# RESULTS AND DISCUSSION

# 4. RESULTS AND DISCUSSION

Moreover, table (5-C) reflects the effect of the interaction between organic manure sources and biofertilization. It is obvious that the control with nitrobein biofertilization gave the highest significant values of tree shoot growth rate in the two seasons of study. In contrast, the least values in this subject were found in cammel organic manure combination with uninfected with nitrogen biofertilization (control) trees.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (5-D). It appears that the pomegranate trees which were fertilized by trench application method in combination with nitrobein enhanced a significant increase in shoot growth rate of trees than the other treatments in two seasons of study. While, the control trees, which were provided with organic manures by the surface method gave the least values of shoot growth rate of trees. Generally, nitrogen biofertilization (nitrobein or rhizobacterein) with surface or trench application method enhanced shoot growth rate of pomegranate trees than control trees with surface or trench method.

Moreover, table (5-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that the highest significant values of shoot growth rate occurred when the control in combination with trench and nitrobein treatment was used. On the other hand, the least values of shoot growth rate of pomegranate trees appeared in the trees treated with cammel manure in combination with surface application and nitrobein in the first season. While, the same trend was shown in trees untreated with cattle manure and biofertilization with surface application in the second season. Generally, poultry manure improved shoot growth rate of pomegranate trees especially with trench application and nitrobein nitrogen biofertilization than cattle or cammel manure. These results are in agreement with the findings of Li *et al.* (1998) on apple and with those of Ashinov and Bokanov (1999) on chery, peach, appricot and wild berry.

### 4.1.2. Leaf area:

The data in table (6) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf area during both seasons. It is clear from table (6-A) that the control pomegranate trees gave the highest significant values of leaf area in the two seasons of study compared with the other treatments. In contrast, the least values of pomegranate leaf area were found when trees were treated with cammel organic manure in the second season, while with both cattle and cammel organic manures in the first season. Furthermore, when concerning the application method, the trench method gave the best significant leaf area values as compared with surface application method. Also, nitrobein nitrogen biofertilization increased leaf area values than rhizobacterein or control treatment.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (6-B). It is apparent that trench application method in combination with control treatment gave the highest significant values of leaf area of pomegranate trees than the other combination of application methods (surface or trench) and organic manure sources under study. However, cammel manure source showed the lowermost significant leaf area when with surface or trench in both seasons of study.

Table 6. Leaf area of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| | Season | |
|---|---|---|
| Variable | 2003 | 2004 |
| Control | 45.4 a | 56.7 a |
| Cattle m. | 43.5 c | 49.4 c |
| Poultry m. | 44.7 b | 52.0 b |
| Camel m. | 43.2 c | 47.5 d |
| Surface | 43.9 b | 50.0 b |
| Trench | 44.5 a | 52.8 a |
| Control | 40.9 c | 48.8 c |
| Nitrobein | 46.7 a | 54.2 a |
| Rhizobactrere | 44.9 b | 51.1 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 45.0 b | 43.1 e | 44.2 c | 43.3 e |
| | Trench | 45.9 a | 43.8 d | 45.2 b | 43.1 e |
| 2004 | Surfac | 55.9 b | 48.6 f | 49.2 e | 46.2 g |
| | Trench | 57.5 a | 50.2 d | 54.7 c | 48.7 f |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 40.9 ij | 40.6 j | 41.0 hi | 41.3 h |
| | Nitro. | 49.4 a | 45.9 d | 46.6 b | 45.1 e |
| | Rhizo. | 46.1 cd | 43.9 f | 46.4 bc | 43.3 g |
| 2004 | Contro | 55.4 cd | 47.2 h | 48.6 g | 44.1 i |
| | Nitro. | 58.4 a | 51.9 d | 55.3 c | 51.1 e |
| | Rhizo. | 56.3 b | 49.2 f | 51.9 d | 47.1 h |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 41.1 e | 46.0 b | 44.7 d |
| | Trench | 40.8 e | 47.5 a | 45.2 c |
| 2004 | Surfac | 46.6 f | 53.8 b | 49.6 e |
| | Trench | 51.1 d | 54.6 a | 52.7 c |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 41.0 ij | 40.7 jk | 40.6 jk | 42.1 h |
| | | Nitro. | 47.9 b | 45.4 e | 46.0 d | 44.6 f |
| | | Rhizo. | 46.2 d | 43.3 g | 46.0 d | 43.3 g |
| | Trench | Contro | 40.8 j | 40.4 k | 41.5 i | 40.5 k |
| | | Nitro. | 50.8 a | 46.4 d | 47.2 c | 45.5 e |
| | | Rhizo. | 46.0 d | 44.5 f | 46.8 c | 43.3 g |
| 2004 | Surfac | Contro | 54.8 ef | 46.8 o | 44.6 p | 40.3 q |
| | | Nitro. | 57.7 b | 51.7 i | 53.9 g | 51.9 i |
| | | Rhizo. | 55.2 e | 47.4 n | 49.2 l | 46.5 o |
| | Trench | Contro | 56.0 d | 47.6 mn | 52.6 h | 48.0 m |
| | | Nitro. | 59.0 a | 52.1 i | 56.8 c | 50.4 k |
| | | Rhizo. | 57.4 bc | 51.0 j | 54.7 f | 47.7 mn |



and second seasons of study, respectively. In most cases, the trees of the control with surface or trench application method and fertilized

Moreover, table (6-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that control trees treated with nitrobein gave the best result of leaf area of pomegranate trees as compared with cattle, poultry or cammel manure with or without nitrogen biofertilization. On the other hand, the least values of leaf area were found in cattle manure without biofertilization treatment.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (6-D). It appears that the trench application method and nitrobein treatment induced the highest significant values of leaf area of pomegranate. In contrast, the least values of leaf area were shown in unfertilized with biofertilization trees (control). Generally, nitrobein or rhizobacterein biofertilization with surface of trench application method improved leaf area than uninfected trees (control) with biofertilization with surface or trench application method in two seasons of study.

Moreover, table (6-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control trees, which was applied with trench method and fertilized with nitrobein bacteria gave the highest significant values of leaf area pomegranate trees as compared to all other treatments under study. On the opposite, cattle or poultry organic manure with surface or trench method and unfertilized with biofertilization treatment and cammel manure with surface application method without nitrogen biofertilization treatment gave the least values of leaf area ($cm^2$) of pomegranate trees in the first



Table 7. Vegetative canopy circumference of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| | Season | |
|---|---|---|
| Variable | 2003 | 2004 |
| Control | 9.1 a | 10.1 a |

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (7-B). It is apparent that application of control or poultry organic manure with trench method induced a significant increase in canopy circumference of trees than the other combinations under study through two seasons of study. On the other hand, combination of surface application and cammel organic manure treatment gave the least values of canopy circumference of pomegranate trees.

Moreover, table (7-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that the pomegranate trees fertilized with control with nitrobein biofertilization gave the highest significant values of canopy circumference in two seasons of study. In contrast, the least values were found in the combination of cammel organic manure and control (not infected with nitrogen biofertilization). Canopy circumference of trees showed fluctuation in the other treatments with regard to the interaction between manure sources and application methods.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (7-D). It is clear that the pomegranate trees treated with the combination of trench application method and nitrobein nitrogen biofertilization induced a significant increased in canopy circumference of trees than the other combination treatments in two seasons of study. While, combination of surface application and control trees (not infected with biofertilization) gave the least significant values of canopy circumference of trees. Generally, nitrogen biofertilization (nitrobein or rhizobacterein) with surface or trench application method improved canopy circumference of pomegranate trees than control trees with surface or trench method.

Moreover, table (7-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control treatment (manures) applied with trench method and supplemented with nitrobein combination gave the highest significant values of canopy circumference of pomegranate trees as compared with all other combination treatments under study in two seasons of study. On the opposite, the least values of canopy circumference of trees were found in the trees treated with cammel manure, surface application method and uninfected with biofertilization. Generally, poultry organic manure treatments with trench method and nitrogen biofertilization (nitrobein or rhizobacterein) improved canopy circumference of trees than cattle or cammel organic manure with surface or trench application method and nitrogen biofertilization. These results are in agreement with the findings of Yuyama and Misquita (2000) on peach palm and Abu Grah (2004) on persimmon.

### 4.1.4. Trunk circumference:

The data in table (8) deal with the effect of organic manure (sources and application methods) and biofertilization on trunk circumference during both seasons. It is clear from (8-A) that the trees treated with control gave the highest significant values of trunk circumference as compared with cattle, poultry and cammel manure treatments. The least values of trunk circumference were found with cammel manure treatments. Generally, the best significant results of trunk circumference were shown in descending order, poultry, cattle and cammel manures, respectively during the two seasons of study.

Furthermore, trench application method was more effective in increasing trunk circumference of pomegranate trees than surface application method in the two seasons of study. Moreover, nitrobein nitrogen biofertilization gave the best significant increase in trunk circumference as compared with trees inoculated with rhizobacterein, which came in the second level. The pomegranate trees, which were uninoculated with nitrogen biofertilization (control), showed the lowest significant effect in this concern.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (8-B). It is clear that control treatment combined with trench application method was more effective in inducing a significant increase in trunk circumference of the trees as compared to all the other combination treatments under study. On the opposite, the least values of trunk circumference of pomegranate trees were shown with the cammel organic manure when combined with surface application method. Generally, poultry manure combined either with surface or trench application method was more effective in increasing trunk circumference of the trees than was cattle or cammel manure combied with surface or trench application method.

Moreover, table (8-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that the combined treatment of control pomegranate trees with nitrobein nitrogen biofertilization treatment gave the highest significant values of trunk circumference. While, the least values of trunk circumference were found with the combined treatment of cammel organic manure and control, which was uninoculated with nitrogen bacteria.

Table 8. Trunk circumference of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 66.9 a | 75.7 a |
| Cattle m. | 60.4 c | 68.1 c |
| Poultry m. | 64.0 b | 73.4 b |
| Camel m. | 49.6 d | 60.7 d |
| Surface | 58.0 b | 66.4 b |
| Trench | 62.5 a | 72.5 a |
| Control | 56.3 c | 61.6 c |
| Nitrobein | 64.1 a | 75.7 a |
| Rhizobactrere | 60.3 b | 71.2 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 66.9 b | 55.1 e | 60.0 d | 49.9 f |
| | Trench | 67.0 a | 65.8 c | 68.0 a | 49.2 g |
| 2004 | Surfac | 73.9 b | 64.0 e | 74.1 b | 53.8 f |
| | Trench | 77.6 a | 72.2 c | 72.7 c | 67.6 d |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 63.5 d | 57.0 f | 60.5 e | 44.4 i |
| | Nitro. | 70.8 a | 64.0 d | 67.7 b | 53.9 g |
| | Rhizo. | 66.5 c | 60.3 e | 63.8 d | 50.5 h |
| 2004 | Contro | 67.5 f | 61.2 h | 67.3 f | 50.3 i |
| | Nitro. | 82.5 a | 74.7 d | 77.2 b | 68.3 e |
| | Rhizo. | 77.2 b | 68.5 e | 75.7 c | 63.3 g |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 53.3 e | 62.6 b | 57.9 d |
| | Trench | 59.3 c | 65.5 a | 62.7 b |
| 2004 | Surfac | 60.6 f | 72.1 c | 66.7 d |
| | Trench | 62.6 e | 79.3 a | 75.7 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 63.3 gh | 50.3 k | 55.0 i | 44.7 l |
| | | Nitro. | 70.6 ab | 60.3 gh | 65.0 f | 54.7 i |
| | | Rhizo. | 66.7 d | 54.7 i | 60.0 h | 50.3 k |
| | Trench | Contro | 63.6 g | 63.7 g | 66.0 e | 44.0 m |
| | | Nitro. | 71.1 a | 67.7 c | 70.3 b | 53.0 j |
| | | Rhizo. | 66.4 de | 66.0 e | 67.7 c | 50.6 k |
| 2004 | Surfac | Contro | 64.7 l | 58.7 q | 72.3 ij | 46.7 s |
| | | Nitro. | 80.3 b | 71.7 j | 75.7 fg | 60.7 p |
| | | Rhizo. | 76.7 e | 61.7 o | 74.3 h | 54.0 r |
| | Trench | Contro | 70.3 k | 63.7 m | 62.3 n | 54.0 r |
| | | Nitro. | 84.7 a | 77.7 d | 78.7 c | 76.0 f |
| | | Rhizo. | 77.7 d | 75.3 g | 77.0 e | 72.7 hi |

Table 9. Tree height of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 3.1 a | 3.8 a |
| Cattle m. | 2.7 c | 3.4 b |
| Poultry m. | 2.8 bc | 3.8 a |
| Camel m. | 2.6 c | 3.5 b |
| Surface | 2.7 b | 3.4 b |
| Trench | 2.9 a | 3.9 a |
| ˆontrol | 2.6 b | 3.3 c |
| robein | 3.0 a | 4.1 a |
| izobactrere | 2.8 b | 3.6 b |

y two values sharing an alphabet are not significantly different at 1% level of significance.

ˉffect of the interaction between manure sources and application methods:

| ɔ | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| | Surfac | 3.0 ab | 2.6 c | 2.7 c | 2.6 c |
| | renct | 3.2 a | 2.8 bc | 2.8 bc | 2.6 c |
| | rfac | 3.5 cd | 3.1 e | 3.5 cd | 3.3 de |
| | nct | 4.2 a | 3.8 b | 4.1 a | 3.7 bc |

the interaction between manure sources and biofertilization

| | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| | ntro | 2.8 cde | 2.6 ef | 2.6 ef | 2.6 ef |
| | tro. | 3.4 a | 2.9 bcd | 3.0 bc | 2.8 cde |
| | ıizo. | 3.1 b | 2.7 def | 2.8 cde | 2.5 f |
| | ɔntro | 3.3 c | 3.2 c | 3.4 c | 3.2 c |
| | Vitro. | 4.3 a | 3.9 b | 4.3 a | 3.8 b |
| | Rhizo. | 3.9 b | 3.3 c | 3.8 b | 3.7 b |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 2.6 c | 2.9 ab | 2.7 bc |
| | Trench | 2.7 bc | 3.1 a | 2.8 bc |
| 2004 | Surfac | 2.9 d | 3.7 bc | 3.5 c |
| | Trench | 3.6 bc | 4.4 a | 3.8 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 2.8 de | 2.5 g | 2.6 fg | 2.5 g |
| | | Nitro. | 3.3 b | 2.8 de | 2.9 cd | 2.7 ef |
| | | Rhizo. | 3.0 c | 2.6 fg | 2.7 ef | 2.5 g |
| | Trench | Contro | 2.8 de | 2.7 ef | 2.7 ef | 2.6 fg |
| | | Nitro. | 3.5 a | 2.9 cd | 3.0 c | 2.8 de |
| | | Rhizo. | 3.3 b | 2.7 ef | 2.8 de | 2.5 g |
| 2004 | Surfac | Contro | 2.8 i | 2.8 i | 3.0 h | 3.0 h |
| | | Nitro. | 3.8 de | 3.7 e | 3.8 de | 3.5 f |
| | | Rhizo. | 3.8 de | 2.8 i | 3.7 e | 3.5 f |
| | Trench | Contro | 3.8 de | 3.5 f | 3.8 de | 3.3 g |
| | | Nitro. | 4.8 a | 4.1 b | 4.7 a | 4.0 bc |
| | | Rhizo. | 3.9 cd | 3.7 e | 3.8 de | 3.8 de |

Fig. 1. Tree height as affected by the interaction between manure forms and application methods (average of two seasons).

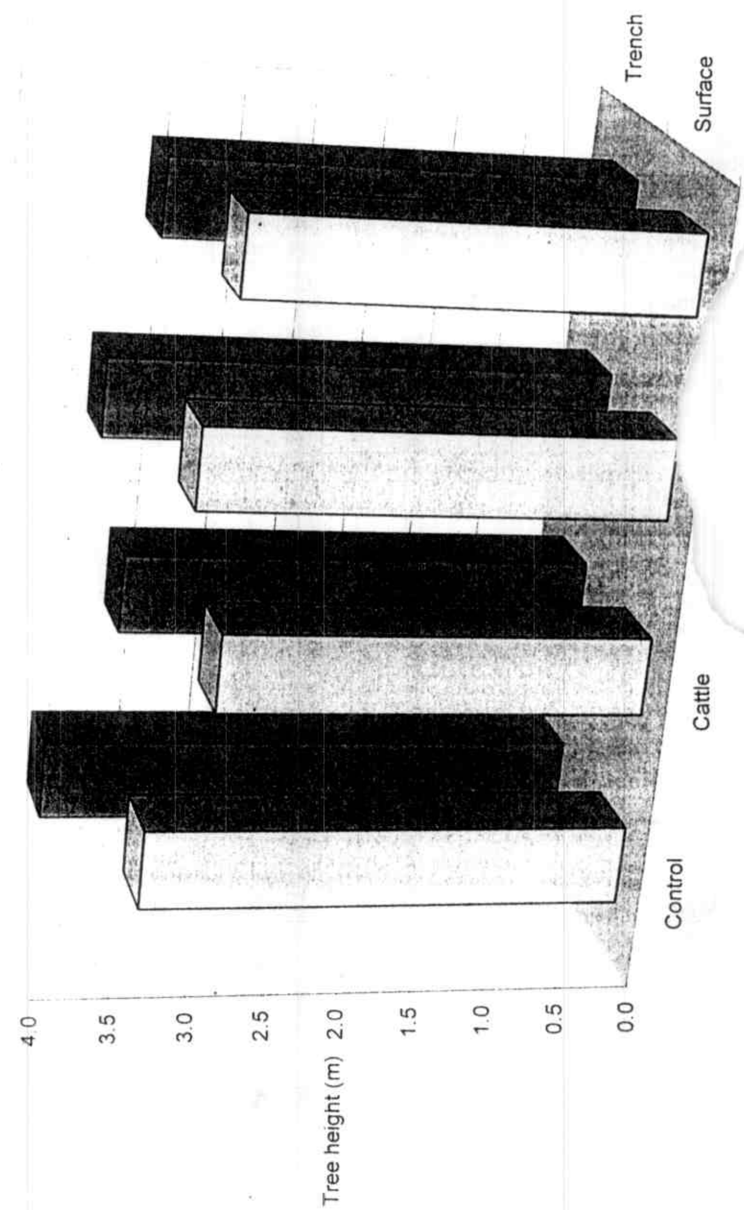


Fig. 2. Tree height as affected by the interaction between manure forms and biofertilization (average of two seasons).

