5.90	6.05	6.07	6.37	6.05

Table (12): Effect of fertilization types (A) and fruit-thinning models (B) factors as well as field treatments (their levels interaction) on the total sugars trait (%).

Fertilization types (levels)	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	75.30	76.00	76.70	77.57	77.73	76.66	74.30	75.97	75.90	76.83	77.40	76.08
a2	77.53	77.80	77.93	78.30	78.40	77.99	77.17	78.03	77.95	78.13	78.27	77.91
a3	78.23	78.70	78.70	79.10	79.00	78.75	78.23	79.34	78.53	79.56	79.67	79.07
a4	79.60	80.27	80.07	81.23	81.67	80.57	79.93	80.17	80.50	81.37	81.83	80.96

Table (13): Effect of fertilization types (A) and fruit-thinning models (B) factors as well as field treatments (their levels interaction) on the soluble tannins trait (%).

Fertilization types (levels)	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	0.323	0.316	0.316	0.310	0.306	0.324	0.322	0.313	0.304	0.301	0.300	0.308
a2	0.280	0.270	0.273	0.263	0.266	0.270	0.279	0.266	0.262	0.243	0.241	0.258
a3	0.193	0.173	0.180	0.156	0.163	0.173	0.200	0.184	0.185	0.163	0.162	0.179
a4	0.169	0.140	0.126	0.106	0.106	0.129	0.166	0.131	0.131	0.103	0.100	0.126
Mean	0.241	0.225	0.224	0.209	0.210	------	0.242	0.223	0.220	0.202	0.201	------

LSD (0.05) : A = 0.015   A = 0.016
B = 0.017   B = 0.018
AB = 0.008   AB = 0.008

Table (5): Effect of fertilization types (A) and fruit-thinning models (B) factors as well as field trait (cm).
treatments (their levels interaction) on the fruit diameter

LSD (0.05) : A = 0.14 A = 0.14
B = 0.17 B = 0.17
AB = 0.08 AB = 0.08

Fertilization types (levels)	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	1.88	2.17	2.30	2.33	2.45	2.23	1.90	2.17	2.40	2.40	2.48	2.27
a2	2.07	2.75	2.87	2.87	2.93	2.70	2.04	2.78	2.90	2.87	2.98	2.71
a3	2.43	2.79	3.00	2.87	3.05	2.83	2.47	2.80	3.01	2.92	3.04	2.85
a4	2.47	2.73	2.73	2.77	2.98	2.74	2.40	2.74	2.85	2.85	2.98	2.18
Mean	2.21	2.61	2.73	2.71	2.85	------	2.20	2.62	2.79	2.76	2.87	------

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الملخص العربى

استجابة محصول نخيل البلح "صنف الزغلول" لنُظم التسميد العضوي والكيماوي المتنوعة والطُرز المختلفة لخف الثمار تحت ظروف التربة الغنية بكربونات الكالسيوم

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أجريت هذه الدراسة بمحطة بحوث البساتين بالنوبارية خلال الموسمين ٢٠٠٢ و ٢٠٠٣ , بهدف بحث استجابة
) بأربعة Aمحصول نخيل البلح "صنف الزغلول" لعدة نُظم من التسميد العضوي والكيماوي (العامل
) , ٢٥ كجم سماد عضوي + ٤ كجم سلفات a1مستويات: بدون سماد عضوي + ٥ كجم سلفات نشادر (
) , ١٠٠ كجم سماد عضوي + صفر a3) , ٥٠ كجم سماد عضوي + ٢ كجم سلفات نشادر (a2نشادر (
), خف b1) بخمسة مستويات: بدون خف ثمار (B)؛ ولعدة طُرز من خف الثمار (العامل a4سلفات نشادر (
), خف ٥٠% من عدد b3) , خف ٢٥% من الشماريخ الزهرية لكل سباطة (b2٢٥% من عدد السباطات (
)؛ وكذلك للمعاملات الحقلية الناتجة b5), خف ٥٠ % من الشماريخ الزهرية لكل سباطة (b4السباطات (
) وعددها ٢٠ معاملة. وتمت دراسة بعضb1-5×a1-4عن التفاعل فيما بين مستويات كلا العاملين (
الصفات الكمية والطبيعية للمحصول والثمار وصفات الجودة للثمار. أوضحت النتائج أن مستويات العاملين التجريبيين والمعاملات الحقلية الناتجة عن التفاعل بين المستويات أثرت معنوياً على معظم الصفات المدروسة ما عدا صفة قطر النواه التي كانت جميع الاختلافات بها ظاهرية وغير حقيقية إحصائياً.
) أدت إلى أفضل القيم إحصائياً للصفات الكمية a4) و(a3ولعامل التسميد, أظهرت النتائج أن المستويات (
والطبيعية للمحصول والثمار من حيث وزن السباطة و وزن الثمرة وأبعاد الثمرة (طول و قطر) وسمك لحم الثمرة, وكذلك أدت إلى أفضل القيم إحصائياً لصفات الجودة للثمار من حيث النسبة المئوية للمواد الصلبة الكلية وحموضة عصير الثمار والبروتين الكلى والسكريات الكلية والتانينات الذائبة. وقد كانت الفروق بين القيم الناتجة عن هذين المستويين غير جوهرية في جميع الأحوال في كلا الموسمين الدراسيين. وأدى المستوى
) إلى أكبر قيمة إحصائياً لصفات وزن وطول النواه كما ارتبط هذا المستوى بالقيم الرديئة لصفات جودة a1(
) متفوقاً معنوياً من حيث القيم الناتجة a2الثمار في كلا الموسمين. وفي جميع الأحوال كان المستوى (
).a1للصفات المدروسة على المستوى (

