Physiological studies on some Apple Rootstocks

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The present study was carried out during two consecutive seasons of 1990 and 1991 at the Experimental Station of the Faculty of Agriculture, Ain-Shams University, Shoubra El-Kheima, Cairo, Egypt.Two year old plants of three apple rootstock namely: MM.106, MM.111 and Balady Crab apple planted in early February in one of the following soils, alluvial, sandy and calcareous soils. All soil types were taken from a depth of 0-30 cm; from ground surface and were chemically and mechanically analysed before period of equilibration.The pots were filled with about (10 Kg.) of each soil type, then the transplants were planted. Irrigation was done with the rate of 750 ml/pot at two days intervals. 2/3 rootstocks were shield budded with Anna or Ein-Shiemer apple buds in June of each year.In each season, N,P and K fertilizers were applied three times a year i.e. 1st May, 15th June and 1st August at three levels. Thus, we had a three factorial experiments each one included 27 treatments arranged in a complete randomized design to study the following terns:-I- Effect of soil type and NPR fertilizer level of 3apple rootstocks on : a.Vegetative growth.b.Leaf 'minerals and stem carbohydrates content.II- Effect of soil type and NPK fertilizer level of Anna plants of budded on the three different rootstocks on : -a.Vegetative growth. b.Leaf gjnerals and stem carbohydrates content.III- Effect of soil type and NPK fertilizer level of Ein-Shiemer plants budded on the three different rootstocks on:-a.Vegetative growth.b.Leaf minerals and stem carbohydrates content.The obtained results could be summarized as follow:I: Effect of soil type and NPR fertlization level on vegetative growth and leaf mineral composition of three apple rootstocks:a. Vegetative growth:1.MM.111 rootstock showed generally the highest values of vegetative growth, (stem length, stem diameter, number of leaves/plant, stem dry weight, root dry weight, total plant dry weight and top/root ratio) while leaves dry weight was the superior in MM.106 apple rootstock seedlings in this respect.2.Concerning the specific effect of soil type on vegetative growth, sandy soil produced the lowest values when compared with either alluvial soil or calcareous media with MM.106, MM.111 and Balady apple rootstock seedlings during the two seasons (1990 and 1991). On the other hand, top/root ratio no definit trend. 3.With respect to the specific effect of fertilization level on vegetative growth, the obtained data showed that the highest fertilization level (N,P3K3) greately increased number of leaves/plant and leaves dry weight while the medium fertilization level (N2P2K2) gained transplants with the greatest value of stem length, stem diameter, stem dry weight and total plant dry weight. 4.A significant interaction between rootstock kind and soil type was detected where, MM.106 rootstock grown on alluvial soil showed the greatest values of leaves, root and total plant dry weight. Meanwhile MM.111 rootstock grown on calcareous soil exhibited the highest stem diameter, stem, root and total plant dry weight during the two seasons of study. 5.A considerable interaction between rootstock and fertilization level was shown. However, MM.111 rootstock received N2P2K2 fertilization exhibited the higher stem length, stem diameter, stem, root and total plant dry weight during 1990 and 1991 seasons.6.A significant interaction was found between fertilization level and soil type regardless of rootstock kind. However, plants grown on alluvial soil and fertilized with N2P2K2 were the best plants for stem length, stem diameter while those received either N3P3K3 level have the highest valueof number of leaves/plant, leaves, roots and total plant dry weight.7. A markable interaction was shown between rootstock kind, soil type and NPR level. Meanwhile, MM.111 transplants grown on alluvial soil and fertilized with N2P2K2 level showed the greatest stem length, number of leaves/plant. On the other hand, MM. 106 grown on alluvial soil and fertilized with N3P3K3program had the highest value of leaves, stem and total plant dry weight.II. Effect of soil