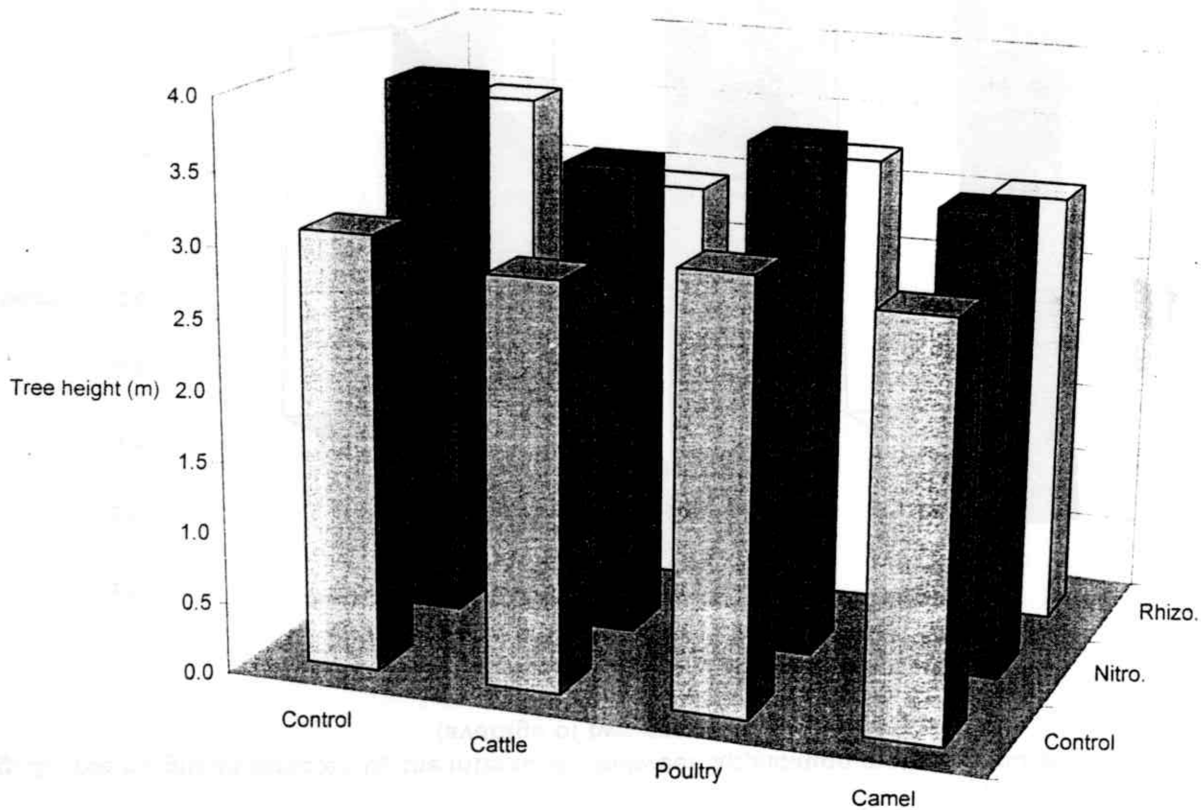
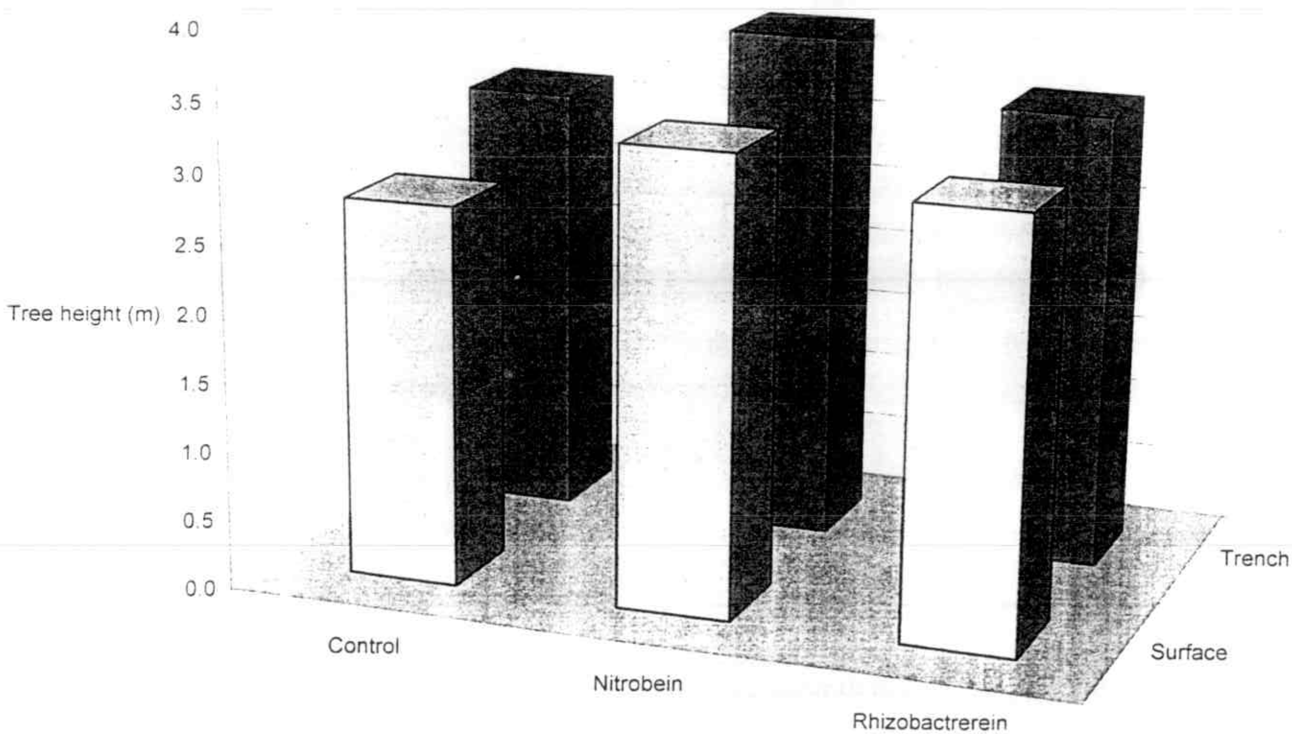


Fig. 3. Tree height as affected by the interaction between application methods and biofertilization (average of two seasons).



The same table (9-B) show also that the fertilized trees with cammel manure with surface application method gave the least values of the height of trees in two seasons of study. Generally, poultry manure with trench method treatment improved the tree height of pomegranate than the trees, which were treated with cattle or cammel manure with surface or trench application method.

Moreover, table (9-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious (9-C) cleared that the pomegranate trees which were fertilized with garden fertilization system (control) and inoculated with nitrobein gave the highest significant values of tree height. While, all organic manures used under study (cattle, poultry and cammel) and uninoculated with nitrogen bacteria decreased the tree height values to lower significant level. Also, poultry manure with nitrobein treatment was more effective in increasing the tree height than cattle or cammel manure with or without nitrobein or rhizobacterein during the two seasons of study.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (9-D) indicated that trench application method with nitrobein treatment was more effective in increasing to highly significantly for tree height values than surface or trench method with or without nitrogen biofertilization used under study. On the other hand, the least tree height values were shown in control trees with surface application method during 2003 and 2004 seasons.

Moreover, table (9-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control plants with trench application method and inoculated with nitrobein gave the highest significant values as compared to all treatments under study. On the opposite, cattle, poultry or cammel manure with surface method and uninoculated with nitrogen biofertilization decreased the values of tree height to the lowest significant level. Generally, poultry manure with trench application method and nitrobein bacteria were coming in the first effect in increasing the values of pomegranate tree height as compared to cattle or cammel manure with surface or trench method and with or without biofertilization through two seasons of study (2003 and 2004). These results are in agreement with the findings of Awad *et al.* (1993) and Abu Sayed Ahmed (1997) on balady mandarin trees.

### 4.1.6. Leaf dry weight percentage:

The data in table (10) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf dry weight percentage during both seasons. It is clear from (10-A) that control plants gave the highest significant values of leaf dry weight as compared with poultry, cattle or cammel manure, which could be arranged in their order. Also, trench application method of organic manures was more effective in increasing leaf dry weight of trees than surface application method. Furthermore, nitrobein bacteria induced a highly significant increase in leaf dry weight percentage of trees as compared with rhizobacterein. In other words, uninoculated trees with nitrogen biofertilization gave the least values of leaf dry weight in the two seasons of study.

Table 10. Plant dry weight percent of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 67.0 a | 72.4 a |
| Cattle m. | 61.3 c | 64.9 c |
| Poultry m. | 65.0 b | 67.4 b |
| Camel m. | 57.4 d | 60.3 d |
| Surface | 61.9 b | 65.1 b |
| Trench | 63.4 a | 67.4 a |
| Control | 60.3 c | 64.6 b |
| Nitrobein | 65.2 a | 69.3 a |
| Rhizobactrere | 62.5 b | 64.7 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 65.7 b | 59.9 e | 64.0 c | 58.2 ef |
| | Trench | 68.3 a | 62.7 d | 65.9 b | 56.6 f |
| 2004 | Surfac | 72.0 cd | 64.5 e | 67.1 cd | 56.8 de |
| | Trench | 72.8 a | 65.3 b | 67.6 a | 63.8 bc |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 65.2 d | 58.7 h | 61.9 e | 55.4 j |
| | Nitro. | 69.1 a | 64.3 e | 67.4 b | 59.8 g |
| | Rhizo. | 66.7 c | 60.9 f | 65.6 d | 56.9 i |
| 2004 | Contro | 70.8 c | 62.7 i | 64.2 h | 60.9 j |
| | Nitro. | 74.4 a | 67.1 f | 70.1 d | 65.5 g |
| | Rhizo. | 71.9 b | 64.8 h | 67.8 e | 54.4 k |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 59.7 d | 64.5 b | 61.6 c |
| | Trench | 60.9 c | 65.8 a | 63.4 b |
| 2004 | Surfac | 64.7 c | 68.6 a | 61.9 d |
| | Trench | 64.6 c | 70.0 a | 67.5 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 64.3 i | 57.3 p | 61.2 l | 56.0 q |
| | | Nitro. | 67.3 cd | 63.2 j | 66.5 ef | 61.2 l |
| | | Rhizo. | 65.5 gh | 59.3 n | 64.3 i | 57.3 p |
| | Trench | Contro | 66.1 fg | 60.1 m | 62.5 k | 54.8 r |
| | | Nitro. | 71.0 a | 65.4 h | 68.4 b | 58.5 o |
| | | Rhizo. | 67.8 c | 62.5 k | 66.9 de | 56.4 q |
| 2004 | Surfac | Contro | 70.9 de | 62.6 l | 64.2 k | 61.0 m |
| | | Nitro. | 73.7 b | 66.2 i | 69.8 f | 64.9 j |
| | | Rhizo. | 71.3 d | 64.6 jk | 67.5 h | 44.4 n |
| | Trench | Contro | 70.7 e | 62.7 l | 64.3 k | 60.8 m |
| | | Nitro. | 75.2 a | 68.1 g | 70.5 e | 66.1 i |
| | | Rhizo. | 72.5 c | 65.0 j | 68.2 g | 64.4 k |

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (10-B). It is clear that control treatment applied by trench method gave the highest significant values of leaf dry weight as compared to the other combination treatments. The least significant values of leaf dry weight of pomegranate trees were found with the application of cammel manure by surface application. Generally, poultry organic manure with trench method was more effective in increasing leaf dry weight than cattle or cammel manure with both application methods.

Moreover, table (10-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that control trees treated with nitrobein gave the best results of leaf dry weight percent of pomegranate trees as compared with cattle, poultry or cammel manure either with or without nitrogen biofertilization. On the other hand, the least values of leaf dry weight percent were found with cammel manure combined with rhizobacterein treatment.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (10-D). Data in this table indicate that trench application method combined with nitrobein treatment induced the highest significant values of leaf dry weight percent of pomegranate. In contrast, the least significant values of leaf dry weight percent were shown when the trees were not infected with biofertilization (control). Generally, nitrogen biofertilization (nitrobein or rhizobacterein) combined with either surface or trench application method improved leaf dry weight percent than uninoculation in the two seasons of study.

Moreover, table (10-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control treatment combined with trench application method and infected with nitrobein bacteria gave the highest significant values of leaf dry weight percent of pomegranate trees as compared with all other combination treatments under study. Generally, the control trees combined with either surface or trench application method and infected with nitrogen biofertilization (nitrobein or rhizobacterein) increased leaf dry weight percent than all organic manures under study in the two seasons. These results are in agreement with the findings of El Kobbia (1999).

### 4.1.7. Number of leaves:

The data in table (11) deal with the effect of organic manure (sources and application methods) and biofertilization on number of leaves during both seasons. It is clear from table (11-A) that the control trees gave the highest significant values of number of leaves as compared with the trees fertilized with cattle, poultry and cammel organic manure. Moreover, trench application method significantly increased the number of leaves than surface application method in the two seasons of study.

Also, nitrobein nitrogen biofertilization induced a significant increase in number of leaves of trees as compared to trees treated with rhizobacterein or uninoculated trees (control).

Table 11. Number of leaves of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 5.1 a | 5.3 a |
| Cattle m. | 4.7 b | 4.8 c |
| Poultry m. | 4.6 b | 5.1 b |
| Camel m. | 4.0 c | 4.5 d |
| Surface | 4.5 b | 4.8 b |
| Trench | 4.8 a | 5.0 a |
| Control | 4.1 c | 4.4 b |
| Nitrobein | 5.0 a | 5.4 a |
| Rhizobactrere | 4.7 b | 5.0 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 5.1 a | 4.5 de | 4.5 de | 3.7 f |
| | Trench | 5.1 a | 4.9 b | 4.7 c | 4.4 e |
| 2004 | Surfac | 5.2 b | 4.8 e | 5.0 cd | 4.3 g |
| | Trench | 5.4 a | 4.9 de | 5.1 bc | 4.6 f |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 4.3 f | 4.3 f | 4.1 g | 3.8 h |
| | Nitro. | 5.8 a | 5.1 c | 5.3 b | 4.0 g |
| | Rhizo. | 5.2 bc | 4.8 d | 4.5 e | 4.4 ef |
| 2004 | Contro | 4.7 e | 4.4 f | 4.4 f | 4.0 g |
| | Nitro. | 5.9 a | 5.3 c | 5.5 b | 4.9 d |
| | Rhizo. | 5.3 c | 4.9 d | 5.3 c | 4.5 f |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 4.2 e | 4.7 c | 4.5 d |
| | Trench | 4.0 f | 5.4 a | 4.9 b |
| 2004 | Surfac | 4.3 d | 5.3 b | 4.8 c |
| | Trench | 4.4 d | 5.5 a | 5.2 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 4.8 fg | 4.3 i | 4.1 j | 3.7 l |
| | | Nitro. | 5.5 b | 4.9 ef | 5.1 d | 3.3 m |
| | | Rhizo. | 5.0 de | 4.5 h | 4.5 h | 4.1 j |
| | Trench | Contro | 3.9 k | 4.4 hi | 4.1 j | 3.8 kl |
| | | Nitro. | 6.0 a | 5.3 c | 5.5 b | 4.7 g |
| | | Rhizo. | 5.4 bc | 5.0 de | 4.5 h | 4.7 g |
| 2004 | Surfac | Contro | 4.8 hi | 4.3 kl | 4.4 k | 3.8 m |
| | | Nitro. | 5.7 b | 5.2 e | 5.4 d | 4.8 hi |
| | | Rhizo. | 5.0 fg | 4.8 hi | 5.1 ef | 4.2 l |
| | Trench | Contro | 4.6 j | 4.4 k | 4.4 k | 4.3 kl |
| | | Nitro. | 6.2 a | 5.4 d | 5.6 bc | 4.9 gh |
| | | Rhizo. | 5.5 cd | 5.1 ef | 5.5 cd | 4.7 ij |

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (11-B). It is shown that the highest significant of number of leaves is found with trench method. While, the least significant values in number of leaves is found with cammel manure and surface application method in the two seasons of study.

Moreover, table (11-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that the control pomegranate trees inoculated with nitrobein gave the highest significant values of number of leaves. While, all organic manures used under study (cattle, poultry and cammel) and uninoculated with nitrogen bacteria significantly decreased the number of leaves. Also, poultry manure with nitrobein treatment was more effective in increasing the number of leaves than cattle or cammel manure with or without nitrobein or rhizobacterein during two seasons of study.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (11-D). It is indicated that trench application method with nitrobein treatment was more effective in increasing the number of leaves than surface or trench method with or without nitrogen biofertilization used under study. On the other hand, the least number of leaves was shown in the control trees with surface application method during 2003 and 2004 seasons.

Moreover, table (11-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control trees with trench application method and inoculated with nitrobein gave the highest significant number of leaves as compared to all treatments under study. On the opposite, cattle, poultry or cammel manure with surface method and uninoculated with nitrogen biofertilization decreased the number of leaves values to a lower significant level. Generally, poultry manure with trench application and nitrobein bacteria were coming in the first effect in increasing the number of leaves values of pomegranate trees as compared to cattle or cammel manure with surface or trench method and with or without biofertilization through two seasons of study (2003 and 2004). These results are in agreement with the findings of Li *et al.* (1998) on apple, El Kobbia (1999) on Washington navel orange.

**4.1.8. Leaf chlorophyll content:**

The data in table (12) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf chlorophyll content during both seasons. It is clear from table (12-A) that the trees treated with poultry manure gave the highest significant values of chlorophyll content of leaves as compared to cattle, cammel and the control trees. The least significant values of chlorophyll in leaves were found with cammel manure treatments. Generally, the best significant results of chlorophyll content of leaves were shown with poultry manure and the control trees during the two seasons of study. Moreover, trench application method was more effective in increasing chlorophyll content of pomegranate leaves than surface method in the two seasons of study. Furthermore, nitrobein nitrogen biofertilization gave the best significant increase in chlorophyll as compared with inoculation with rhizobacterein. Nitrogen biofertilization was highly significantly advantageous for the pomegranate trees than uninoculation in both years of study.