) أدى إلى أفضل قيمة لوزن للسباطة ولكن هذه القيمة لم b4ولعامل خف الثمار, أوضحت النتائج أن المستوى(
) أدى إلى أفضل القيم إحصائياً b5). والمستوى (b2تختلف جوهرياً عن وزن السباطة الناتج عن المستوى (
من حيث وزن وأبعاد الثمرة وسمك لحم الثمرة و وزن وطول النواه , ولكن القيم الناتجة لم تختلف معنوياً عن
) في الموسم الثاني من حيث وزن b4) و(b3) في الموسم الأول والمستويان (b3تلك الناتجة عن المستوى (
) من حيث قطر الثمرة وسمك لحم b4) و(b3الثمرة, كما لم تختلف معنوياً عن تلك الخاصة بالمستويين (
الثمار و وزن النواه في كلا الموسمين. وبدراسة صفات الجودة للثمار , فقد كانت قيم نسبة المواد الصلبة الذائبة الكلية الناتجة عن جميع طُرز خف الثمار مرتفعة معنوياً بالمقارنة بتلك الناتجة عن أشجار نخيل بدون
). ولم تتأثر صفات النسبة المئوية لحموضة عصير الثمار والبروتين الكلى إحصائياً بعامل طُرز خف b1خف(
الثمار. أما صفات النسبة المئوية للسكريات الكلية والتانينات الذائبة فقد تأثرت معنوياً بعامل خف الثمار, حيث ارتفعت قيمة النسبة المئوية للسكريات الكلية وانخفضت قيمة النسبة المئوية للتانينات الذائبة في لحم الثمار
) في كلا b4) ولكنها لم تختلف جوهرياً عن تلك القيم الناتجة عن المستوى (b5الناتجة عن المستوى (
الموسمين التجريبيين.

) متفوقة معنوياً من حيث قيمة وزن a4b4وللمعاملات التجريبية, فقد بينت النتائج أن المعاملة الحقلية (
) في كلا a4b2) و(a3b4السباطة بالمقارنة بجميع المعاملات إلا أنها لا تختلف جوهرياً عن المعاملتين (
) متفوقة إحصائياً من حيث قيمة وزن الثمرة بالمقارنة بجميع a3b5الموسمين التجريبيين. وأن المعاملة (
) في الموسم الثاني, a2b5) و(a4b5المعاملات في الموسم الأول إلا أنها لم تختلف معنوياً عن المعاملتين (
ومن حيث قيم طول وقطر الثمرة بالمقارنة بجميع المعاملات في كلا الموسمين التجريبيين. وكانت الاختلافات في قيمة سمك لحم الثمار وقيمة وزن النواه الناتجة عن المعاملات الحقلية غير حقيقية إحصائياً. وكانت أعلى
) للموسم الثاني إلا أنها a1b5) في الموسم الأول و المعاملة (a1b3قيمة لطول النواه مسجلة كناتج للمعاملة (
) تؤدى إلى أقل a3b1لا تختلف جوهرياً عن بعض المعاملات الحقلية في كلا الموسمين , كانت المعاملة (
قيمة لطول النواه إلا إنها لا تختلف معنوياً عن بعض المعاملات في كلا الموسمين. وبدراسة صفات الجودة,
) a3b4) و(a3b5) و(a4b2) و(a4b3) و(a4b4) و(a4b5فقد بينت النتائج أن المعاملات الحقلية(
) ارتبطت دائماً بأفضل القيم إحصائياً لصفات جودة الثمار, أما أقل القيم معنوياً لهذه a3b2) و(a3b3و(
) في كلا الموسمين.a1b2) فقط أو بالإضافة للمعاملة (a1b1الصفات فقد نتجت عن المعاملة (

Fertilization types levels	First season (2002)						Second season (2003)					
	Fruit-thinning models (levels)					Mean	Fruit-thinning models (levels)					Mean
	b1	b2	b3	b4	b5		b1	b2	b3	b4	b5	
a1	20.23	26.90	23.53	28.63	26.50	25.16	20.70	26.70	23.33	27.53	25.93	24.84
a2	26.97	30.90	26.13	32.13	27.15	28.66	26.52	30.71	26.75	32.60	26.33	28.58
a3	30.68	33.89	29.56	34.60	28.40	31.43	30.47	33.92	29.67	34.73	27.37	31.23
a4	32.83	34.50	29.15	34.77	29.30	32.11	31.97	34.17	29.27	34.19	28.93	31.71
Mean	27.68	31.55	27.09	32.38	27.84	------	27.42	31.38	27.26	32.27	27.14	------