type and NPK fertilization level of Anna plants budded on three apple rootstocks on vegetative growth : 1.Anna scions budded on MM.111 had significantly the greatest values of vegetative growth i.e (scion length, scion diameter, number of leaves/plant, leaves , stem, root and total plant dry weight) during 1990 and 1991 seasons.2.Concerning the specific effect of soil type on vegetative growth, alluvial soil proved to be the best soil for the vegetative growth of Anna transplants regardless of NPK level i.e. (scion length, scion diameter, number of leaves/plant, leaves, stem, root and total plant dry weight.In addition, sandy soil produced the lowest value in this respect during the two seasons of study.3. With respE.ct to the specific effect of fertilization level on vegetative growth, the obtained result showed that N3P3F3 and N2P2K2 levels proved to be the proper fertilization program for scion length, scion diameter, number of leaves/plant, leaves, root and total plant dry weight during 1990 and 1991 seasons, respectively.4. A significant effect was detected as a result of the interaction between rootstock kind and soil type, where, Anna scion budded on MM.111 rootstock grown on alluvial soil showed the highest value of scion length and diameter whereas those budded on MM.106 rootstock grown on sandy soil took the other way around during the study.In addition, Anna scion budded on MM.106 rootstock grown on alluvial sol had the greatest value of number of leaves/plant, leaves, stem, root and total plant dry weight during the two seasons of study. Moreover; Anna scion budded on MM.106 or MM.111 rootstock and grown on alluvial soil and those budded on Balady apple rootstock and grown on either calcareous or sandy soil showed the greatest value of top/root ratio.5. A considerable interaction between rootstock kind and fertilization level was found. In this respect, Anna scion budded on MM.111 or MM.106 rootstocks, and received N3P3K3 level exhibited the higher value of scion length, sciondiameter, number of leaves/ plant, leaves and stem dry weight during 1990 and 1991 seasons, respectively.6.A Significant interaction was found between fertilization level and soil type regardless of rootstock kind. However, Anna plants grown on alluvial soil and fertilized with N2 P2 K2 level were the best plants for scion length and those grown on alluvial soil and received N1P1K1 level had the highest value of scion diameter and leaves dry weight during the study.7.A markable interaction was found between rootstock kind, soil type and NPK fertilization level. Meanwhile, Anna scions budded on MM.111 rootstock grown on alluvial soil and fertilized with N3P3K3 level showed a greatest value of scion length, number of leaves/plant, leaves, stem and total plant dry weight during the study. In addition those budded on Balady apple rootstock grown on calcareous soil and fertilized with N3P3K3 level gave the greatest value of scion length, number of leaves/plant, leaves, stem, root and total plant dry weight.III. Effect of soil type and NPK fertilization level of Ein Shimer plants budded on three apple rootstocks on vegetative growth:1. Ein-Shiemer scion when budded on MM.111 significantly increased vegetative growth i.e. (scion legnth, number of leaves/plant, leaves, stem, root and total plant dry weight) during the study. 2.Regarding the specific effect of soil type on vegetative growth, alluvial soil proved to be the best soil for the vegetative growth of Ein-Shiemer transplants regardless of NPK level i.e. (scion length, scion diameter, number of leaves/plant, leaves, stem, root and total plant dry weight as well as top/root ratio during the two seasons of study.3.With respect to the specific effect of fertilization level on vegetative growth, the obtained data showed that N2P2K2 level proved to be the proper fertilization on number of leaves/plant, leaves dry weight and top/root ratio while N2 P2 K2 level had the hight value of scion diameter, stem, root and total plant dry weight during 1990 and 1991 seasons of study.4.A Significant effect was detected as a result of the interaction between rootstock kind and soil type, where, Ein-Shiemer scion budded on MM.111 and grown on alluvial soil showed the highest value of scion diameter, leaves, stem and total plant dry weight during the two seasons of study.5.A considerable interaction between rootstock kind and fertilization level was noticed. In this concern, Ein-Shiemer scion budded on MM.111 rootstock and received N2P2K2 treatmentexhibited the highest value of scion diameter, number of leaves/plant and total plant dry weight during the study.6.A significant interaction was found between fertilization level and soil type regardless of rootstock kind. Plants grown on alluvial soil and received N2P2K level had the highest value of root and total plant dry weight during the two seasons of study.7.A markable interaction was found between rootstock kind, soil type and NPK fertilization level. Scions budded on MM.106 rootstock grown on alluvial soil and received N3P3K3 level had the highest value of leaves, root and total plant dry weight during 1990