Table 12 Total chlorophyll in pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season 2003 | Season 2004 |
|---|---|---|
| Control | 42.2 b | 46.1 b |
| Cattle m. | 39.9 c | 44.7 c |
| Poultry m. | 42.7 a | 47.5 a |
| Camel m. | 38.9 d | 41.4 d |
| Surface | 40.5 b | 43.8 b |
| Trench | 41.3 a | 46.1 a |
| Control | 36.8 c | 40.1 c |
| Nitrobein | 44.4 a | 48.8 a |
| Rhizobactrere | 41.5 b | 45.8 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 41.1 c | 39.4 e | 42.7 b | 38.8 e |
| | Trench | 43.3 a | 40.3 d | 42.6 b | 39.0 e |
| 2004 | Surfac | 44.5 d | 43.7 e | 46.9 b | 40.0 g |
| | Trench | 47.7 a | 45.8 c | 48.1 a | 42.8 f |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 36.3 j | 36.2 jk | 39.0 i | 35.8 k |
| | Nitro. | 47.8 a | 43.0 d | 45.5 b | 41.3 f |
| | Rhizo. | 42.5 e | 40.5 g | 43.5 c | 39.5 h |
| 2004 | Contro | 35.6 k | 42.3 h | 44.2 g | 38.5 j |
| | Nitro. | 53.5 a | 46.9 e | 50.8 b | 44.1 g |
| | Rhizo. | 49.3 c | 45.0 f | 47.6 d | 41.5 i |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 36.6 e | 43.9 b | 41.0 d |
| | Trench | 37.0 e | 44.9 a | 42.0 c |
| 2004 | Surfac | 38.5 f | 47.8 b | 45.0 d |
| | Trench | 41.8 e | 49.8 a | 46.6 c |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 34.3 n | 35.7 m | 39.3 i | 37.3 k |
| | | Nitro. | 47.0 b | 42.3 g | 46.0 c | 40.3 h |
| | | Rhizo. | 42.0 g | 40.3 h | 43.0 f | 38.7 j |
| | Trench | Contro | 38.3 j | 36.7 l | 38.7 j | 34.3 n |
| | | Nitro. | 48.7 a | 43.7 e | 45.0 d | 42.3 g |
| | | Rhizo. | 43.0 f | 40.7 h | 44.0 e | 40.3 h |
| 2004 | Surfac | Contro | 31.7 q | 40.9 n | 44.0 jk | 37.3 p |
| | | Nitro. | 53.0 b | 46.0 h | 49.3 e | 43.0 m |
| | | Rhizo. | 48.8 f | 44.2 j | 47.5 g | 39.7 o |
| | Trench | Contro | 39.4 o | 43.6 kl | 44.3 j | 39.7 o |
| | | Nitro. | 53.9 a | 47.9 g | 52.3 c | 45.3 i |
| | | Rhizo. | 49.8 d | 45.7 h | 47.7 g | 43.3 lm |

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (12-B). It can be seen that control trees combined with trench application method was more effective in increasing chlorophyll content of the leaves as compared to the other treatments under study. On the opposite, the least significant values of chlorophyll were shown with cammel organic manure applied by surface method. Generally, poultry manure applied by either surface or trench method was more effective in increasing chlorophyll content than cattle or cammel manure with both application methods.

Moreover, table (12-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that the control pomegranate trees, which were inoculated with nitrobein nitrogen biofertilization gave the highest significant values of chlorophyll content in leaves. While, the least values of chlorophyll content were found with cammel organic manure that was not inoculated with nitrogen bacteria. Generally, the trees fertilized with poultry manure combined with nitrobein ranked the second in increasing chlorophyll. Also, nitrogen bacteria induced a significant increase in chlorophyll content of leaves when combined with all organic manures especially poultry manure.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (12-D). It is clear that the pomegranate trees, which were treated by trench method and inoculated with nitrobein nitrogen biofertilization, gave the highest significant values of chlorophyll. In contrast, surface application method combined with rhizobacterein was more effective in decreasing level of chlorophyll. Generally, trench method combined with biofertilization increased chlorophyll content especially with nitrobein bacteria as compared with surface method either with or without biofertilization.

Moreover, table (12-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control trees combined with trench application method and infected with nitrobein gave the highest significant values of chlorophyll as compared with all other treatments under study in the two seasons (2003 and 2004). On the other hand, the least values of chlorophyll were shown when trees were treated with cammel manure by trench application method and uninfected with biofertilization. Generally, poultry manure by trench application method and infected with nitrobein was more effective in increasing chlorophyll than cattle or cammel organic manure either with surface or trench method either with inoculation with biofertilization or without it.

Generally, the pomegranate trees treated with the control by trench application method and infection with nitrobein bacteria gave the highest significant values of shoot growth rate, leaf area, canopy circumference, trunk circumference, tree height, leaf dry weight, number of leaves and leaf chlorophyll content. These results are in agreement with the findings of El-Kobbia (1999) on Washington navel orange, Yuyama and Mesquita (2000) on peach palm and Salama (2002) on Balady mandarin.

### 4.2. Leaf mineral content:

#### 4.2.1. Leaf nitrogen content:

The data in table (13) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf nitrogen content during both seasons. It is clear from (13-A) that the control pomegranate trees gave the highest significant values of leaf nitrogen content in the first season, while poultry manure did in the second. On the contrast, cammel and cattle manures were more effective in decreasing leaf N content in the first and second seasons, respectively. Moreover, trench application method was more effective than surface method in leaf N content in the first season, but the opposite was true in the second season. Biofertilization with Nitrobein was more effective in increasing leaf N content through the two seasons of study. While, rhizobacterein treatment showed fluctuated pattern in both seasons. It decreased leaf N content than control plants in the first and increased it in the second seasons.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (13-B). It is clear that control trees receiving their fertilization by trench application method treatment in the first season and poultry manure with trench application method treatment in the second season gave the highest significant level of leaf N content. On the opposite, cammel manure by surface method or control trees by trench method treatments significantly decreased leaf N content than the other treatments of the interaction between manure sources and application methods in the first and second seasons of study, respectively.

Table 13. Leaf nitrogen content of pomegranate as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season 2003 | Season 2004 |
|---|---|---|
| Control | 1.44 a | 1.69 c |
| Cattle m. | 1.41 b | 1.55 d |
| Poultry m. | 1.38 c | 2.01 a |
| Camel m. | 1.21 d | 1.77 b |
| Surface | 1.33 b | 1.78 a |
| Trench | 1.39 a | 1.73 b |
| Control | 1.33 b | 1.50 c |
| Nitrobein | 1.46 a | 1.95 a |
| Rhizobactrere | 1.29 c | 1.82 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 1.30 d | 1.32 d | 1.54 b | 1.18 f |
| | Trench | 1.58 a | 1.51 c | 1.23 e | 1.23 e |
| 2004 | Surfac | 1.97 b | 1.39 f | 1.92 c | 1.85 d |
| | Trench | 1.42 f | 1.70 e | 2.09 a | 1.69 e |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 1.18 f | 1.20 f | 1.69 b | 1.27 e |
| | Nitro. | 1.43 c | 1.88 a | 1.19 f | 1.35 d |
| | Rhizo. | 1.72 b | 1.17 f | 1.27 e | 1.00 g |
| 2004 | Contro | 1.63 f | 1.38 j | 1.47 i | 1.52 h |
| | Nitro. | 1.59 g | 1.93 d | 2.45 a | 1.83 e |
| | Rhizo. | 1.86 e | 1.33 k | 2.11 b | 1.98 c |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 1.39 c | 1.46 a | 1.16 e |
| | Trench | 1.28 d | 1.47 a | 1.42 b |
| 2004 | Surfac | 1.50 d | 2.06 a | 1.79 c |
| | Trench | 1.49 d | 1.84 b | 1.85 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 1.17 jk | 1.25 i | 1.93 c | 1.20 j |
| | | Nitro. | 1.55 d | 1.38 f | 1.55 d | 1.35 fg |
| | | Rhizo. | 1.18 j | 1.33 gh | 1.13 k | 1.00 L |
| | Trench | Contro | 1.18 j | 1.14 k | 1.45 e | 1.33 gh |
| | | Nitro. | 1.30 h | 2.38 a | 0.83 m | 1.35 fg |
| | | Rhizo. | 2.25 b | 1.00 l | 1.42 e | 1.01 l |
| 2004 | Surfac | Contro | 1.63 h | 1.30 n | 1.43 lm | 1.63 h |
| | | Nitro. | 2.23 c | 1.53 i | 2.30 b | 2.18 d |
| | | Rhizo. | 2.05 e | 1.33 n | 2.04 e | 1.75 f |
| | Trench | Contro | 1.62 h | 1.45 kl | 1.50 ij | 1.40 m |
| | | Nitro. | 0.95 o | 2.33 b | 2.60 a | 1.48 jk |
| | | Rhizo. | 1.68 g | 1.33 n | 2.18 d | 2.20 cd |

Moreover, table (13-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that cattle and poultry manure combined with nitrobein was more effective in increasing leaf N content of pomegranate trees than all the other treatments of study in the first and second seasons, respectively. The least significant values of leaf N content were found in the trees treated with cattle manure and rhizobacterein in two seasons of study. Generally, nitrobein bacteria with all manure sources under study improved leaf N content of trees as compared to the analogous ones of rhizobacterein treatments.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (13-D). It is obvious that surface or trench application method combined with inoculation with nitrobein gave the best results of leaf N content compared with the other treatments of the application method and nitrogen biofertilization in the first season. The same trend was shown with nitrobein biofertilization combined with surface application method on leaf N content in the second season.

On the other hand, the pomegranate trees, which treated with surface method and inoculated with rhizobacterein gave the least significant values of leaf N content in the first season (Table 13-E). The surface or trench method with uninoculation with biofertilization in the second season gave the least significant values of leaf N content. Generally, nitrobein bacteria combined with surface or trench application method was more effective in increasing leaf N content of trees than rhizobacterein or uninoculated with nitrogen biofertilization (control). Cattle manure by trench application method and inoculated with nitrobein in the first season or poultry manure with trench method and nitrobein treatment gave the highest significant values of leaf N content of pomegranate trees as compared to all treatments under study. While, lowest significant values of leaf N content were found in trees that were treated with poultry manure by trench method and inoculated with nitrobein in the first or second season of study, respectively. Generally, trench application method and nitrobein bacteris with control or three manure sources improved leaf N content of trees than surface method and rhizobacterein with control or organic manure sources. Also, cammel manure decreased leaf N content with or without biofertilization and the application method of surface or trench. Our findings agree with those by Tkachuk (1983) on apple, Smith (1994) on banana plants, and those of Moustafa (2002) on Washington navel orange trees.

### 4.2.2. Leaf phosphorus content:

The data in table (14) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf phosphorus content during both seasons. It is clear from table (14-A) that the pomegranate trees of the control treatment gave the highest significant values of leaf phosphorus content as compared to the organic manures (cattle, poultry and cammel) used under study. In the same time, cammel organic manure increased leaf P content than cattle and poultry manure in the first season, while poultry manure gave the same trend in increasing leaf P content over cattle and cammel manure in the second season. Also, when concerned leaf P content with application method, the data in table (14-A) indicated that surface method gave the same values in this concern which came with trench method in two seasons of study.

Table 14. Leaf phosphorus content of B100pomegranate as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 0.59 a | 0.68 a |
| Cattle m. | 0.50 b | 0.53 d |
| Poultry m. | 0.50 b | 0.62 b |
| Camel m. | 0.57 a | 0.56 c |
| Surface | 0.53 a | 0.60 a |
| Trench | 0.55 a | 0.60 a |
| Control | 0.60 a | 0.64 a |
| Nitrobein | 0.56 b | 0.61 b |
| Rhizobactrere | 0.47 c | 0.55 c |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 0.56 c | 0.53 cd | 0.54 c | 0.50 de |
| | Trench | 0.61 b | 0.47 ef | 0.46 f | 0.65 a |
| 2004 | Surfac | 0.73 a | 0.47 f | 0.72 a | 0.46 f |
| | Trench | 0.62 c | 0.58 d | 0.53 e | 0.66 b |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 0.71 a | 0.54 de | 0.56 cd | 0.58 c |
| | Nitro. | 0.58 c | 0.52 e | 0.49 f | 0.65 b |
| | Rhizo. | 0.47 fg | 0.45 g | 0.45 g | 0.49 f |
| 2004 | Contro | 0.71 b | 0.58 de | 0.74 a | 0.52 f |
| | Nitro. | 0.76 a | 0.42 g | 0.61 d | 0.66 c |
| | Rhizo. | 0.56 e | 0.59 de | 0.52 f | 0.52 f |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 0.61 a | 0.53 b | 0.45 c |
| | Trench | 0.58 a | 0.59 a | 0.48 c |
| 2004 | Surfac | 0.56 c | 0.61 b | 0.62 b |
| | Trench | 0.71 a | 0.61 b | 0.47 d |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 0.76 a | 0.59 ef | 0.58 ef | 0.52 ij |
| | | Nitro. | 0.43 lm | 0.61 de | 0.52 ij | 0.55 gh |
| | | Rhizo. | 0.49 k | 0.40 m | 0.50 jk | 0.42 lm |
| | Trench | Contro | 0.66 c | 0.49 k | 0.54 hi | 0.63 d |
| | | Nitro. | 0.72 b | 0.42 lm | 0.45 l | 0.76 a |
| | | Rhizo. | 0.45 l | 0.51 jk | 0.40 m | 0.57 fg |
| 2004 | Surfac | Contro | 0.71 c | 0.44 j | 0.76 b | 0.32 l |
| | | Nitro. | 0.83 a | 0.35 k | 0.62 f | 0.63 ef |
| | | Rhizo. | 0.65 e | 0.63 ef | 0.77 b | 0.44 j |
| | Trench | Contro | 0.71 c | 0.71 c | 0.72 c | 0.71 c |
| | | Nitro. | 0.68 d | 0.49 i | 0.59 g | 0.69 cd |
| | | Rhizo. | 0.47 i | 0.54 h | 0.27 m | 0.59 g |

Moreover, uninoculated trees with nitrogen biofertilization were more effective in increasing leaf P content than nitrobein or rhizobacterein. In the same time, nitrobein induced an increase in leaf P content of pomegranate trees than rhizobacterein.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (14-B). This table shows that cammel manure and trench application method treatment was more effective in increasing leaf P content than the other treatment in the interaction between manure sources and application method in the first season. While, control plants or poultry manure trees came the same trend in the highest significant values of leaf P content in the second season. The least significant values of leaf P content were found in cattle manure with surface method treatment in the first and second season, respectively.

Moreover, table (14-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that uninoculated control plants with biofertilizatin and control trees gave the best result in leaf P content in the first season, while control plants with nitrobein gave the best result in this concern in the second season. In contrast, cattle or poultry manure trees which inoculated with rhizobacterein came in the least significant values of leaf P content in the first season, while cattle manure with nitrobein treatment gave the same least values in this concern in the second season. Generally, poultry manure and uninoculated with biofertilization improved leaf P content than cattle or cammel manure and without bacteria especially in the second season.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (14-D). It is clear that surface or trench method without infection with nitrogen bacteria gave the highest significant values of leaf P content in the second season. Also, surface or trench method with nitrobein treatments came in the second level of leaf P content, while rhizobacterein with surface or trench method treatment were coming the third rank and the least level.

Moreover, table (14-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control plants with surface method and uninoculated with bacteria treatment in the first season and control trees with surface method and fertilized with nitrobein treatment in the second season were more effective in increasing leaf P content than all treatments under study. In the opposite, the trees fertilized with cattle manure with surface method and rhizobacterein in the first season and the pomegranate trees fertilized with cammel manure with surface method and without nitrogen bacteria came in the last significant values of leaf P content in the second season. Our results agreed with those by Tkachuk (1983) on apple, Smith (1994) on banana plants, and Salama (2002) on balady mandarin.

### 4.2.3. Leaf potassium content:

The data in table (15) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf potassium content during both seasons. It is clear from table (15-A) that the pomegranate trees, which fertilized with poultry organic manure, gave the highest significant values of leaf potassium content in the first season, while cammel manure did in the second season. On the other hand, cattle and the control gave the least significant values of leaf potassium content of trees in the first and second seasons of study, respectively. Moreover, surface application method was more effective than trench method in leaf potassium content in the first season, but the opposite was true in the second season of this study.

Furthermore, the uninoculation with biofertilization gave the highest significant values of leaf potassium content in the first season. While, rhizobacterein treatment gave the same result in the second season. Additionally, biofertilization (rhizobacterein and nitrobein) treatments gave the least significant values of leaf potassium content in the first season. On the opposite, the control treatment decreased leaf potassium content in the second season.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (15-B). It is obvious that poultry manure by trench application method gave the highest significant level of leaf potassium content in both seasons of study. On the opposite, the control trees that were fertilized by trench method in the first season and poultry manure by surface application method significantly decreased leaf potassium content of trees than the other treatments in both seasons of study.

Moreover, table (15-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious (15-C) that poultry manure with nitrobein and cattle manure with rhizobacterein treatments were more effective in increasing leaf potassium content of pomegranate trees than the other treatments in the first and second seasons, respectively. The least significant values of leaf potassium content were found in the control trees combined with nitrobein bacteria in the first season. Generally, rhizobacterein bacteria with all manure sources under study improved leaf potassium content of trees as compared to the analogous ones of nitrobein treatments.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (15-D). It is clear that the control trees with surface or trench application method gave the highest significant values of leaf potassium content. While, trench method with nitrobein bacteria was the second in increasing leaf potassium content in the first season. Beside, rhizobacterein trees with surface application method gave the best result of leaf potassium content in the second season. On the other hand, the pomegranate trees treated with surface method and inoculated with nitrobein bacteria gave the least significant values of leaf potassium content. Generally, nitrobein bacteria with trench application method gave the best result in leaf potassium content of trees than rhizobacterein nitrogen biofertilization.

Moreover, table (15-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that cammel manure with surface method and uninoculated with nitrogen biofertilizatin (control) and poultry manure with trench method and nitrobein bacteria gave the highest significant values of leaf potassium content compared with the other treatments in the first season. Cattle or poultry or cammel manure with trench method and nitrobein treated gave the highest significant values of leaf potassium content of pomegranate trees as compared to all treatments under study.

