V. SUMMARY AND CONCLUSION

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This investigation was carried out in the Experimental station of the Horticulture Research Institute at Giza Governorate during three successive seasons of 1987, 1988 and 1989 on rooted cuttings of Picual and Manzanillo olive cvs. The main purpose was to investigate the response of such nursery plants concerning their nutritional status and vegetative growth to GA and some nutritional treatments. Since, two experiments were envolved. The first included some foliar spray treatments with two N sources "Urea and $(NH_4)_2 SO_4$" ,"Zn SO_4 and gibberellin" either solely or in combinations. Second dealing with the application method, rate and some combinations of soil applied N,P,K fertilizers. Treatments of each experiment were arranged in a complete randomized design with 5 replicates each was represented by 2 nursery plants. Thus the different treatments of each experiment were as follows :

Experiment, I :

1. Tap water spray "control" .
2. Urea foliar spray at 1% .
3. $(NH_4)_2 SO_4$ foliar spray at 1% .
4. Zn SO_4 foliar spray at 500 ppm .
5. Gibberellin foliar spray at 100 ppm .
6. Urea 1% + Zn SO_4 500 ppm .
7. Urea 1% + gibberellin 100 ppm .
8. $(NH_4)_2 SO_4$ 1% + Zn SO_4 500 ppm .
9. $(NH_4)_2 SO_4$ 1% + gibberellin 100 ppm .

Experiment, II :

1. No fertilizer application "control" .
2. Nitrogen foliar application "$(NH_4)_2 SO_4$ 1%"
3. N_1 soil application "2 gm. actual N/plant as$(NH_4)_2 SO_4$"
4. N_2 soil application "4 gm. actual N/plant as$(NH_4)_2 SO_4$"
5. P_1 soil application "2 gm.P_2O_5/plant as superphosphate"
6. P_2 soil application "4 gm.P_2O_5/plant as superphosphate"
7. K_1 soil application "2 gm. K_2O/plant as $K_2 SO_4$"
8. K_2 soil application "4 gm. K_2O/plant as $K_2 SO_4$"
9. (N_2+P_2) soil application"4 gm. of N and P_2O_5/plant"
10. (N_2+K_2) soil application"4 gm. of N + 4 gm K_2O /plant"
11. (N_2+P_2+K_2)soil application"4 gm. from each of N, P_2O_5 and K_2O".
12. P foliar application 0.5 % orthophosphoric acid.

All foliar spray treatments in this study were applied 8 times at 15 days intervals, started on early May during 1987 and 1988 seasons, as well as on early August in 1989 season. However, the dose of each soil application treatment was fractionated into four equal frequencies at one month interval.

The obtained results could be summarized as follows :

V. 1. Vegetative growth :

V. 1.1. Stem length :

V. 1.1.a. Experiment, I :

Obtained data revealed that all the foliar spray treatments used in the experiment"I" i.e. urea 1%, $(NH_4)_2 SO_4$ 1%, Zn SO_4 500 ppm, GA 100 ppm and their combinations increased significantly stem length in nursery plants of both Picual and Manzanillo olive cvs. over the control during three seasons of study. On the other hand, both (Urea 1% + GA 100 ppm) and $(NH_4)_2 SO_4$ 1% + GA 100 ppm) treatments were the superior as an average of three seasons was concerned for both cvs.

V. 1.1.b. Experiment "II" :-

Obtained data showed that N foliar application "$(NH_4)_2 SO_4$ at 1%" treatment was more effective than soil application either at 2.0 or 4.0 gm. actual N/plant (N_1, N_2) treatments, where the spray application enhanced statistically stem length in both olive cultivars over control. While soil application of $(NH_4)_2 SO_4$ at the N_1 rate induced statistically the same stem length value of control, but the N_2 soil application (4.0 gm. actual N per plant) suppressed stem elongation. This trend was true either in 1987 and 1988

seasons or in 1988 and 1989 seasons regarding N_1 and N_2 treatments respectively, as well as if the average of the three seasons of both N levels was compared. Moreover, soil application of phosphorus and potassium as each was added solely either at low or high level showed highly significant increase over control, since they were the superior in both cvs. On the other hand, different treatments of N,P,K combinations, i.e. (N_2+P_2), (N_2+K_2) and (N_2+P_2+K_2) treatments showed variable responses, where (N_2+P_2) induced relative increase, especially in Manzanillo cv. On the contrary the other two combinations i.e. (N_2+K_2) and (N_2+P_2+K_2) treatments stunted shoot length, especially the forward one with Picual cv. In addition,P foliar sprays enhanced stem length.