and 1991 seasonS.I.b. Leaf mineral and stem carbohydrtes contents:1.The specific effect of rootstock kind on leaf mineral content showed a significant increase in leaf N and P contents of MM.106 and MM.111 transplants. On the other hand, Balady apple rootstock had the highest value of leaf-K, Ca, Mg and Mn contents during the study.2.Concerning the specific effect of soil type on leaf mineral contents, alluvial soil proved to be the best soil for improving leaf N,P, and Zn content, while sandy and calcareous soil seemed to be the poorest medium in this minerals. Moreover, calcareous soil had the highest value of leaf-CaHowever, plants grown on alluvial soil and fertilized with N3P3K3 showed the highest value of leaf P,K and Zn content.7.A markable interaction was shown between rootstock kind, soil type and NPR level. Meanwhile, M74.106 or MM.111 transplants grown on alluvial or calcareous soil and fertilized with M2P2K2 level showed the highest value of leaf N during the study. In addition, MM.106 and MM.111 grown on either calcareous or sandy soil and received N3P3K3 level had the highest value of leaf-P content during the study.8.MM.111 plants had significantly the greatest value of stem carbohydrates content. Moreover, alluvial soil proved to be the best soil for improving stem carbohydrates content. In addition, N3P3K3 proved to be the proper fertilization program in 1st season while N2P2K2 level exhibited plants with the greatest value of stem carbohydrates content during the 2nd season. In addition, a significant interaction between rootstock and soil type, however, MM.111 rootstock grown on alluvial soil exhibited the highest value of stem carbohydrates content. Meanwhile, a considerable interaction between rootstock and fertilization level was noticed. However, MM.111 fertilized with N3P3K3 or N2P2K2 levels had the highest value of stem carbohydrate during 1st and 2nd seasons, respectively.With respect to the interaction between fertilization level and soil type. One can say that plants grown on alluvialsoil and fertilized with N2P2K, level were the best plants for stem carbohydrate content during the two seasons of study.II.b. Leaf minerals and stem total carbohydrates contents:1.Anna scions budded on MM.111 had significantly the highest leaf, N,P,K,Ca,Mg and Mn contents.2.Concerning the specific effect of soil type on leaf mineral content, alluvial soil proved to be the best soil for leaf P,K and Zn content while calcareous soil produced plants with the highest value of leaf-Ca content during the study.3.With respect to the specific effect of fertilization level on leaf mineral content, N3P3K3 level proved to be the proper fertilization program for leaf, N,K and Mn whereas where N2P2K2 treatment proved to be the proper fertilization level for leaf P,Ca and Zn content during 1990 and 1991 seasons.4.A significant effect was found as a result of the interaction between rootstock kind and soil type, where Anna scion budded on MM.111 rootstock and grown on calcareous soil had the highest value of leaf N and P content during the two seasons of study. In addition, Anna scion budded on MM.106 and grown on calcareous soil had the greatest value of leaf K,Ca and Mn content while those budded on MM.111 and grown on sandy soil gave the highest value of leaf Mg content. In addition,Anna scion budded on MM.111 rootstock and grown on alluvial soil had the greatest value of leaf Mn and Zn content5.A considerable interaction between rootstock kind and fertiliization level was notced. In this respect, Anna scion budded on MM.111 rootstock and received N3P2K2 level exhibited the higher value of leaf N and Mn contents; during the study whreas those fertilized with N2P2K2 level increased in their leaf P and Mg contents.6.A significant interaction was found between fertilization level and soil type regardless of rootstock kind. However, Anna plants grown on either calcareous or sandy soil and fertilized with N,P2K2 level increased leaf P and Mg during the study. On the other hand, plants grown on alluvial soil and fertilized with N2P2K2 level had the highest value of leaf-K and Zn content.7.A markable interaction was found between rootstock kind, soil type and NPK fertilization level. However, Anna scion budded on MM.111 rootstock grown on alluvial soil and received with N3P3K3 level showed the highest value of leaf N,K Mn and Zn content. In addition; scion budded on MM.106 grown on calcareous soil and fertilized with N2P2K2 level gave the greatest value of leaf K and Mn content during 1990 and 1991 season.8. Anna scion budded on MM.106 rootstock had highest value of stem carbohydrates content. Moreover; calcareous soil proved to be the best soil for improving stem carbohydrate content. On the other hand, N3P3K3 level proved to be the proper fertilization program during 1st and 2nd season, respectively.Moreover, a significant interaction between rootstock and soil type was found. However, Anna scion budded on Balady apple rootstock and grown on calcareous soil exhibited the highest value of stem carbohydrates content.