Table 15. Leaf potassium content of pomegranate as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| | Season | |
|---|---|---|
| Variable | 2003 | 2004 |
| Control | 0.55 ab | 0.78 c |
| Cattle m. | 0.54 b | 0.87 b |
| Poultry m. | 0.57 a | 0.86 b |
| Camel m. | 0.56 ab | 0.94 a |
| Surface | 0.56 a | 0.83 b |
| Trench | 0.55 a | 0.90 a |
| Control | 0.58 a | 0.75 c |
| Nitrobein | 0.54 b | 0.89 b |
| Rhizobactrere | 0.54 b | 0.95 a |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 0.58 ab | 0.54 de | 0.55 cd | 0.57 bc |
| | Trench | 0.52 e | 0.55 cd | 0.60 a | 0.55 cd |
| 2004 | Surfac | 0.83 d | 0.78 e | 0.71 g | 0.98 ab |
| | Trench | 0.74 f | 0.96 b | 1.00 a | 0.89 cd |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 0.62 a | 0.54 cd | 0.58 b | 0.58 b |
| | Nitro. | 0.47 e | 0.53 d | 0.62 a | 0.56 bc |
| | Rhizo. | 0.56 bc | 0.56 bc | 0.52 d | 0.54 cd |
| 2004 | Contro | 0.67 g | 0.61 h | 0.84 e | 0.90 d |
| | Nitro. | 0.84 e | 0.97 b | 0.80 f | 0.94 c |
| | Rhizo. | 0.84 e | 1.04 a | 0.94 c | 0.97 b |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 0.59 a | 0.53 e | 0.55 cd |
| | Trench | 0.57 ab | 0.56 bc | 0.54 de |
| 2004 | Surfac | 0.74 d | 0.74 d | 1.01 a |
| | Trench | 0.77 c | 1.03 a | 0.89 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 0.62 ab | 0.58 cd | 0.54 fg | 0.63 a |
| | | Nitro. | 0.50 h | 0.48 h | 0.60 bc | 0.53 g |
| | | Rhizo. | 0.62 ab | 0.55 ef | 0.50 h | 0.54 fg |
| | Trench | Contro | 0.62 ab | 0.49 h | 0.62 ab | 0.53 g |
| | | Nitro. | 0.44 i | 0.58 cd | 0.63 a | 0.58 cd |
| | | Rhizo. | 0.50 h | 0.57 de | 0.54 fg | 0.55 ef |
| 2004 | Surfac | Contro | 0.67 i | 0.47 j | 0.74 h | 1.07 c |
| | | Nitro. | 0.87 f | 0.74 h | 0.40 k | 0.94 e |
| | | Rhizo. | 0.94 e | 1.14 b | 1.00 d | 0.94 e |
| | Trench | Contro | 0.67 i | 0.74 h | 0.94 e | 0.74 h |
| | | Nitro. | 0.80 g | 1.20 a | 1.20 a | 0.94 e |
| | | Rhizo. | 0.74 h | 0.94 e | 0.87 f | 1.00 d |

Generally, trench application method combined with nitrobein treatment and three organic manure sources improved leaf potassium content of trees. These results agree with those of Bhangoo *et al.* (1988), El Kobbia (1999) on Washington navel orange and Abo Grah (2004) on persimmon trees.

### 4.2.4. Leaf calcium content:

The data in table (16) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf calcium content during both seasons. It is clear from table (16-A) that the pomegranate trees treated with poultry organic manure gave the highest significant values of leaf calcium content in the first season. However, cattle manure gave the highest significant values of leaf calcium content in the second season. On the other hand, trench and surface application methods exhibited approximately the same effect on leaf calcium content in the first season of pomegranate trees. But, cattle manure gave the same trend in increasing leaf calcium content in pomegranate trees in the second season. Moreover, nitrobein and uninoculation with nitrogen biofertilization were more effective in increasing leaf calcium content than rhizobacterein. In the same time, rhizobacterein bacteria induced an increase in leaf calcium content of pomegranate trees in the second season.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (16-B). It is evident that poultry manure and surface application method treatment was more effective in increasing leaf calcium content than other treatments in the interaction between manure sources and application methods in the first season. While, cattle manure came in the same trend of the highest significant values of leaf calcium content in the second season. The least significant values of leaf calcium content were found in cattle manure with trench method or cammel manure wih surface method treatment in the first and second season, respectively.

Moreover, table (16-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that poultry manure with nitrobacterein gave the best result in leaf calcium content in the first season, while cattle manure with nitrobein bacteria gave the best result in this concern in the second season. In the opposite, cattle manure with rhizobacterein gave the best significant values of leaf calcium content in the first season, while cammel manure with nitrobein bacteria gave the least values in this concern in the second season.

Generally, poultry manure and nitrobein bacteria improved the leaf calcium content in the first season. Beside, cattle manure with nitrobein improved the leaf calcium content in pomegranate trees in the second season.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (16-D). It is indicated that the nitrobein bacteria with surface application method gave the best results in leaf calcium content in the first season, while rhizobacterein bacteria with surface method was more effective in increasing values in leaf calcium content in the pomegranate in the second season.

Table 16. Leaf calcium content of pomegranate as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 0.23 b | 1.52 c |
| Cattle m. | 0.19 c | 1.71 a |
| Poultry m. | 0.28 a | 1.65 b |
| Camel m. | 0.25 b | 1.20 d |
| Surface | 0.24 a | 1.48 b |
| Trench | 0.24 a | 1.56 a |
| Control | 0.26 a | 1.50 b |
| Nitrobein | 0.26 a | 1.46 c |
| Rhizobactrere | 0.19 b | 1.60 a |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 0.19 e | 0.21 d | 0.29 a | 0.25 bc |
| | Trench | 0.28 a | 0.16 f | 0.27 ab | 0.24 c |
| 2004 | Surfac | 1.46 d | 1.42 e | 1.87 b | 1.15 g |
| | Trench | 1.58 c | 2.00 a | 1.43 de | 1.25 f |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 0.25 de | 0.30 ab | 0.25 de | 0.24 ef |
| | Nitro. | 0.26 cd | 0.23 f | 0.31 a | 0.27 c |
| | Rhizo. | 0.20 g | 0.04 h | 0.29 b | 0.24 ef |
| 2004 | Contro | 1.73 c | 1.40 h | 1.81 b | 1.04 j |
| | Nitro. | 1.23 i | 2.00 a | 1.69 d | 0.92 k |
| | Rhizo. | 1.59 f | 1.73 c | 1.46 g | 1.64 e |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 0.23 b | 0.29 a | 0.19 c |
| | Trench | 0.28 a | 0.24 b | 0.19 c |
| 2004 | Surfac | 1.45 d | 1.31 e | 1.66 a |
| | Trench | 1.54 c | 1.60 b | 1.54 c |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 0.14 i | 0.30 bc | 0.25 e | 0.24 ef |
| | | Nitro. | 0.20 g | 0.31 b | 0.34 a | 0.29 cd |
| | | Rhizo. | 0.22 fg | 0.03 j | 0.28 d | 0.23 f |
| | Trench | Contro | 0.35 a | 0.29 cd | 0.24 ef | 0.25 e |
| | | Nitro. | 0.31 b | 0.15 hi | 0.28 d | 0.24 ef |
| | | Rhizo. | 0.17 h | 0.04 j | 0.30 bc | 0.25 e |
| 2004 | Surfac | Contro | 1.73 e | 1.00 j | 1.80 d | 1.27 h |
| | | Nitro. | 0.91 k | 1.80 d | 1.91 c | 0.64 m |
| | | Rhizo. | 1.73 e | 1.47 g | 1.91 c | 1.55 f |
| | Trench | Contro | 1.73 e | 1.80 d | 1.82 d | 0.82 l |
| | | Nitro. | 1.55 f | 2.20 a | 1.47 g | 1.20 i |
| | | Rhizo. | 1.45 g | 2.00 b | 1.00 j | 1.73 e |

On the opposite, table (16-D) infered that rhizobacterein bacteria with surface or trench application method gave the least values of leaf calcium content in the first season. While nitrobein bacteria with surface method gave the least values of leaf calcium content in the pomegranate trees in the second season. Generally, nitrobein bacteria with trench application method improved leaf calcium content.

Moreover, table (16-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that poultry manure with nitrobein bacteria with surface method gave the highest significant values of leaf calcium content in pomegranate trees in the first season. While, Cattle manure with trench application method with nitrobein bacteria gave the highest significant values in the second season in pomegranate trees. On the other hand, control trees with uninoculated niofertilization and surface method gave the least significant values of leaf calcium content in pomegranate trees in the first season. Moreover, cammel manure and nitrobein bacteria with surface method gave the least significant values of leaf calcium content in pomegranate trees in the second season.

Our results go with those of El Kobbia (1999) on Washington navel orange and Salama (2002) on balady mandarin.

### 4.2.5. Leaf magnesium content:

The data in table (17) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf magnesium content during both seasons. It is clear from table (17-A) that the control and cattle manure gave the highest significant values of leaf magnesium content in the first season, while control trees gave the best result of leaf magnesium content in pomegranate trees in the second season. Also, the data in table (17-A) indicated that trench application method gave the highest significant values in leaf Mg content in pomegranate trees in the first season, but in the second season surface method gave same trend in highest significant values of leaf Mg content in pomegranate trees. Moreover, uninoculated trees with nitrogen biofertilization and nitrobein were more effective in increasing leaf Mg content than rhizobacterein. In the second season, rhizobacterein gave the highest significant leaf Mg content of pomegranate.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (17-B). It is shown that control trees with trench surface application method treatment was more effective in increasing leaf Mg content than other treatments in the interaction between manure sources and application methods in the first season. While, control plants with surface method gave best result of leaf Mg content in pomegranate trees in the second season. The least significant values of leaf Mg content were found in poultry manure with surface method or poultry manure with trench method treatment in the first and second season, respectively.

Moreover, table (17-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious (17-C) that control trees without inoculating the plants with biofertilization gave the highest significant values of leaf Mg content in the two seasons of study. In contrast, poultry manure with uninoculated with biofertilization or cattle manure with biofertilization gave the least values of leaf Mg content in pomegranate trees in the first season and second season, respectively. Generally, three organic manures with rhizobacterein treatment improved the leaf Mg content in pomegranate trees than with nitrobein or uninoculated with biofertilization treatments.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (17-D). It is clear that control trees with trench application method or rhizobacterein with surface method gave the best value of leaf Mg content in pomegranate trees in the first season and second season, respectively. On the other hand, control trees with surface method or control trees with trench method gave the least values in leaf Mg content in the first and second season, respectively. Generally, nitrogen biofertilization with surface application method improved the leaf Mg content than other treatments.

Moreover, table (17-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control plants with trench method and uninoculated with bacteria treatment in the first season and control trees with surface method and uninoculated biofertilization treatment in the second season were more effective on increasing leaf Mg content than all treatments under study. On the opposite, poultry manure with surface method and uninoculated with biofertilization or cammel manure with trench method and uninoculated with biofertilization gave the least values of leaf Mg content in pomegranate trees in the first and second season, respectively.

These findings parallel those of El Kobbia (1999) and Moustafa (2002) on Washington navel orange.

Table 17. Leaf magnesium content of pomegranate as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season 2003 | Season 2004 |
|---|---|---|
| Control | 0.12 a | 0.72 a |
| Cattle m | 0.12 a | 0.59 b |
| Poultry m. | 0.07 c | 0.60 b |
| Camel m. | 0.09 b | 0.59 b |
| Surface | 0.08 b | 0.71 a |
| Trench | 0.12 a | 0.54 b |
| Control | 0.10 a | 0.57 b |
| Nitrobein | 0.10 a | 0.59 b |
| Rhizobactrere | 0.09 b | 0.71 a |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 0.09 cd | 0.10 c | 0.05 e | 0.09 cd |
| | Trench | 0.16 a | 0.14 b | 0.08 d | 0.09 cd |
| 2004 | Surfac | 0.84 a | 0.57 d | 0.76 b | 0.65 c |
| | Trench | 0.60 d | 0.60 d | 0.43 f | 0.53 e |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 0.15 a | 0.13 bc | 0.06 i | 0.08 gh |
| | Nitro. | 0.11 de | 0.12 cd | 0.07 hi | 0.11 de |
| | Rhizo. | 0.12 cd | 0.10 ef | 0.07 hi | 0.09 fg |
| 2004 | Contro | 0.86 a | 0.41 j | 0.55 gh | 0.47 i |
| | Nitro. | 0.63 e | 0.62 ef | 0.59 fg | 0.53 h |
| | Rhizo. | 0.68 d | 0.74 c | 0.66 de | 0.78 b |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 0.07 d | 0.09 c | 0.08 cd |
| | Trench | 0.14 a | 0.11 b | 0.11 b |
| 2004 | Surfac | 0.71 b | 0.62 c | 0.79 a |
| | Trench | 0.44 e | 0.56 d | 0.64 c |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 0.06 j | 0.11 ef | 0.02 k | 0.09 gh |
| | | Nitro. | 0.08 hi | 0.10 fg | 0.07 ij | 0.12 de |
| | | Rhizo. | 0.12 de | 0.08 hi | 0.06 j | 0.07 ij |
| | Trench | Contro | 0.23 a | 0.15 b | 0.10 fg | 0.07 ij |
| | | Nitro. | 0.13 cd | 0.14 c | 0.07 ij | 0.10 fg |
| | | Rhizo. | 0.11 ef | 0.12 de | 0.08 hi | 0.11 ef |
| 2004 | Surfac | Contro | 0.97 a | 0.34 p | 0.80 e | 0.73 g |
| | | Nitro. | 0.60 j | 0.76 f | 0.60 j | 0.53 l |
| | | Rhizo. | 0.95 b | 0.61 j | 0.88 c | 0.70 h |
| | Trench | Contro | 0.75 f | 0.48 m | 0.29 q | 0.22 r |
| | | Nitro. | 0.65 i | 0.47 m | 0.57 k | 0.53 l |
| | | Rhizo. | 0.41 o | 0.86 d | 0.44 n | 0.85 d |

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (18-D). It is evident that the trees which uninoculated with biofertilization with trench method or rhizobacterein with trench application method gave the best results in leaf Na content comparing with other treatments of the application method and nitrogen biofertilization in the first and second seasons, respectively. On the opposite, rhizobacterein with trench method or control trees with trench application method gave the least values in leaf Na content of the trees in the first and second seasons. Generally, nitrobein bacteria with surface method improved the leaf sodium content than other treatments of this study.

Moreover, table (18-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that cammel manure with uninoculated with biofertilization trees and trench method or cammel manure with rhizobacterein bacteria and trench method were more effective in leaf Na content in pomegranate trees in the first and second season under study, respectively. While, lowest significant values of leaf Na content were found in trees in were treated with poultry manure with uninoculated with biofertilizatin (control) and surface method in the first season or poultry manure with uninoculation with biofertilization (control) and trench method in the second season. Generally, trench application method and control trees and nitrobein or rhizobacterein bacteria gave the highest significant values of leaf sodium content than three organic sources in two seasons under study except cammel manure with rhizobacterein and trench method in the second season.

Our findings agree with those of Smith (1994) on banana and Abo Grah (2004) on persimmon trees.

### 4.2.7. Leaf iron content:

The data in table (19) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf iron content during both seasons. It is clear from (19-A) cleared that the cammel manure gave the highest significant values of leaf iron content in two seasons of study as compared with other organic manure treatment and control. While, control trees gave the least significant values in two seasons under study. Also, when concerned leaf iron content with application method, the data in table (19-A) showed that surface method in two seasons and trench method in the first season gave the highest significant values of leaf iron content of pomegranate trees. Moreover, nitrobein bacteria was more effective in increasing leaf iron content in the first season. While, rhizzobacterein bacteria gave the best result in the second season.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (19-B). It is shown that cammel manure with surface method or poultry and cattle manure with surface method were more effective in increasing leaf iron content than the other treatments in the first and second season, respectively. Moreover, control plants with surface method treatment in the first season or control plants with trench method in the second gave the lowest significant values in leaf iron content in pomegranate trees.

Table 19. Leaf iron content of pomegranate as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season 2003 | Season 2004 |
|---|---|---|
| Control | 4.46 d | 8.99 d |
| Cattle m. | 4.72 b | 9.36 c |
| Poultry m. | 4.61 c | 9.64 b |
| Camel m. | 5.32 a | 9.96 a |
| Surface | 4.81 a | 10.16 a |
| Trench | 4.75 a | 8.81 b |
| Control | 4.67 c | 8.31 c |
| Nitrobein | 4.86 a | 9.56 b |
| Rhizobactrere | 4.80 b | 10.58 a |

* any two values sharing an alphabet are not significantly different at 1% level of significance

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 3.64 g | 5.12 b | 4.76 d | 5.71 a |
| | Trench | 5.28 b | 4.31 f | 4.46 e | 4.93 c |
| 2004 | Surfac | 10.03 c | 10.46 a | 10.49 a | 9.67 d |
| | Trench | 7.96 g | 8.26 f | 8.78 e | 10.24 b |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 4.59 f | 4.58 fg | 4.73 e | 4.79 d |
| | Nitro. | 4.56 g | 5.27 b | 4.80 cd | 4.82 c |
| | Rhizo. | 4.23 i | 4.30 h | 4.30 h | 6.35 a |
| 2004 | Contro | 8.26 h | 8.19 h | 8.66 g | 8.15 h |
| | Nitro. | 8.65 g | 10.80 c | 8.89 f | 9.91 e |
| | Rhizo. | 10.08 d | 9.09 f | 11.36 b | 11.81 a |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 4.81 b | 5.41 a | 4.20 d |
| | Trench | 4.54 c | 4.32 d | 5.39 a |
| 2004 | Surfac | 8.98 d | 10.36 b | 11.15 a |
| | Trench | 7.65 f | 8.76 e | 10.02 c |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 4.30 j | 5.13 e | 4.85 h | 4.96 f |
| | | Nitro. | 4.16 k | 5.08 e | 5.38 d | 7.01 b |
| | | Rhizo. | 2.45 o | 5.15 e | 4.04 l | 5.16 e |
| | Trench | Contro | 4.87 gh | 4.03 l | 4.61 i | 4.62 i |
| | | Nitro. | 4.95 fg | 5.46 d | 4.22 jk | 2.62 n |
| | | Rhizo. | 6.01 c | 3.45 m | 4.56 i | 7.54 a |
| 2004 | Surfac | Contro | 8.26 h | 9.29 e | 9.10 ef | 9.25 e |
| | | Nitro. | 9.21 e | 12.82 b | 9.50 d | 9.91 c |
| | | Rhizo. | 12.62 b | 9.26 e | 12.87 b | 9.85 c |
| | Trench | Contro | 8.25 h | 7.08 j | 8.22 h | 7.05 j |
| | | Nitro. | 8.08 h | 8.78 g | 8.28 h | 9.91 c |
| | | Rhizo. | 7.54 i | 8.92 fg | 9.85 c | 13.76 a |

Moreover, table (19-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that cammel cammel manure with rhizobacterein bacteria gave the best result in leaf iron content in two seasons under study. In contrast, control plants with rhizobacterein or cammel manure with uninoculated with biofertilization came in the least significant values of leaf iron content in the first season and second seasons, respectively. Generally, rhizobacterein bacteria with cammel manure and cattle manure with nitrobein improved the leaf Fe content than other treatments in the first season. Also, control plants, poultry and cattle manure with rhizobacterein or cattle manure with nitrobein bacteria improved leaf iron content than other treatments in the second season.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (19-D). It is expressed that the nitrobein with surface method and rhizobacterein with trench method or rhizobacterein with surface method gave the highest significant values of leaf iron content in the first and second season, respectively. Also, rhizobacterein with surface method or control plants (uninoculated with biofertilization) with trench method gave the least values of leaf iron content in the first and second seasons, respectively.