V. 1.2. Stem dry weight :

V. 1.2.a. Experiment "I" :

Concerning stem dry weight of Picual and Manzanillo rooted cuttings in response to the different treatments used in experiment "I" data showed nearly the same trend that previously found with stem length, where all treatments showed a significant increase over control. Meanwhile, the (Urea +GA) and $(NH_4)_2 SO_4$ treatments were the superior, followed by GA treatment in a descending order.

V. 1.2.b. Experiment "II" :

Data obtained showed that foliar application of ammonium sulphate (1%) increased significantly the stem dry weight than control from one hand and it was more effective than soil application either at 2.0 or 4.0 gm. actual N/plant from the other. Since, stem dry weight of the lower N soil applied rooted cuttings was nearly the same as control, especially in Picual cv., but the higher N level stunted significantly stem growth in both cultivars.

Moreover, soil application of both superphosphate and potassium sulphate enhanced significantly stem growth in both olive cultivars. However, the lower rate of each i.e. 2.0 gm. of P_2O_5/ K_2O per plant was tended to be the superior in this concern. In addition, the P foliar spray with orthophosphoric acid at the rate of 200 ppm P_2O_5 seemed to be uneffective.

Nevertheless, treatments of the three N,P,K combinations used were greatly varied. Since, the (N_2+P_2) treatment was the superior combination and significantly surpassed the control, but the (N_2+k_2) treatment was the inferior and decreased the stem dry weight below the control. In addition, the (N_2+P_2+K_2) treatment was in between the above mentioned combinations, in this respect.

V. 1.3. Leaves dry weight :

V. 1.3.a. Experiment, I :-

Data obtained revealed that the response of leaves dry weight in both olive cvs. to the different spray treatments applied in experiment "I" showed a similar trend to that previously mentioned with both length and dry weight of stem, where all treatments showed a highly significant increase over control. On the other hand, urea 1% foliar spray alone and its combinations either with Zn SO_4 or GA were the superior followed by those of ammonium sulphate 1% and its combinations, while the foliar spray with GA alone ranked the last in this concern.

V. 1.3.b. Experiment, II :

Concerning the leaves dry weight, data obtained showed that N foliar application was more beneficial than soil application. Moreover, the N_2 soil application showed a harmfull effect in this concern.

Besides, soil application of superphosphate at both P_1 and P_2 rates as well as K_2 SO_4 application enhanced statistically leaves growth. However, the rate of both P and K fertilizers did not show a specific trend for both cultivars in each season of study. As for the P foliar application and the soil application of the different combinations of N,P,K

fertilizers, obtained data showed the same response that previously detected concerning stem growth to these treatments.

V. 1.4. Root dry weight :

V. 1.4. a. Experiment, I :-

From the data obtained, it is quite evident that all the foliar spray treatments used in the first experiment increased significantly the root dry weight in rooted cuttings of both two olive cultivars. Both two N sources were statistically of the same effect. However, the GA foliar spray at 100 ppm either alone or combined with urea/ammonium sulphate treatments showed the lowest increase in root dry weight as compared to the other used treatments. On the contrary the foliar spray treatments of Zn SO_4 at 500 ppm, (urea + Zinc sulphate) and (ammonium sulphate + zinc sulphate) were the superior ones, since they statistically exceeded all the other treatments in most cases with both olive cultivars.