Meanwhile, a considerable interaction between rootstock and fertilization level was noticed. However, Anna scion budded on MM.106 and fertilized with N3P3K3 level had the highest value of stem carbohydrates content. In addition, the interaction between fertilization level and soil type was significant where plants grown on calcareous soil and received N3P3K3 level showed the highest stem carbohydrate content.III.b. Leaf mineral and stem carbohydrate contents : 1.Ein-Shiemer scion budded on MM.111 had significantly the highest leaf N,P,K, Ca and Mg content while those budded on MM.106 had the highest value of leaf Mn and Zn content.2.Concerning the specific effect of soil type on leaf mineral content, results indicated that the three kind of soil had no significant effect on leaf N and P content. Moreover; calcareous soil proved to be the best one in inducing the highest value of leaf K, Ca and Mg content whereas alluvialsoil proved to be the best soil for improving leaf Mn and Zn content of Ein-Shiemer plant during the study.3.With respect to the specific effect of fertilization level on leaf mineral content. N2P2K2 level significantly increased leaf K, Ca, Mg and Zn content, and the N3P3K3 level proved to be the proper fertilization level for leaf N,P and Mn content during the study.4.A significant effect was noticed as a result of the interaction between rootstock kind and soil type, where Ein-Shiemer scion budded on MM.111 and grown on calcareous soil gave the highest value of leaf P, K and Ca content. In addition, Ein-Shiemer scion budded on MM.111 or MM.106 and grown on alluvial soil had the greatest value of leaf Mn and Zn content, respectively.5.A considerable interaction between rootstock kind and fertilization level was detected. In this respect, Ein-Shiemer scion budded on MM.111 rootstock and received N2P2K2 level exhibited the highest value of leaf K, Ca, Mg and Zn content, while, those fertilized with N3P3K3 level caused the highest value of leaf N and Mn content during the two season of study.6.A significant interaction was found between fertilization level and soil type regardless of rootstock kind. However, Ein-Shiemer plants grown on alluvial soil and fertilized with N2P,K2 or N3P3F72 levels had the highest value of leaf Zn and Mn content, respectively. In addition, calcareous soil received N2P2K2 level showed the highest value of leaf P, K, Ca, and Mg content during the two season of study.7.A markable interaction was found between rootstock kind, soil type and NPR fertilization level. However, Ein-Shiemer scion budded on MM.111 grown on alluvial soil and received N2P2K2 or N3P3K3 levels had the highest value of leaf Mg and Mn content, respectively and those grown on calcareous soil and fertilized with N2P2K2 level produced plants with the highest value of leaf P content.8.Ein-Shiemer scion budded on either MM.106 or MM.111 rootstocks had the highest value of stem carbohydrate content. Moreover; alluvial soil and NIPIK1 fertilization level improved stem carbohydrate content during the study.