Moreover, table (19-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that cammel manure with rhizobacterein and trench method treatment was more effective in increasing leaf iron content in two seasons under study. Furthermore, control plants with rhizobacterein and surface application method treatment or cammel manure with uninoculated with biofertilization trees (control) with trench method came in the least significant values of leaf Fe content in the first and second season under study.

The results of El Kobbia (1999) and Moustafa (2002) on Washington navel orange went well with our findings.

### 4.2.8. Leaf manganese content:

The data in table (20) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf manganese content during both seasons. It is clear from table (20-A) that the cattle manure or cammel manure gave the highest significant values of leaf manganese content in the first and second seasons under study, respectively. While, cammel manure gave the least values of Mn content in two seasons under study. In addition, when concerned leaf manganese content with application method, the data in table (20-A) cleared that surface application method was more over than trench application method leaf manganese content in the first season, but the contrast was true when concerning the second season in this concern. Nitrobein treatment as a biofertilization was more effective in increasing to highly significant in leaf manganese content in the first season, while rhizobacterein was coming in the same level in this concern in the second season. In the other side, rhizobacterein treatment decreased significant values of leaf Mn content of trees in the first season, while nitrobein gave the least values in the second season.

Table 20. Leaf manganese content of pomegranate as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 18.94 c | 41.72 a |
| Cattle m. | 21.89 a | 36.33 d |
| Poultry m. | 21.17 b | 40.72 b |
| Camel m. | 16.72 d | 39.39 c |
| Surface | 20.81 a | 39.03 b |
| Trench | 18.56 b | 40.06 a |
| Control | 20.00 a | 40.17 b |
| Nitrobein | 20.17 a | 37.83 c |
| Rhizobactrere | 18.88 b | 40.63 a |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 21.67 c | 21.00 d | 19.89 e | 20.67 d |
| | Trench | 16.22 f | 22.78 a | 22.44 b | 12.78 |
| 2004 | Surfac | 44.67 a | 32.67 g | 43.67 b | 35.11 f |
| | Trench | 38.78 d | 40.00 c | 37.78 e | 43.67 b |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 19.00 h | 20.50 e | 25.33 a | 15.17 j |
| | Nitro. | 18.17 i | 23.67 b | 18.17 i | 20.67 d |
| | Rhizo. | 19.67 g | 21.50 c | 20.00 f | 14.33 k |
| 2004 | Contro | 45.00 b | 39.00 f | 39.00 f | 37.67 g |
| | Nitro. | 37.17 h | 43.50 d | 39.17 f | 31.50 i |
| | Rhizo. | 43.00 d | 26.50 j | 44.00 c | 49.00 a |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 20.25 b | 20.67 b | 21.50 a |
| | Trench | 19.75 c | 19.67 c | 16.25 d |
| 2004 | Surfac | 37.33 d | 40.00 c | 39.75 c |
| | Trench | 43.00 a | 35.67 e | 41.50 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 21.00 fg | 16.00 k | 23.33 c | 20.67 g |
| | | Nitro. | 19.00 i | 25.33 b | 17.00 j | 21.33 ef |
| | | Rhizo. | 25.00 b | 21.67 de | 19.33 i | 20.00 h |
| | Trench | Contro | 17.00 j | 25.00 b | 27.33 a | 9.67 m |
| | | Nitro. | 17.33 j | 22.00 d | 19.33 i | 20.00 h |
| | | Rhizo. | 14.33 l | 21.33 ef | 20.67 g | 8.67 n |
| 2004 | Surfac | Contro | 45.00 e | 35.00 l | 36.00 k | 33.33 m |
| | | Nitro. | 39.00 j | 51.00 c | 42.00 h | 28.00 n |
| | | Rhizo. | 50.00 d | 12.00 o | 53.00 b | 44.00 f |
| | Trench | Contro | 45.00 e | 43.00 g | 42.00 h | 42.00 h |
| | | Nitro. | 35.33 l | 36.00 k | 36.33 k | 35.00 l |
| | | Rhizo. | 36.00 k | 41.00 i | 35.00 l | 54.00 a |

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (20-B). It is clear that cattle manure with trench method or control plants with surface method were gave the highest significant level of leaf Mn content in the first and second season, respectively. On the opposite, control plants with trench applicationmethod in the first season or cammel manure and surface method in the second seasn were decreased the significant values of leaf Mn content of pomegranate trees.

Moreover, table (20-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that poultry manure with uninoculated plants with rhizobacterein or cammel manure with rhizobacterein bacteria were more effective in increasing leaf Mn content of pomegranate trees than the other treatment of study in the first and second season, respectively. The least significant values of leaf Mn content were found in the trees treated with cammel manure and rhizobacterein in the first season and cattle manure with rhizobacterein in the second season, respectively. Generally, poultry and cammel manure with rhizobacterein bacteria improved the leaf Mn content of trees.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (20-D). It is clear that rhizobacterein bacteria with surface application method or control trees with trench method gave the best results of leaf Mn content in the first and second seasons, respectively. In contrast, rhizobacterein with trench method or nitrobein with trench method were gave the least values of leaf Mn content in the first and second seasons, respectively. The same trend in highly significant was shown in nitrobein trees with surface application method in leaf Mn content in the two seasons.

Moreover, table (20-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that that poultry manure with uninoculated with biofertilization treatments and trench method gave the highest significant values of leaf Mn content in the first season. While, cammel manure with rhizobacterein bacteria and trench method gave the highest significant values of leaf Mn content in the second season.

The results of El Kobbia (1999) on Washington navel orange and those of Salama (2002) on balady mandarin went well with our findings.

**4.2.9. Leaf zinc content:**

The data in table (21) deal with the effect of organic manure (sources and application methods) and biofertilization on leaf zinc content during both seasons. It is clear from table (21-A) that control trees in the first season or control and cammel trees in the second season were gave the highest significant values of leaf zinc content of pomegranate trees. In contrast, cattle manure gave the least values of leaf zinc content in two seasons under study. Also, when concerned leaf zinc content with application method, the data in table (21-A) showed that surface method in two seasons gave the highest significant values of leaf zinc content of pomegranate trees. Moreover, nitrobein bacteria were more effective in increasing leaf zinc content than rhizobacterein in the first season. While, rhizobacterein bacteria gave the best result in the second season.

Table 21. Leaf zinc content of pomegranate as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 19.50 a | 16.17 a |
| Cattle m. | 9.00 b | 14.33 c |
| Poultry m. | 13.56 d | 15.83 b |
| Camel m. | 17.28 c | 16.28 a |
| Surface | 17.39 a | 16.83 a |
| Trench | 12.28 b | 14.47 b |
| Control | 15.00 b | 14.00 c |
| Nitrobein | 17.08 a | 15.96 b |
| Rhizobactrere | 12.42 c | 17.00 a |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Seaso | Metho | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surfac | 24.33 a | 10.22 f | 16.78 c | 18.22 b |
| | Trench | 14.67 e | 7.78 g | 10.33 f | 16.33 d |
| 2004 | Surfac | 17.00 b | 15.00 d | 18.33 a | 17.00 b |
| | Trench | 15.33 cd | 13.67 e | 13.33 e | 15.56 c |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Contro | 20.33 c | 8.83 j | 17.83 d | 13.00 f |
| | Nitro. | 31.50 a | 8.17 k | 12.17 g | 16.50 e |
| | Rhizo. | 6.67 l | 10.00 i | 10.67 h | 22.33 b |
| 2004 | Contro | 14.50 f | 13.00 h | 13.50 g | 15.00 e |
| | Nitro. | 18.00 b | 15.50 d | 16.00 c | 14.33 f |
| | Rhizo. | 16.00 c | 14.50 f | 18.00 b | 19.50 a |

D. Effect of the interaction between application methods and biofertilization

| Seaso | Metho | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surfac | 17.50 b | 24.17 a | 10.50 e |
| | Trench | 12.50 d | 10.00 f | 14.33 c |
| 2004 | Surfac | 15.25 d | 15.75 c | 19.50 a |
| | Trench | 12.75 f | 16.17 b | 14.50 e |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Seaso | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surfac | Contro | 17.00 f | 10.00 l | 27.67 c | 15.33 g |
| | | Nitro. | 47.67 a | 8.33 m | 14.67 h | 26.00 d |
| | | Rhizo. | 8.33 m | 12.33 j | 8.00 mn | 13.33 i |
| | Trench | Contro | 23.67 e | 7.67 n | 8.00 mn | 10.67 k |
| | | Nitro. | 15.33 g | 8.00 mn | 9.67 l | 7.00 o |
| | | Rhizo. | 5.00 p | 7.67 n | 13.33 i | 31.33 b |
| 2004 | Surfac | Contro | 15.00 f | 13.00 h | 16.00 d | 17.00 d |
| | | Nitro. | 16.00 d | 16.00 d | 16.00 d | 15.00 f |
| | | Rhizo. | 20.00 b | 16.00 d | 23.00 a | 19.00 c |
| | Trench | Contro | 14.00 g | 13.00 h | 11.00 j | 13.00 h |
| | | Nitro. | 20.00 b | 15.00 f | 16.00 d | 13.67 g |
| | | Rhizo. | 12.00 i | 13.00 h | 13.00 h | 20.00 b |

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (21-B). It is evident that control trees with surface method or poultry manure with surface method were more effective in increasing leaf Zn content than other treatments in the first and second season, respectively. Moreover, cattle manure with trench method treatment in the first season or cattle manure with trench method in the second season gave the lowest values in leaf Zn content of pomegranate trees.

Moreover, table (21-C) reflects the effect of interaction between organic manure source and biofertilization. The control trees with nitrobein bacteria or cammel trees with rhizobacterein gave the best results in leaf Zn content in the first and second seasons, respectively. In contrast, control plants with rhizobacterein bacteria or cattle manure with uninoculated with biofertilization trees came in the least significant values of leaf zinc content than other treatments in the first and second seasons, respectively. Also, nitrobein bacteria with control treatment and cammel manure with rhizobacterein improved the leaf zinc content than other treatments in the first or second season.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (21-D). It is expressed that nitrobein bacteria with surface method or rhizobacterein bacteria with surface method gave the highest significant values of leaf Zn content in the first and second seasons, respectively. Also, nitrobein with trench method or uninoculated with biofertilization trees with trench method gave the least values of leaf Zn content in the first and second seasons, respectively.

Moreover, table (21-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that that control trees with nitrobein bacteria or poultry manure rhizobacterein bacteria were more effective in increasing leaf zinc content in the first and second seasons, respectively. Furthermore, control trees with manure with trench method with uninoculated with biofertilization trees came in the least significant values of leaf Zn content in the first and second seasons under study, respectively.

Generally, the pomegranate trees of the control treatment combined with trench application method and inoculated with nitrobein bacteria improved leaf N, P, K, Ca, Mg, Na, Fe, Mn and Zn contents. Also, cattle manure with trench method and nitrobein gave the best leaf N content comparing with the other treaments under study. Moreover, control plants with trench or surface method and nitrobein or uninoculated with bacteria increased leaf P, K, Ca and Mg contents than the other treatments. Furthermore, cammel organic manure with trench method and rhizobacterein treatment induced an increase in leaf Fe, Mn and Zn than the analogous ones of treatment under study. The least values of leaf N, P, K, Ca, Mg, Na, Fe, Mn and Zn contents were shown in cammel organic manure with surface or trench method with or without nitrogen biofertilization treatments. These results agreed with the findings of many scientific researches such as Villasurda and Baluyut (1990) on guava, Smith (1994) on banana, El-Kobbia (1999) and Mostafa

(2002) on Washington navel orange, Salama (2002) on Balady mandarin, Abou Grah (2004) on persimmon tree.

### 4.3. Fruit yield:

The data in table (22) and in figs. (2-a, 2-b, 2-c) deal with the effect of organic manure (sources and application methods) and biofertilization on fruit yield during both seasons. Table (22-A) clears that control trees which fertilized with garden fertilization system gave the highest significant values of fruit yield as compared with the trees fertilized with cattle, poultry and cammel manures. Poultry manure was more effective in increasing to significant level in fruit yield than cattle or cammel manure. Moreover, trench application method increased to significant level fruit yield than surface application method in two seasons of study. Also, nitrobein nitrogen biofertilization induced a significant increase in fruit yield as compared to trees treated with rhizobacterein or uninoculated trees (control).

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (22-B). It is shown that trench application with unfertilized trees with organic manures (cattle, poultry and cammel manure) induced a significant increase in fruit yield than all treatments under study. While, the trees which fertilized with cammel manure with surface application method gave the least significant values of the fruit yield in two seasons of study. Generally, poultry manure with trench method treatment improved the fruit yield of pomegranate trees than the trees treated with cattle or cammel manure with surface or trench application method.

Moreover, table (22-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that the pomegranate trees with nitrobein gave the highest significant values of fruit yield. While, all organic manures used under study (cattle, poultry and cammel) and uninoculated with nitrogen bacteria decreased the fruit yield values to lower significant level. Additionally, poultry manure with nitrobein treatment was more effective in increasing the fruit yield than cattle or cammel manure with or without nitrobein or rhizobacterein during two seasons of study.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (22-D). It is proved that trench application method with nitrobein treatment was more effective in increasing to highly significantly for fruit yield values than surface or trench method with or without nitrogen biofertilization used under study. Furthermore, the least fruit yield values were found in control trees with surface application method during 2003 and 2004 seasons.

Moreover, table (22-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that that control plants with trench application method and inoculated with nitrobein gave the highest significant values as compared to all treatments under study. On the opposite, cattle, poultry or cammel manure with surface method and uninoculated with nitrogen biofertilizatin decreased the fruit yield values of trees to the lower significant level.

Table 22. Fruit yield of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 10.3 a | 44.7 a |
| Cattle m. | 6.7 c | 35.0 c |
| Poultry m. | 8.1 b | 39.3 b |
| Camel m. | 5.8 d | 32.0 d |
| Surface | 7.0 b | 35.7 b |
| Trench | 8.4 a | 39.7 a |
| Control | 6.2 c | 32.3 c |
| Nitrobein | 9.4 a | 42.5 a |
| Rhizobactrerein | 7.6 b | 38.4 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 9.0 b | 6.0 de | 7.5 c | 5.6 e |
| | Trench | 11.6 a | 7.4 c | 8.7 b | 6.1 d |
| 2004 | Surface | 41.6 b | 33.4 e | 37.0 c | 30.9 f |
| | Trench | 47.8 a | 36.5 d | 41.6 b | 33.1 e |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 8.3 c | 5.6 g | 6.2 ef | 4.7 h |
| | Nitro. | 12.7 a | 7.9 c | 9.8 b | 7.1 d |
| | Rhizo. | 9.9 b | 6.6 e | 8.3 c | 5.8 fg |
| 2004 | Control | 39.2 e | 29.5 h | 33.8 g | 26.7 i |
| | Nitro. | 49.6 a | 39.8 d | 44.5 c | 36.0 f |
| | Rhizo. | 45.3 b | 35.6 f | 39.5 de | 33.3 g |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 5.6 e | 8.5 b | 7.0 d |
| | Trench | 6.8 d | 10.2 a | 8.3 c |
| 2004 | Surface | 31.1 f | 40.3 c | 35.8 d |
| | Trench | 33.5 e | 44.6 a | 41.1 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 6.7 jk | 5.0 n | 6.3 kl | 4.3 o |
| | | Nitro. | 11.7 b | 6.7 jk | 8.8 fg | 7.0 ij |
| | | Rhizo. | 8.7 gh | 6.4 kl | 7.3 hi | 5.6 m |
| | Trench | Control | 10.0 e | 6.3 kl | 6.0 lm | 5.0 n |
| | | Nitro. | 13.7 a | 9.2 fg | 10.7 d | 7.2 hi |
| | | Rhizo. | 11.2 c | 6.7 jk | 9.3 f | 6.0 lm |
| 2004 | Surface | Control | 37.3 i | 28.7 p | 32.7 m | 25.7 r |
| | | Nitro. | 46.3 d | 37.9 h | 41.6 g | 35.3 k |
| | | Rhizo. | 41.0 h | 33.7 l | 36.7 j | 31.7 n |
| | Trench | Control | 41.0 h | 30.3 o | 35.0 k | 27.7 q |
| | | Nitro. | 52.8 a | 41.7 f | 47.4 c | 36.7 j |
| | | Rhizo. | 49.5 b | 37.6 hi | 42.3 e | 35.0 k |

Fig. 4. Pomegranate fruit yield as affected by the interaction between manure forms and application methods (average of two seasons).