V. 1.4.b. Experiment, II :-

As for the root dry weight response to the different treatments applied in the second experiment, data obtained cleared that the foliar application of $(NH_4)_2 SO_4$ was more effective than soil application at both 2.0 and 4.0 gm. ac-

tual N/plant. Since, the $(NH_4)_2 SO_4$ foliar spray enhanced significantly root growth and N_2 soil application retarded it but the N_1 soil treatment was in between. Moreover, the soil application, of superphosphate produced statistically the heaviest root dry weight, since both P_1 and P_2 levels were the superior with Picual and Manzanillo cvs., respectively as an average of three seasons were concerned. In addition, both rates of $K_2 SO_4$ soil application enhanced significantly root dry weight in nursery olive plants of both cvs., however, no definite tendency could be observed regarding K rate response for both cultivars in all seasons of study. Moreover, the N,P,K combinations were varied greatly concerning their effect since the (N_2+P_2) treatment was the superior but the (N_2+K_2) was the inferior, as well as the $(N_2+P_2+K_2)$ came in between, in this concern. Beside P foliar spray was not effective as compared to control.

V. 1.5. Total plant dry weight :-

V. 1.5.a. Experiment, I :-

Data obtained, disclosed that all foliar spray treatments investigated in the first experiment increased significantly the total plant dry weight of nursery olive plants in both cultivars. However, the increase in most cases was appreceably of same value, but it could be generally concluded that urea and its combinations as well

as ammonium sulphate either solely or in combinations especially with GA tended to be the most effective treatments in this respect.

V. 1.5.b. Experiment, II :-

Data obtained concerning the influence of the different treatments applied in the second experiment on the total plant dry weight "i.e. rate and application method as well as some combinations of N,P,K fertilizers" revealed that $(NH_4)_2 SO_4$ foliar spray was more effective than the soil application. Moreover, the N_2 soil application suppressed growth. Besides, superphosphate soil application either at 2.0 or 4.0 gm. P_2O_5/plant were the superior treatments with Picual and Manzanillo cvs., respectively as an average of three seasons was concerned. In addition, as the $K_2 SO_4$ was applied solely a marked increase in total plant dry weight was gained, while the reverse was true as it was added to ammonium sulphate i.e. (N_2+K_2) treatment. On the other hand, (N_2+P_2) treatment showed that adding superphosphate to the ammonium sulphate eliminated to great extent the harmfull effect of higher N soil application, where the applied plants exceeded statistically those of control. However, the (N_2+P_2+K_2) applied nursery olive plants of both cultivars were to some extent of the same total plant dry weight as compared with the corresponding ones of control. This prove also that superphosphate showed a beneficial effect in a

coming back to health for the nursery olive plants which suffer from (N_2+K_2) soil application.

V. 1.6. Top/root ratio :

V. 1.6.a. Experiment, I :-

Regarding the top/root ratio in nursery plants of both Picual and Manzanillo olive cvs. as influenced by the foliar sprays treatments used in the first experiment, data obtained declared that gibberellin application either solely or combined with urea/ammonium sulphate resulted in the highest ratio. On the contrary, foliar sprays with zinc sulphate at 500 ppm either alone or in combination showed the least value of top/root ratio. These responses were generally more pronounced with Manzanillo than Picual cultivar.

V.1.6. b. Experiment, II :-

With respect to the top/root ratio in response to the different treatments applied in the second experiment, it is clear that N foliar spray was not effective, while with N soil application especially at level of 4.0 gm. actual N / plant the ratio tended to be decreased. Moreover, superphosphate soil application decreased the ratio especially when it was added at the rate of 4.0 gm. P_2O_5/plant. As for the

effect of K_2SO_4 treatments, however no definite trend was occurred, but the ratio tended to be generally decreased with the higher rate of K_2SO_4 application.

In addition, soil application of the (N_2+P_2+K_2) combination showed the lowest value of top/root ratio as compared with those of both the other two combinations i.e. (N_2+P_2) and (N_2+K_2) treatments.

Generally it could be concluded that superphosphate soil application at both levels, N soil application of ammonium sulphate especially at the higher rate as well as the (N_2+P_2+K_2) combination, all resulted in decreasing the top/root ratio. Besides, nursery olive plants of Manzanillo cv. were more responded to such treatments than those of Picual.

V. 2. Leaves, stem and roots mineral contents:-

V. 2.1. Experiment, I :

1. Spraying both Picual and Manzanillo rooted cuttings either with urea or $(NH_4)_2SO_4$ solutions each at 1% concentration increased significantly leaf N, Ca and Mg contents as well as stem and roots N and Ca %. On the contrary, both N foliar spray treatments resulted in a significant decrease in P and K contents below the control in the three plant organs of the rooted cuttings of both olive cvs.

2. Foliar application with Zn SO_4 at 500 ppm decreased significantly leaves, stem and roots P and Ca %, but it increased significantly leaf Mg %. In addition, leaf, stem and root N and K percentages were not affected as compared with the control treatments in both Picual and Manzanillo olive rooted cuttings.

3. GA foliar sprays caused a significant increase in leaf, stem and root N, K and Ca % in both two olive vareities, except in Manzanillo where the increase in Ca % was not significant in all plant organs. Moreover, leaf Mg % showed the same trend of both N and K leaf %.

   Meanwhile, leaves, stem and root P % was significantly decreased in two olive cvs. during the two seasons of study.

4. Spraying both Picual and Manzanillo olive rooted cuttings either with (urea + Zn SO_4) or ($(NH_4)_2$ SO_4 + Zn SO_4) treatments increased significantly N and Mg contents in leaves, stem and root while P,K and Ca was significantly decreased in both two olive cvs. Besides, roots P content was increased as compared with the control during the study.

5. In addition, foliar sprays with both combinations of (urea + GA) and ($(NH_4)_2$ SO_4+ GA) caused a significant increase in leaf, stem and root N, Ca and Mg contents, but the reverse was true with P and K contents in both Picual

and Manzanillo rooted cuttings during the study.

6. Urea foliar sprayed rooted cuttings showed a significant increase in P and Ca levels in their different plant organs as compared with $(NH_4)_2SO_4$ sprayed ones. Meanwhile, N level in Manzanillo rooted cuttings showed the same trend that previously mentioned with P and Ca but the reverse was found with Picual cultivar. In addition, K % did not show a specific effect concerning the effect of N source in this respect.

V. 2.2. Experiment, II :-

1. $(NH_4)_2 SO_4$ application either as foliar spray at 1% or soil application at (2.0 gm. - 4.0 gm. N/plant) caused highly significant increase in leaf, stem and root N, Ca and Mg contents. While it decreased significantly P and K contents as compared with the control in both Picual and Manzanillo rooted cuttings during the study.

2. P soil application at the rate of (2.0 gm. - 4.0 gm. P_2O_5 /plant) increased significantly N, P, Ca and Mg contents in leaf, stem and root in both two olive cvs., while K content was decreased significantly. Rising the supply of P fertilizer from (2.0 gm. to 4.0 gm. P_2O_5/plant) increased significantly P and Mg contents in leaves, stem and roots, while N,K and Ca levels were not affected in

both Picual and Manzanillo rooted cuttings during the study.

3. K soil application caused a significant increase in leaves, stem and root N,P,K and Mg contents as compared with the control in both two olive cvs., while Ca content was decreased significantly. On the other hand, rising the K supply from (2.0 gm. to 4.0 gm. K_2O /plant) increased N,P,K and Mg contents in both Picual and Manzanillo olive rooted cuttings during the two seasons of study.

4. In addition, all combinations of N,P,K fertilizers, i.e. (N_2+P_2), (N_2+K_2) and (N_2+P_2+K_2) treatments caused a significant increase in leaf, stem and root N,P,K,Ca and Mg contents in Picual and Manzanillo olive rooted cuttings. However, few exceptions could be neglicted i.e. K and P levels in both (N_2+P_2) and (N_2+K_2) applied nursery olive plants, respectively.

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