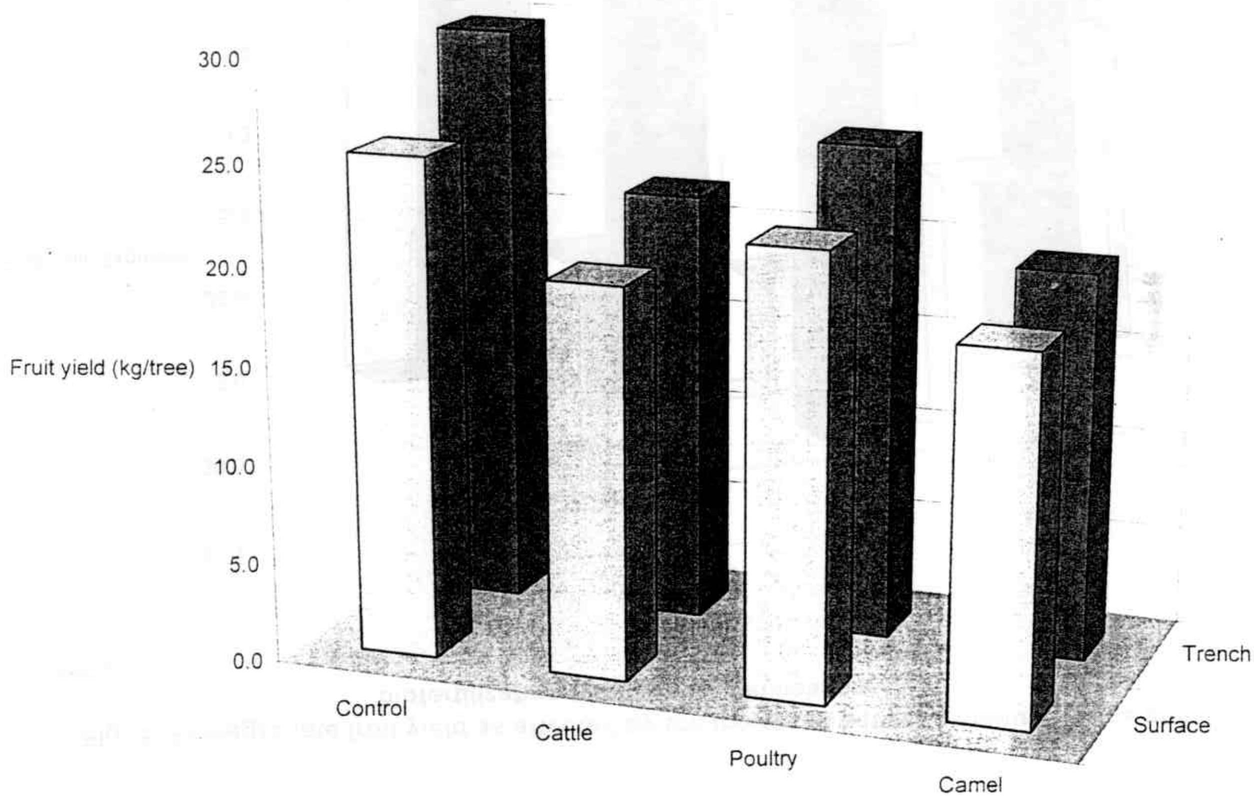


Fig. 5. Pomegranate fruit yield as affected by the interactin between manure forms and biofertilization (average of two seasons).

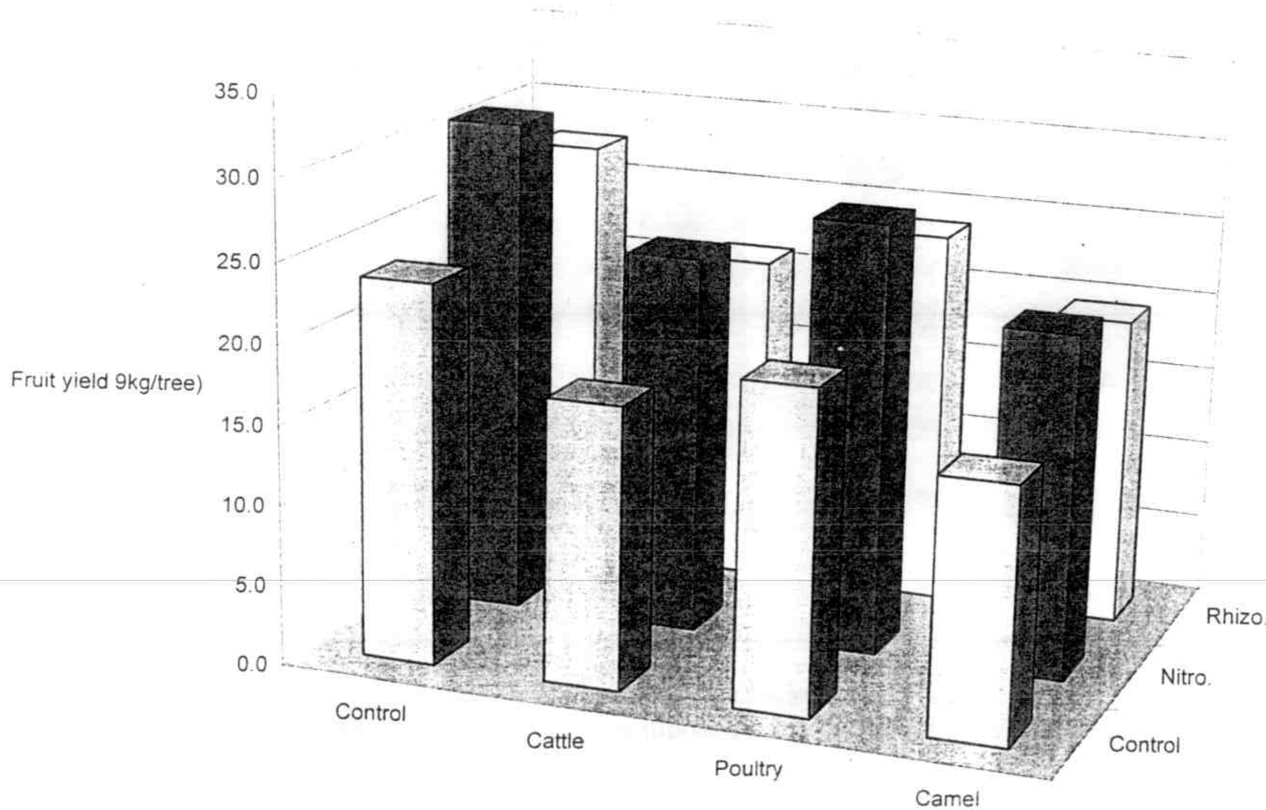
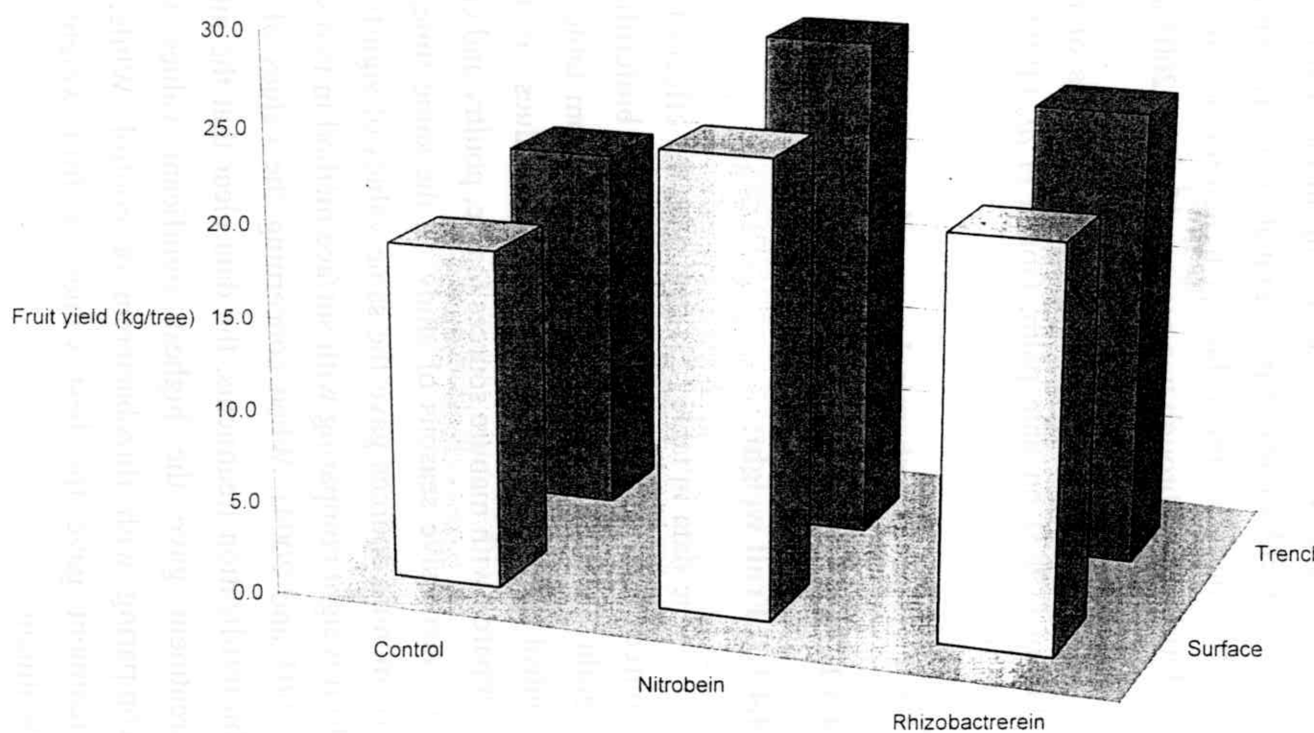


Fig. 6. Pomegranate fruit yield as affected by the interaction between the application methods and biofertilization (average of two seasons).



Generally, poultry manure with trench application method and nitrobein bacteria were coming in the first effect in increasing the fruit yield values of pomegranate trees as compared to cattle or cammel manure with surface or trench method and with or without biofertilization through two seasons of study (2003 and 2004).

These findings agree with the findings of Bacha and Abo-Hassan (1983) on date palm, Gouda *et al.* (1992) and El Kobbia (1999).

## 4.4. Physical and chemical properties of fruits:

### 4.4.1. Physical properties:

#### 4.4.1.1. Fruit weight:

The data in table (23) deal with the effect of organic manure (sources and application methods) and biofertilization on fruit weight during both seasons. It is clear from table (23-A) that the control gave the highest significant values of fruit weight as compared with manure sources (cattle, poultry and cammel) through two successive seasons of study. In the same time, trench method for manure sources gave the same values of significant increase in fruit weight comparing with surface method in two seasons of study (2003 and 2004). When concerning the values of fruit weight in biofertilization treatments, the data clear that the nitrobein bacteria treatment gave the highest significant values in this subject comparing with rhizobacterein or control. While, rhizobacterein treatment gave the best values of fruit weight above control treatment.

Table 23. Fruit weight of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 347 a | 407 a |
| Cattle m. | 311 b | 392 b |
| Poultry m. | 315 b | 397 b |
| Camel m. | 303 c | 386 c |
| Surface | 303 b | 390 b |
| Trench | 335 a | 401 a |
| Control | 307 c | 382 c |
| Nitrobein | 332 a | 407 a |
| Rhizobactrerein | 318 b | 397 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 338 b | 292 e | 300 d | 281 f |
| | Trench | 356 a | 330 c | 329 c | 325 c |
| 2004 | Surface | 405 a | 384 d | 390 c | 380 d |
| | Trench | 410 a | 399 b | 405 a | 391 c |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 329 c | 303 g | 303 g | 295 h |
| | Nitro. | 361 a | 322 d | 328 c | 316 e |
| | Rhizo. | 351 b | 309 f | 314 e | 298 gh |
| 2004 | Control | 397 c | 377 f | 385 e | 369 g |
| | Nitro. | 419 a | 405 b | 408 b | 398 c |
| | Rhizo. | 406 b | 394 cd | 398 c | 391 d |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 293 d | 315 c | 300 d |
| | Trench | 321 c | 348 a | 336 b |
| 2004 | Surface | 380 d | 399 b | 390 c |
| | Trench | 384 cd | 416 a | 404 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 328 e | 280 j | 295 hi | 270 k |
| | | Nitro. | 348 c | 305 g | 309 g | 298 h |
| | | Rhizo. | 338 d | 290 i | 298 h | 275 j |
| | Trench | Control | 330 e | 325 ef | 310 g | 320 f |
| | | Nitro. | 373 a | 338 d | 348 c | 334 de |
| | | Rhizo. | 365 b | 328 e | 330 e | 322 f |
| 2004 | Surface | Control | 395 fg | 374 j | 380 i | 370 k |
| | | Nitro. | 415 b | 394 fg | 398 ef | 390 gh |
| | | Rhizo. | 404 cd | 385 hi | 391 g | 380 i |
| | Trench | Control | 398 ef | 380 i | 390 gh | 368 k |
| | | Nitro. | 423 a | 415 b | 419 ab | 405 cd |
| | | Rhizo. | 409 c | 402 de | 406 cd | 401 de |

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (23-B). The best fruit weight was obtained with trench application method combined with control. While, the least values in fruit weight are finding with cammel manure and surface application method in two seasons of study.

Moreover, table (23-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that the pomegranate trees which fertilized with garden fertilization as a control with nitrobein biofertilization gave the highest significant values of fruit weight of trees in two seasons of study. In contrast, the least values in this subject were found in cammel organic manure with uninfected with nitrobein biofertilization (control) trees.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (23-D). This table cleared that the pomegranate trees treated by trench application method and nitrobein nitrogen biofertilization induced a significant increased in fruit weight than the other treatment in two seasons of study. Moreover, the control trees, which were supplied with organic manures with surface method, gave the least values of fruit weight. Generally, nitrogen biofertilization with or trench application method improved fruit weight of pomegranate trees than control trees with surface or trench method.

Moreover, table (23-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that the highest significant values of fruit weight were found in control with trench and nitrobein treatment.

On the other hand, the least values of fruit weight of pomegranate trees were found in trees treated with cammel manure with surface application. Generally, poultry, cammel and the control trees improved fruit weight of pomegranate trees especially with trench application and nitrobein nitrogen biofertilization.

Our results went well with the findings of Bhangoo *et al.* (1988) on Tompson seedless grape and those of Salama (2002) on balady mandarin.

#### 4.4.1.2. Fruit diameter:

The data in table (24) deal with the effect of organic manure (sources and application methods) and biofertilization on fruit diameter during both seasons. It is clear from table (24-A) that the pomegranate trees of the control gave the highest significant values of fruit diameter in the two seasons of study. In contrast, the least values of pomegranate trees were found when trees treated with cammel organic manure. Furthermore, when concerning the application method, the trench method gave the best fruit diameter values as compared with surface method. Also, nitrobein nitrogen biofertilizatin increased fruit diameter values than rhizobacterein or control treatment.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (24-B). It is clear that trench application method with control treatment gave the highest significant values of fruit diameter of pomegranate trees than surface or trench method with all organic manures under study. While, the least values of fruit diameter were found with pomegranate trees treated with cammel manure applied with surface method.

Table 24. Fruit diameter of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 8.66 a | 9.54 a |
| Cattle m. | 8.47 c | 9.40 c |
| Poultry m. | 8.61 b | 9.44 b |
| Camel m. | 8.32 d | 9.30 d |
| Surface | 8.38 b | 9.40 b |
| Trench | 8.66 a | 9.44 a |
| Control | 8.39 c | 9.37 b |
| Nitrobein | 8.71 a | 9.44 a |
| Rhizobactrerein | 8.46 b | 9.44 a |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 8.55 d | 8.34 f | 8.49 e | 8.13 g |
| | Trench | 8.78 a | 8.60 c | 8.73 b | 8.52 de |
| 2004 | Surface | 9.53 a | 9.37 d | 9.40 cd | 9.31 e |
| | Trench | 9.54 a | 9.43 c | 9.48 b | 9.30 e |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 8.55 ef | 8.34 h | 8.52 f | 8.16 j |
| | Nitro. | 8.83 a | 8.66 c | 8.76 b | 8.58 de |
| | Rhizo. | 8.61 d | 8.43 g | 8.56 ef | 8.23 i |
| 2004 | Control | 9.47 cd | 9.38 gh | 9.39 fg | 9.27 j |
| | Nitro. | 9.52 b | 9.44 de | 9.49 bc | 9.34 hi |
| | Rhizo. | 9.63 a | 9.40 efg | 9.43 def | 9.31 ij |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 8.24 e | 8.60 b | 8.29 d |
| | Trench | 8.54 c | 8.81 a | 8.63 b |
| 2004 | Surface | 9.37 c | 9.40 bc | 9.44 ab |
| | Trench | 9.38 c | 9.48 a | 9.45 a |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 8.40 lm | 8.22 o | 8.38 mn | 7.97 p |
| | | Nitro. | 8.75 c | 8.55 h | 8.68 ef | 8.44 jkl |
| | | Rhizo. | 8.50 i | 8.25 o | 8.42 klm | 7.97 p |
| | Trench | Control | 8.70 de | 8.45 jk | 8.65 f | 8.35 n |
| | | Nitro. | 8.91 a | 8.76 c | 8.85 b | 8.72 cd |
| | | Rhizo. | 8.72 cd | 8.60 g | 8.70 de | 8.48 ij |
| 2004 | Surface | Control | 9.49 cd | 9.35 ij | 9.35 ij | 9.28 lm |
| | | Nitro. | 9.44 efg | 9.40 gh | 9.45 def | 9.33 jk |
| | | Rhizo. | 9.67 a | 9.37 hij | 9.39 hi | 9.31 kl |
| | Trench | Control | 9.45 def | 9.40 gh | 9.42 fg | 9.25 m |
| | | Nitro. | 9.59 b | 9.47 de | 9.53 c | 9.34 jk |
| | | Rhizo. | 9.59 b | 9.43 efg | 9.48 de | 9.30 kl |

Moreover, table (24-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that the control trees treated with nitrobein gave the best result of fruit diameter of pomegranate trees as compared with cattle or poultry manure with or without nitrogen biofertilization. On the other hand, the best values of fruit diameter were found in cammel manure without biofertilization treatment.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (24-D). the table indicated that trench application method and nitrobein treatment induced the highest significant values of fruit diameter of pomegranate. In contrast, the least values of fruit diameter were shown in unfertilized with biofertilization trees (control). Generally, nitrobein or rhizobacterein nitrogen biofertilization with surface or trench application method improved fruit diameter than uninfected trees (control) with biofertilization with surface or trench application method in two seasons of study.

Moreover, table (24-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control combined with trench method and fertilized with nitrobein bacteria gave the highest significant values of fruit diameter of pomegranate trees as compared to all treatments under study. On the opposite, cattle or poultry organic manure with surface method and unfertilized with biofertilization treatment gave the least values of fruit diameter of pomegranate trees in the first and second seasons of study, respectively. Generally, the control trees with surface or trench application method and fertilized with nitrogen biofertilization with nitrobein or rhizobacterein bacteria increased fruit diameter than all organic manures under study in the two seasons of study.

Our results conincide those of Gasanov (1984) on persimmon trees and those of Moustafa (2002) on Washington navel orange.

### 4.4.1.3. Fruit length:

The data in table (25) deal with the effect of organic manure (sources and application methods) and biofertilization on fruit length during both seasons. Table (25-A) expresses that the control pomegranate trees induced a significant increase in fruit length than organic manures under study (cattle, cammel and poultry). The least significant values of fruit length were found when trees treated with cammel manure. Furthermore, trench application method for organic manures increased fruit length than surface method during the two seasons of study.

Moreover, nitrobein bacteria as a biofertilization a significant increased fruit length than rhizobacterein nitrogen biofertilization or control treatment. Also, rhizobacterein treatment improved fruit length than control plants.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (25-B). It is highlighted that control trees with trench application method treatment induced a significant increase in fruit length than the other treatments under study through two seasons of study. Also, cammel organic manure with surface treatment gave the least values of fruit length of pomegranate trees.

Table 25. Fruit length of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season 2003 | Season 2004 |
|---|---|---|
| Control | 7.88 a | 8.62 a |
| Cattle m. | 7.17 c | 8.04 c |
| Poultry m. | 7.48 b | 8.38 b |
| Camel m. | 7.02 d | 7.93 d |
| Surface | 7.22 b | 8.11 b |
| Trench | 7.55 a | 8.39 a |
| Control | 7.06 c | 7.96 c |
| Nitrobein | 7.70 a | 8.52 a |
| Rhizobactrerein | 7.40 b | 8.25 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 7.57 c | 7.04 e | 7.27 d | 7.01 f |
| | Trench | 8.19 a | 7.29 d | 7.70 b | 7.03 f |
| 2004 | Surface | 8.54 b | 7.83 e | 8.26 c | 7.79 f |
| | Trench | 8.70 a | 8.26 c | 8.51 b | 8.08 d |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 7.58 d | 6.88 i | 7.03 h | 6.75 j |
| | Nitro. | 8.12 a | 7.47 e | 7.83 c | 7.37 f |
| | Rhizo. | 7.93 b | 7.15 g | 7.58 d | 6.93 hi |
| 2004 | Control | 8.50 cd | 7.72 h | 8.12 f | 7.52 i |
| | Nitro. | 8.77 a | 8.42 d | 8.62 b | 8.28 e |
| | Rhizo. | 8.60 dc | 8.00 g | 8.42 d | 8.00 g |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 6.89 e | 7.53 b | 7.24 c |
| | Trench | 7.23 d | 7.86 a | 7.56 b |
| 2004 | Surface | 7.84 d | 8.38 b | 8.09 c |
| | Trench | 8.08 c | 8.66 a | 8.42 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 7.30 i | 6.77 l | 6.77 l | 6.73 l |
| | | Nitro. | 7.67 f | 7.37 hi | 7.67 f | 7.43 h |
| | | Rhizo. | 7.73 ef | 7.00 j | 7.37 hi | 6.87 k |
| | Trench | Control | 7.87 d | 7.00 j | 7.30 i | 6.77 l |
| | | Nitro. | 8.57 a | 7.57 g | 8.00 c | 7.31 i |
| | | Rhizo. | 8.13 b | 7.30 i | 7.80 de | 7.00 j |
| 2004 | Surface | Control | 8.43 f | 7.57 m | 8.00 j | 7.37 n |
| | | Nitro. | 8.67 c | 8.27 gh | 8.47 ef | 8.13 i |
| | | Rhizo. | 8.53 de | 7.67 l | 8.30 gh | 7.87 k |
| | Trench | Control | 8.57 d | 7.87 k | 8.23 h | 7.67 l |
| | | Nitro. | 8.87 a | 8.57 d | 8.77 b | 8.43 f |
| | | Rhizo. | 8.67 c | 8.33 g | 8.53 de | 8.13 i |

Moreover, table (25-C) reflects the effect of interaction between organic manure source and biofertilization. This table shows that the pomegranate trees of the control with nitrobein biofertilization gave the highest significant values of fruit length of trees in two seasons of study. In contrast, the least values were found with cammel organic manure with uninfected with nitrogen biofertilization (control) trees.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (25-D). It is evident that the pomegranate trees fertilized by trench application method and nitrobein nitrogen biofertilization induced a significant increase in fruit length than the other treatments in two seasons of study. While, control trees receiving organic manures by surface application method gave the least significant values of fruit length. Generally, nitrogen biofertilization (nitrobein or rhizobacterein) with surface or trench application method improved fruit length than control trees with surface or trench method.

Moreover, table (25-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control trees with trench method and nitrobein treatment gave the highest significant values of fruit length of pomegranate trees as compared to all treatments under study in two seasons of study. On the opposite, the least values of fruit length of trees were found in the trees which treated with cammel manure, surface application method and uninfected with biofertilization. Generally, poultry organic manure treatments with trench method and nitrogen biofertilization (nitrobein or rhizobacterein) improved fruit length of trees than cattle or cammel organic manure with surface or trench application method and nitrogen biofertilization.

Our results confirmed those found by Bhangoo *et al.* (1988) on Tompson seedless grape and those by Salama (2002) on balady mandarin.

### 4.4.1.4. Fruit volume:

The data in table (26) deal with the effect of organic manure (sources and application methods) and biofertilization on fruit volume during both seasons. It is clear from table (26-A) that the control trees gave the best values in significant of fruit volume as a compared to cattle, poultry and cammel manure treatments. The least values of fruit volume were found in cammel manure treatments. Generally, the best results in fruit volume were shown in descending order, poultry, cattle and cammel manures, respectively during the two seasons of study. Furthermore, trench application method was more effective in increasing fruit volume in pomegranate trees than surface method in two seasons of study. Moreover, nitrobein nitrogen biofertilization gave the least results in significant increase of fruit volume ascompared with trees inoculated with rhizobacterein which is coming in the second level. While, the pomegranate trees which uninoculated with nitrogen biofertilization as a control came the lowest level effect in this study.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (26-B). Thic table expresses that control trees with trench application method treatment was more effective in increasing to the significant level in fruit volume as compared to the other treatments under study in this interaction concerning. On the opposite, the least values of fruit volume were shown in cammel organic manure and surface method treatment. Generally, poultry manure with surface or trench method treatments was more effective in increasing fruit volume than cattle or cammel manure with surface or trench application method.

Moreover, table (26-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that control pomegranate trees, which were inoculated with nitrobein nitrogen biofertilization, gave the highest significant values to significant level in fruit volume. While, the least values of fruit volume were found in trees treated with cammel organic manure and uninoculated with nitrogen bacteria. Generally, the trees fertilized with poultry manure and nitrobein were coming in the second level in increasing fruit volume. Also, nitrogen bacteria induced an increase in fruit volume in the trees fertilized with all organic manures especially poultry manure.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (26-D). It is clear that the pomegranate trees treated with trench method and inoculated with nitrobein nitrogen biofertilization gave the highest significant values of fruit volume. In the contrast, surface application method and the trees uninoculated with nitrogen biofertilization were more effective in decreasing fruit volume. Generally, trench method with biofertilization especially with nitrobein bacteria increased fruit volume as compared with surface method with or without nitrogen biofertilization.

Table 26. Fruit volume of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 332 a | 414 a |
| Cattle m. | 294 c | 369 c |
| Poultry m. | 304 b | 385 b |
| Camel m. | 284 d | 361 d |
| Surface | 289 b | 375 b |
| Trench | 318 a | 390 a |
| Control | 274 c | 362 c |
| Nitrobein | 328 a | 410 a |
| Rhizobactrerein | 308 b | 376 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 320 b | 278 f | 288 e | 269 g |
| | Trench | 344 a | 309 c | 319 b | 299 d |
| 2004 | Surface | 412 a | 362 d | 377 c | 351 e |
| | Trench | 417 a | 377 c | 393 b | 371 c |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 298 e | 264 h | 278 g | 255 i |
| | Nitro. | 360 a | 317 cd | 324 c | 311 d |
| | Rhizo. | 337 b | 300 e | 309 d | 287 f |
| 2004 | Control | 392 d | 351 g | 365 f | 340 h |
| | Nitro. | 448 a | 392 d | 415 b | 386 d |
| | Rhizo. | 404 c | 365 f | 376 e | 358 fg |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 259 e | 314 c | 294 d |
| | Trench | 289 d | 342 a | 323 b |
| 2004 | Surface | 362 e | 393 b | 371 d |
| | Trench | 361 e | 427 a | 380 c |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 291 jkl | 245 o | 261 n | 238 o |
| | | Nitro. | 347 bc | 303 hi | 305 gh | 301 hij |
| | | Rhizo. | 322 e | 287 kl | 298 ij | 269 mn |
| | Trench | Control | 305 gh | 283 l | 295 ijk | 272 m |
| | | Nitro. | 374 a | 332 d | 342 c | 321 ef |
| | | Rhizo. | 352 b | 313 fg | 321 ef | 306 gh |
| 2004 | Surface | Control | 390 f | 351 k | 369 ghi | 339 l |
| | | Nitro. | 444 ab | 375 g | 390 f | 363 ij |
| | | Rhizo. | 401 de | 360 j | 373 gh | 350 k |
| | Trench | Control | 394 ef | 350 k | 360 j | 341 l |
| | | Nitro. | 451 a | 410 c | 439 b | 408 cd |
| | | Rhizo. | 406 cd | 370 gh | 380 f | 365 hij |

Moreover, table (26-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control trees (treated with garden fertilization system) with trench application method and nitrobein gave the highest significant values to the significant level of fruit volume trees as compared with all treatments under study in the two seasons (2003 and 2004).

On the other hand, the least values in significant level of fruit volume were shown when trees treated with cammel manure, surface method and unfertilized with biofertilization in the first and second seasons of study. Generally, the control trees which fertilized with garden fertilization system with trench application method and nitrobein nitrogen biofertilization were more effective in increasing fruit volume than cattle or cammel or poultry organic manure with surface or trench method with or without biofertilization.

Our results conincided with those reported by Piatkoweski *et al.* (1990) on apple, Gouda (1992) on grape and El Kobbia (1999) on Washington navel orange.

### 4.4.1.5. Fruit dry matter percentage:

The data in table (27) deal with the effect of organic manure (sources and application methods) and biofertilization on fruit dry matter percentage during both seasons. It is clear from table (27-A) that the control trees gave the highest significant values of fruit dry matter percent as compared with the trees fertilized with cattle, poultry and cammel organic manures. Additionally, trench application method increased to significant level fruit dry matter percent than surface application method in two seasons of study.

Furthermore, nitrobein nitrogen biofertilization induced a significant increase in dry matter percent of pomegranate fruits as compared to trees treated with rhizobacterein or uninoculated trees (control).

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (27-B). The results showed that highest significant values of fruit dry matter percent are finding in trench method with control. While, the least significant values in dry matter percent of fruits as compared to which found with cammel manure and surface application method treatment in two seasons of study.

Moreover, table (27-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that the pomegranate trees which fertilized with garden fertilization system (control) and inoculated with nitrobein gave the highest significant values of dry matter percent of fruits. While, all organic manures used under study (cattle, poultry and cammel) and uninoculated with nitrogen bacteria decreased the dry matter percent of pomegranate fruits values to lower significant level. Moreover, poultry manure with nitrobein treatment was more effective in increasing the dry matter percent of fruits than cattle or cammel manure with or without nitrobein or rhizobacterein during two seasons of study.

Table 27. Fruit dry matter % of pomegranate trees as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 22.41 a | 29.59 a |
| Cattle m. | 21.61 c | 21.95 c |
| Poultry m. | 22.04 b | 25.44 b |
| Camel m. | 21.55 c | 18.67 d |
| Surface | 21.79 b | 18.55 b |
| Trench | 22.01 a | 29.27 a |
| Control | 21.64 c | 20.96 c |
| Nitrobein | 22.20 a | 26.84 a |
| Rhizobactrerein | 21.87 b | 23.94 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 22.22 b | 21.55 e | 21.95 c | 21.46 f |
| | Trench | 22.61 a | 21.68 d | 22.14 b | 21.63 de |
| 2004 | Surface | 22.98 e | 17.61 g | 19.42 f | 14.20 h |
| | Trench | 36.20 e | 26.30 c | 31.46 b | 23.14 d |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 22.18 c | 21.35 i | 21.81 f | 21.23 j |
| | Nitro. | 22.68 a | 21.90 e | 22.24 c | 21.98 e |
| | Rhizo. | 22.38 b | 21.59 g | 22.08 d | 21.43 h |
| 2004 | Control | 24.63 e | 19.58 i | 22.64 f | 16.98 k |
| | Nitro. | 33.99 a | 24.75 e | 28.30 c | 20.31 h |
| | Rhizo. | 30.14 b | 21.54 g | 25.38 d | 18.72 j |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 21.47 e | 22.16 a | 21.76 d |
| | Trench | 21.82 c | 22.24 a | 21.98 b |
| 2004 | Surface | 16.48 f | 20.10 d | 19.07 e |
| | Trench | 25.44 c | 33.57 a | 28.81 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 22.00 gh | 21.10 o | 21.70 j | 21.05 o |
| | | Nitro. | 22.43 bc | 22.04 g | 22.18 f | 21.98 ghi |
| | | Rhizo. | 22.22 ef | 21.50 m | 21.95 hi | 21.35 n |
| | Trench | Control | 22.36 cd | 21.60 l | 21.91 i | 21.40 n |
| | | Nitro. | 22.93 a | 21.75 j | 22.30 de | 21.98 ghi |
| | | Rhizo. | 22.54 b | 21.67 kl | 22.21 ef | 21.50 m |
| 2004 | Surface | Control | 18.91 e | 16.85 b | 17.40 f | 12.75 i |
| | | Nitro. | 25.50 b | 18.17 b | 21.25 g | 15.49 c |
| | | Rhizo. | 24.51 d | 17.82 g | 19.60 d | 14.35 e |
| | Trench | Control | 30.35 e | 22.30 e | 27.88 g | 21.21 a |
| | | Nitro. | 42.49 e | 31.33 a | 35.35 h | 25.12 a |
| | | Rhizo. | 35.77 f | 25.25 f | 31.15 f | 23.08 b |

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (27-D). This table indicates that trench application method with nitrobein treatment was more effective in increasing dry matter percent values than surface or trench method with or without nitrogen biofertilization used under study. On the other hand, the dry matter percent values were shown in control trees with surface application method during 2003 and 2004 seasons.

Moreover, table (27-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control trees with trench application method and inoculated with nitrobein gave the highest significant values as compared to all treatments under study. On the other side, cattle or poultry or cammel manure with surface method and uninoculated with nitrogen biofertilization decreased the dry matter percent of fruits values to the lower significant level.

Generally, poultry manure with trench application method and nitrobein bacteria were coming to the first effect in increasing the dry matter percent of pomegranate fruits as compared to cattle or cammel manure with surface or trench method and with or without biofertilization through two seasons of study (2003 and 2004).

Our data assure those found by Bhangoo *et al.* (1988) on Tompson seedless grape and those by Goeded (1993) on mango trees.

### 4.4.2. Chemical properties of fruits:

#### 4.4.2.1. Total sugar percentage:

The data in table (28) deal with the effect of organic manure (sources and application methods) and biofertilization on shoot growth rate during both seasons. It is clear from table (28-A) that control trees gave the highest significant values of total sugar percentage in juice of fruits as compared with cattle or poultry or cammel manure without chemical fertilization. Cammel manure did not significantly affect total sugar percentage. Poultry manure gave the best significant values of total sugar as compared with cattle or cammel organic manure.

Moreover, trench application method for organic manure was more effective in increasing total sugar than surface method. Furthermore, nitrobein bacteria induced a highly significant increase in total sugar as compared with rhizobacterein, which ranked second in this study. While, unioculated trees with nitrogen biofertilization gave the least values of total sugar in two seasons of study.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (28-B). It can be stressed that the control trees with trench application method gave the highest significant values of total sugar as compared to the other treatments in this interaction treatments. While, the least significant values of total sugar of pomegranate fruits were found in cammel manure with trench application method. Generally, poultry organic manure with trench method was more effective in increasing total sugar than cattle or cammel manure with two application methods.

Table 28. Total sugar % of pomegranate fruits as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season 2003 | Season 2004 |
|---|---|---|
| Control | 12.66 a | 12.83 a |
| Cattle m. | 9.76 c | 9.06 c |
| Poultry m. | 10.87 b | 10.79 b |
| Camel m. | 8.46 d | 8.33 d |
| Surface | 10.38 b | 9.76 b |
| Trench | 10.49 a | 10.75 a |
| Control | 8.71 c | 8.32 c |
| Nitrobein | 11.89 a | 11.82 a |
| Rhizobactrerein | 10.71 b | 10.62 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 12.22 b | 10.00 e | 10.73 d | 8.57 g |
| | Trench | 13.09 a | 9.51 f | 11.01 c | 8.35 h |
| 2004 | Surface | 11.84 b | 8.97 f | 10.13 d | 8.08 h |
| | Trench | 13.82 a | 9.14 e | 11.46 c | 8.58 g |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 11.21 e | 8.33 j | 8.81 i | 6.50 k |
| | Nitro. | 14.00 a | 10.97 f | 12.46 c | 10.13 g |
| | Rhizo. | 12.76 b | 9.97 h | 11.36 d | 8.75 i |
| 2004 | Control | 10.41 f | 7.26 k | 8.91 i | 6.70 l |
| | Nitro. | 14.56 a | 10.55 e | 12.57 c | 9.59 g |
| | Rhizo. | 13.53 b | 9.36 h | 10.90 d | 8.70 j |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 9.00 d | 11.45 b | 10.69 c |
| | Trench | 8.42 e | 12.32 a | 10.73 c |
| 2004 | Surface | 7.87 f | 11.12 b | 10.28 d |
| | Trench | 8.77 e | 12.52 a | 10.96 c |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 11.00 i | 9.00 o | 9.01 o | 7.00 r |
| | | Nitro. | 13.50 b | 10.67 j | 11.90 f | 9.75 m |
| | | Rhizo. | 12.17 e | 10.33 l | 11.29 h | 8.95 o |
| | Trench | Control | 11.41 g | 7.67 q | 8.60 p | 6.00 s |
| | | Nitro. | 14.50 a | 11.27 h | 13.02 d | 10.50 k |
| | | Rhizo. | 13.35 c | 9.60 n | 11.43 g | 8.55 p |
| 2004 | Surface | Control | 9.41 de | 7.10 b | 8.41 ef | 6.55 h |
| | | Nitro. | 13.67 b | 10.10 b | 11.52 fg | 9.18 bc |
| | | Rhizo. | 12.44 cd | 9.71 fg | 10.45 cd | 8.50 de |
| | Trench | Control | 11.40 de | 7.42 de | 9.40 fg | 6.85 a |
| | | Nitro. | 15.44 de | 11.01 a | 13.61 g | 10.00 a |
| | | Rhizo. | 14.61 ef | 9.00 ef | 11.35 ef | 8.89 b |

Moreover, table (28-C) reflects the effect of interaction between organic manure source and biofertilization. Table (28-C) expressed that control trees treated with nitrobein gave the beast result in significant level of total sugar percent of pomegranate fruits as compared with cattle or poultry or cammel manure with or without nitrogen biofertilization. On the other hand, the least values of total sugar percent were found in cammel manure with uninoculated with nitrogen biofertilization treatment.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (28-D). It is indicated that trench application method and nitrobein treatment induced the highest significant values of total sugar percent of pomegranate fruits. In contrast, the least values in significant level of total sugar percent were shown in unfertilized with biofertilization trees (control). Generally, nitrogen biofertilization (nitrobein and rhizobacterein) with surface or trench application method improved total sugar percent in juice of fruits than uninfected trees (control) with biofertilization and surface or trench application method in two seasons of study.

Moreover, table (28-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control trees fertilized by trench method and fertilized with nitrobein bacteria gave the highest significant values of total sugar percent of pomegranate fruit juice as compared to all treatments under study. On the other side, cammel manure with uninoculated trees with nitrogen biofertilization and surface or trench method gave the least values of total sugar of pomegranate fruits than other treatments. Generally, the trees treated according to control combined with surface or trench application method and fertilized with nitrogen biofertilization with nitrobein or rhizobacterein bacteria increased total sugar percent than all organic manures under study in the two seasons of study.

Our date coincided with those of Sermann *et al.* (1975) on vines and Rabh *et al.* (1993) on balady mandarin.

### 4.4.2.2. Total soluble solids:

The data in table (29) deal with the effect of organic manure (sources and application methods) and biofertilization on total soluble solids (TSS) during both seasons. It is clear from table (29-A) that the trees which treated with garden fertilization system (control) gave the highest significant values of total soluble solids (TSS) as compared to poultry, cattle or cammel manure treatments. While, the least significant values of TSS of fruits were foud in cammel manure treatments.

Generally, the best results in total soluble solids (TSS) were found in the control trees which fertilized with garden manure system and the trees which treated with poultry manure, respectively, during the two seasons of study. Besides, trench application method was more effective in increasing total soluble solids (TSS) of pomegranate fruits than surface method in two seasons of study.

Table 29. Total soluble solids (TSS) % of pomegranate fruits as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season 2003 | Season 2004 |
|---|---|---|
| Control | 14.06 a | 16.78 a |
| Cattle m. | 10.83 c | 12.44 c |
| Poultry m. | 12.11 b | 14.22 b |
| Camel m. | 9.89 d | 11.67 d |
| Surface | 11.61 b | 12.97 b |
| Trench | 11.83 a | 14.58 a |
| Control | 10.13 c | 12.04 c |
| Nitrobein | 13.00 a | 15.13 a |
| Rhizobactrerein | 12.04 b | 14.17 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 13.78 b | 11.00 e | 11.89 d | 9.78 h |
| | Trench | 14.33 a | 10.67 f | 12.33 c | 10.00 g |
| 2004 | Surface | 16.11 b | 11.33 g | 13.67 d | 10.78 h |
| | Trench | 17.44 a | 13.56 e | 14.78 c | 12.56 f |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 12.50 d | 9.17 i | 10.67 g | 8.17 j |
| | Nitro. | 15.50 a | 12.00 e | 13.17 c | 11.33 f |
| | Rhizo. | 14.17 b | 11.33 f | 12.50 d | 10.17 h |
| 2004 | Control | 14.67 d | 11.00 j | 12.67 h | 9.83 k |
| | Nitro. | 18.00 a | 13.67 f | 15.50 c | 13.33 g |
| | Rhizo. | 17.67 b | 12.67 h | 14.50 e | 11.83 i |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 10.08 e | 12.92 b | 11.83 d |
| | Trench | 10.17 e | 13.08 a | 12.25 c |
| 2004 | Surface | 11.08 f | 14.33 c | 13.50 d |
| | Trench | 13.00 e | 15.92 a | 14.83 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 12.33 f | 9.33 l | 10.67 i | 8.00 o |
| | | Nitro. | 15.33 b | 12.33 f | 12.67 e | 11.33 h |
| | | Rhizo. | 13.67 d | 11.33 h | 12.33 f | 10.00 k |
| | Trench | Control | 12.67 e | 9.00 m | 10.67 i | 8.33 n |
| | | Nitro. | 15.67 a | 11.67 g | 13.67 d | 11.33 h |
| | | Rhizo. | 14.67 c | 11.33 h | 12.67 e | 10.33 j |
| 2004 | Surface | Control | 13.67 j | 9.67 r | 12.00 n | 9.00 s |
| | | Nitro. | 17.33 c | 12.67 l | 15.00 f | 12.33 m |
| | | Rhizo. | 17.33 c | 11.67 o | 14.00 i | 11.00 p |
| | Trench | Control | 15.67 e | 12.33 m | 13.33 k | 10.67 q |
| | | Nitro. | 18.67 a | 14.67 g | 16.00 d | 14.33 h |
| | | Rhizo. | 18.00 b | 13.67 j | 15.00 f | 12.67 l |

Furthermore, nitrobein nitrogen biofertilization gave the best results in significant increase of total soluble solids (TSS) as compared with trees inoculated with rhizobacterein which is coming in the second level. While, the pomegranate trees, which were uninoculated with nitrogen biofertilization was of the lowest effect in this study.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (29-B). The control trees with trench application method treatment was more effective in increasing to the significant level in total soluble solids (TSS) in fruits as compared to the other treatments under study in this interaction.

On the other hand, the least significant values of total soluble solids (TSS) were found with cammel organic manure and surface method treatment. Moreover, poultry manure with surface method treatments was more effective in increasing total soluble solids (TSS) in fruits than cattle or cammel manure with surface or trench application method.

Moreover, table (29-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious from table (29-C) that the control pomegranate trees gave the highest significant values to significant level of total soluble solids (TSS). On the other hand, the least significant values of total soluble solids (TSS) were found in the trees which treated with cammel organic manure and uninoculated with nitrogen bacteria. Generally, the trees fertilized with poultry manure and nitrobein were coming in the second level in increasing total soluble solids. Moreover, nitrogen bacteria induced an increase in total soluble solids (TSS) trees fertilized with all organic manures especially poultry manure.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (29-D). Pomegranate trees which treated with trench method and inoculated with nitrobein nitrogen biofertilization gave the highest significant values of total soluble solids (TSS). In the contrast, surface application method and rhizobacterein were more effective in decreasing to the significant level total soluble solids (TSS) trees. Generally, trench method with biofertilization increased total soluble solids (TSS) trees 3specially with nitrobein bacteria as compared with surface method with or without nitrogen biofertilization.

Moreover, table (29-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that control trees which treated with garden fertilization system with trench application method and nitrobein gave the highest significant values of total soluble solids (TSS) in fruits as compared with all treatments under study in the two seasons (2003 and 2004). Moreover, the least values in significant level of total soluble solids (TSS) trees were shown when trees treated with cammel manure, surface method and unfertilized with biofertilization. Generally, poultry manure with trench application method and nitrobein were more effective in increasing total soluble solids (TSS) trees than cattle or cammel organic manure with surface or trench method and inoculated with or without biofertilization.

Generally, poultry manure with trench application method and nitrobein bacteria were coming to the first effect in increasing the total soluble solids percentage of pomegranate fruits as compared to cattle or cammel manure with surface or trench method and with or without biofertilization through two seasons of study (2003 and 2004).

Our findings assured those by Gasanov (1984) and Abu Grah (2004) on persimmon and Kalu-Singh *et al.* (1984) on mango.

### 4.4.2.3. Acidity percentage:

The data in table (30) deal with the effect of organic manure (sources and application methods) and biofertilization on acidity percentage during both seasons. It is clear from table (30-A) that the control trees gave the highest significant values of acidity in fruit juice as compared with manure sources cattle, poultry or cammel through two successive seasons of study. In the same time, trench method for manure sources gave the highest significant values of acidity in fruit juice as comparing with surface method in two seasons of study (2003 and 2004). In the other side, concerning the values of fruit acidity percent in biofertilization treatments, the data shoed that the nitrobein bacteria treatment gave the highest significant values in this subject comparing with rhizobacterein or control. In addition, rhizobacterein treatment gave the best values of acidity percent above control treatments.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (30-B). the highest acidity was found with trench method when combined with the control. While, the least significant values of acidity in fruit juice are finding with cammel manure and surface application method in two seasons of study.

Table 30. Titratable acidity % of pomegranate fruits as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 27.56 a | 24.06 a |
| Cattle m. | 19.48 c | 13.92 c |
| Poultry m | 20.96 b | 14.52 b |
| Camel m. | 18.27 d | 12.49 d |
| Surface | 18.85 b | 13.40 b |
| Trench | 24.28 a | 19.09 a |
| Control | 18.16 c | 13.21 c |
| Nitrobein | 24.08 a | 18.47 a |
| Rhizobactrerein | 22.46 b | 17.06 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 22.56 c | 17.65 g | 18.72 f | 16.48 g |
| | Trench | 32.56 a | 21.30 d | 23.20 b | 20.06 e |
| 2004 | Surface | 18.67 b | 11.95 g | 12.56 f | 10.43 h |
| | Trench | 29.44 a | 15.88 d | 16.49 c | 14.55 e |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 22.67 d | 16.27 i | 18.05 h | 15.64 j |
| | Nitro. | 31.00 a | 21.68 e | 23.25 c | 20.40 f |
| | Rhizo. | 29.00 b | 20.49 f | 21.59 e | 18.78 g |
| 2004 | Control | 20.17 c | 11.38 j | 10.80 k | 10.48 l |
| | Nitro. | 26.67 a | 15.84 e | 17.03 d | 14.35 h |
| | Rhizo. | 25.33 b | 14.53 g | 15.74 f | 12.64 i |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 15.99 f | 21.29 c | 19.28 e |
| | Trench | 20.32 d | 26.88 a | 25.64 b |
| 2004 | Surface | 10.59 f | 15.62 d | 13.98 e |
| | Trench | 15.82 c | 21.32 a | 20.14 b |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 17.67 p | 15.00 t | 16.50 r | 14.78 u |
| | | Nitro. | 26.00 d | 19.70 k | 21.00 j | 18.44 n |
| | | Rhizo. | 24.00 f | 18.25 o | 18.67 m | 16.22 s |
| | Trench | Control | 27.67 c | 17.53 q | 19.60 l | 16.50 r |
| | | Nitro. | 36.00 a | 23.66 g | 25.50 e | 22.35 i |
| | | Rhizo. | 34.00 b | 22.72 h | 24.51 e | 21.33 i |
| 2004 | Surface | Control | 14.67 j | 9.27 t | 10.00 s | 8.43 u |
| | | Nitro. | 21.67 d | 13.92 k | 14.67 j | 12.24 p |
| | | Rhizo. | 19.67 e | 12.66 n | 13.00 m | 10.60 r |
| | Trench | Control | 25.67 c | 13.49 l | 11.60 q | 12.53 o |
| | | Nitro. | 31.67 a | 17.76 h | 19.40 f | 16.46 i |
| | | Rhizo. | 31.00 b | 16.40 i | 18.47 g | 14.67 j |

Moreover, table (30-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious that the pomegranate trees which fertilized with garden fertilization as a control with nitrobein biofertilization gave the highest significant values of fruit acidity of trees in two seasons of study. On the other hand, the least significant values in this subject were shown in cammel organic manure with uninoculated with nitrogen biofertilization (control) trees.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (30-D). Pomegranate trees treated with trench application method and nitrobein nitrogen biofertilization induced a significant increase in fruit acidity percent than the other treatments in two seasons of study. Moreover, the control trees which applied with organic manures with surface method gave the least significant values of fruit acidity percent. Generally, nitrogen biofertilization with surface or trench application method improved the fruit acidity percent of pomegranate trees than control trees with surface of trench method.

Moreover, table (30-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that highest significant values of fruit acidity were found in control with trench and nitrobein treatment. The least significant values of fruit acidity were found in the trees treated with cammel manure with surface application. Generally, poultry, cattle and the control trees improved the acidity in juice of pomegranate fruits especially with trench application method and nitrobein nitrogen biofertilization.

The obtained results go firmly with those of Silva (1998) on mango trees, Zavaleto-Beckler *et al.* (2001) and Salama (2002) on balady mandarin.

### 4.4.2.4. TSS: acidity ratio:

The data in table (31) deal with the effect of organic manure (sources and application methods) and biofertilization on TSS: Acidity ratio during both seasons. It is clear from table (31-A) that the pomegranate trees treated with poultry manure gave the highest significant values of TSS: acidity ratio in two seasons of study. In contrast, the least significant values of pomegranate trees were found when trees treated with control. Furthermore, when concerning the application method, the surface method gave the best TSS: acidity ratio as compared with trench. In addition, nitrobein nitrogen biofertilization increased TSS: acidity ratio values than rhizobacterein or control treatments.

Meanwhile, the effect of the interaction between organic manure sources and applicatin method is tabulated in table (31-B). It is clear that the surface application method with organic manure sources (cattle, poultry, cammel and control) gave the highest significant values of TSS: acidity ratio of pomegranate trees than trench method with organic manure sources. Beside, trench method with control gave the least significant values of TSS: acidity ratio of pomegranate trees for the two seasons of study.

Table 31. Titratable acidity: TSS of pomegranate fruits as affected by different organic manure sources, application methods as well as biofertilization during 2003 and 2004 seasons.

A. Effect of organic manure sources, application methods as well as biofertilizers:*

| Variable | Season | |
|---|---|---|
| | 2003 | 2004 |
| Control | 0.5 b | 0.7 c |
| Cattle m. | 0.6 a | 0.9 b |
| Poultry m. | 0.6 a | 1.0 a |
| Camel m. | 0.5 b | 0.9 b |
| Surface | 0.6 a | 1.0 a |
| Trench | 0.5 b | 0.8 b |
| Control | 0.6 a | 1.0 a |
| Nitrobein | 0.6 a | 0.9 b |
| Rhizobactrerein | 0.5 b | 0.9 b |

* any two values sharing an alphabet are not significantly different at 1% level of significance.

B. Effect of the interaction between manure sources and application methods:

| Season | Method | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Surface | 0.6 a | 0.6 a | 0.6 a | 0.6 a |
| | Trench | 0.4 c | 0.5 b | 0.5 b | 0.5 b |
| 2004 | Surface | 0.8 d | 0.9 c | 1.1 a | 1.0 b |
| | Trench | 0.6 d | 0.9 c | 0.9 c | 0.9 c |

C. Effect of the interaction between manure sources and biofertilization

| Season | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|
| 2003 | Control | 0.6 a | 0.6 a | 0.6 a | 0.5 b |
| | Nitro. | 0.5 b | 0.6 a | 0.6 a | 0.5 b |
| | Rhizo. | 0.5 b | 0.5 b | 0.6 a | 0.5 b |
| 2004 | Control | 0.8 d | 1.0 b | 1.1 a | 1.0 b |
| | Nitro. | 0.7 e | 0.9 c | 0.9 c | 0.9 c |
| | Rhizo. | 0.7 e | 0.8 d | 0.9 c | 1.0 b |

D. Effect of the interaction between application methods and biofertilization

| Season | Method | Control | Nitrobein | Rhizobactrerein |
|---|---|---|---|---|
| 2003 | Surface | 0.6 a | 0.6 a | 0.6 a |
| | Trench | 0.5 b | 0.5 b | 0.5 b |
| 2004 | Surface | 1.1 a | 0.9 b | 0.9 b |
| | Trench | 0.9 b | 0.8 c | 0.8 c |

E. Effect of the interaction between Three-factor interaction Sources x Methods x Biofertilization

| Season | App. Method | | Control | Cattle m. | Poultry m. | Camel m. |
|---|---|---|---|---|---|---|
| 2003 | Surface | Control | 0.7 a | 0.6 b | 0.7 a | 0.5 c |
| | | Nitro. | 0.6 b | 0.6 b | 0.6 b | 0.6 b |
| | | Rhizo. | 0.6 b | 0.6 b | 0.6 b | 0.6 b |
| | Trench | Control | 0.5 c | 0.5 c | 0.6 b | 0.5 c |
| | | Nitro. | 0.4 d | 0.5 c | 0.5 c | 0.5 c |
| | | Rhizo. | 0.4 d | 0.5 c | 0.5 c | 0.5 c |
| 2004 | Surface | Control | 0.9 d | 1.1 b | 1.2 a | 1.1 b |
| | | Nitro. | 0.8 e | 0.9 d | 1.0 c | 1.0 c |
| | | Rhizo. | 0.8 e | 0.8 e | 1.1 b | 1.0 c |
| | Trench | Control | 0.6 f | 0.9 d | 1.1 b | 0.9 d |
| | | Nitro. | 0.6 f | 0.8 e | 0.8 e | 0.9 d |
| | | Rhizo. | 0.6 f | 0.8 e | 0.8 e | 0.9 d |

Moreover, table (31-C) reflects the effect of interaction between organic manure source and biofertilization. It is obvious from table (31-C) that poultry and cattle manure with uninfected with nitrogen biofertilization treatments gave the highest significant values of TSS: acidity ratio of pomegranate trees. On the other hand, the trees fertilized with garden system (control) and treated with nitrobein and rhizobacterein gave the least significant values of TSS: acidity ratio of the two seasons of study.

In addition, the effect of interaction between application method and nitrogen biofertilization is tabulated in table (31-D). Surface application method and control treatment induced the highest significant values of TSS: acidity ratio of pomegranate fruits. In contrast, the least significant values of TSS: acidity ratio were shown in trench method with nitrobein and rhizobacterein in nitrogen biofertilization.

Moreover, table (31-E) reflects the effect of the interaction among organic manure sources, application method and biofertilization. It is clear that the trees treated with poultry organic manure and surface method and unfertilized with biofertilization treatment gave the highest significant values of TSS: acidity ratio of pomegranate trees. On the opposite, the control trees applied with trench method and fertilized with nitrobein and rhizobacterein bacteria gave the least significant values of TSS: acidity ratio of pomegranate trees in the first and second seasons of study. Generally, the trees which treated with garden fertilization as a control and the trees which treated with organic manure sources with surface application method with or without nitrogen biofertilization gave the highest significant values of TSS: acidity ratio of pomegranate trees than the same treatments with trench application method.

Generally, the trees fertilized with garden system as a control with trench and inoculated with nitrobein bacteria treatment gave the highest significant yield and fruit quality of pomegranate trees as compared to all treatments under investigation. The least values of yield and fruit quality were obtained with cammel manure with surface method and uninoculated nitrogen biofertilization. Generally, the pomegranate trees which were grown in calcareous soil and treated with mixed organic manure (40 kg/tree from cammel, cattle and poultry manure) with trench application method and nitrobein nitrogen biofertilization increased vegetative growth, yield, physical or chemical properties. These results are in agreement with the findings of Rabeh (1993) on Balady mandarin, Huang et al. (1995), El-Kobbia (1999) and Song et al. (1999) on Washington navel orange and Fuji apple, Abou-Grah (2004) on Persimmon tree.