Studies on mango nutrition

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Summary- A Et X 1-1.1rt 4a AT L7 Et I COMMThis investigation was conducted on 6 month old, potted mango seedlings in the green house of the Plant Res. Dept, Nuclear Res. Cent., Atomic Energy Authority at Enshas region, Sharkia Governorate. It aimed to investigate the influence of soil drench applied rates in combination with various zinc rates of phosphorus applied either as soil drench ”experiment, I” or foliar sprays ”experiment, II” on mango seedlings regarding the response of their growth measurements and nutritional status during both 1997 and 1998 seasons. Moreover, absorption, translocation and utilization of the radioactive isotope of zinc (Zn-65) foliar applied in relation to concentration of zinc solution and P soil applied rate was also studied ”experiment, III” during 1999 year.V.I. Experiment, I: Growth and nutrieional status of mango seedlings in relation to various levels of both phosphorus and zinc soil drench application:In this experiment sixteen fertilization treatments represented the various combinations between four soil application rates of both phosphorus (0.0, 25.0, 50.0 and 100 ppm) and zinc (0.0, 5.0, 10.0 and 20.0 ppm) were investigated pertaining the specific effect of each fertilizer element and interaction effect of their combinations on growth and mineral composition of 6 month old mango seedlings grown in plastic containers filled with 10 kg of sand + clay mixture (2:1, v/v).V. II. Experiment, II: Growth and nutritional states of mango seedlings in response to various combinations between four levels of P soil and Zn foliar application:Foliar sprays with four concentrations of zinc solutions i.e. 0.0, 0.125, 0.25 and 0.50% in combination with four soil drench application rates of phosphorus previously mentioned in the I’ experiment were the sixteen investigated fertilization treatments in this experiment. Experimental work:The complete randomized block design with five replications each represented by a single seedling was employed for arranging the 16 fertilization treatments investigated in either 1st or 2nd experiment. Moreover, seedlings of both experiments received annually the same N-K soil application rates. On mid Mach during each season the various P-Zn fertilization treatments ”combinations” investigated in each experiment were applied. In late October of each season both, 1st and 2nd experiments were terminated, then seedlings subjected to the following procedures. Vegetative growth measurements:Plant height, stem thickness at 5.0 cm. above ground surface; No. of leaves per seedling; dry weight of the three plant organs (leaves, stem, root) per plant; total plant dry weight and top/root ratio were determined. Chemical analysis:Total nitrogen, phosphorus, potassium and zinc contents in the various plant organs (leaf, stem and root) were determined and estimated either asa percentage or ppm of dry matter of the three plant organs for the three macro nutrient elements (N,P,K) and Zn, respectively.VIII. Experiment, III: Absorption translocation; distribution and utilization of zinc foliar application in mango seedlings supplied with various phosphorus soil fertilization:In this experiment foliar application of 6 month old mango seedlings with 3 concentrations of the labelled zinc with Zn-65 solution combined with four P soil applied rates were included to study the absorption, translocation distribution and utilization of zinc during 1999 year. Mango seedlings used for this experiment were supplied similarly with the N,K application at the same rates and sources applied, in both 1st and 2”d experiments. Meanwhile, they varied in the P rates (the same levels used with the aforesaid two experiments) and the concentration of labelled zinc solutions, used. The three various zinc solutions prepared for foliar application were labelled with the isotope Zn-65-carrier free to give 125000, 250000, 500000 cpm/lml. that corresponding the 3 investigated zinc concentrations i.e. 0.125; 0.250 and 0.500%, respectively.On March 15th 1999 year N,P and K applications were done at the same

rates and sources previously mentioned in 1st and 2nd experiments, while zinc foliar application was done by fixing the middle leaf of each plant, then 1.0 ml. of the corresponding zinc solution was added in small DROPlets on the upper surface of the fixed leaf without causing run-off ”using micro-pipette”. Two weeks later, experiment was terminated and activities of Zn-65 isotope in 6 plant samples namly: a) treated leaf, b)leaves above treated leaf, c) stem above treated leaf, d) leaves belowtreated leaf, c) stems below treated leaf and f) root were determined using a single ehanel analyzer ”Gamma Counter”: then, the following measurements were calculated as a cpm/plant:(1)-Retained Zn-65 in treated leaf, (2)- upward translocation of Zn-65 in stems and leaves, (3)-downward translocation of Zn-65 in stems, leaves and roots, (4)- total absorption of Zn-65 per plant and (5)—utilization percentage of Zn-65.Taking into consideration that all data obtained for each experiment were subjected to statistical analysis and values of each studied parameter were compared by the Duncan’s multiple range.Obtained results could be summarized as follows:V.I. Experiment, I: Growth and nutritional status of mango seedlings in relation to various levels of both phosphorusand zinc soil drench application: V.I.I. Vegetative growth: A — Specific effect:Data obtained during both 1997 and 1998 seasons revealed that all growth parameters considered in this experiment i.e., number of leaves per plant; plant height; stem thickness; dry weight of leaves, stem, root per seedling, as well as total plant dry weight and top/root ratio were specifically responded to the soil applied and rate of any of the two fertilizer elements, viz phosphorus and zinc. Such response showed obviously that all studied growth measurements except top/root ratio were in a closed positive relationship with the soil applied rate of either P or Zn.However, the top/root ratio took the other way around, whereas it was reduced by increasing the applied rate of either P or Zn. Differences in all growth measurements values of 6 month old mango seedlings exhibited as a response to the specific effect of the soil applied rate of each fertilizer element were significant, irrespective of zinc or phosphorus was concerned. However, the rate of changes exhibited in response to specific effect of soil application rate was not constant, since it varied not only from an investigated element to the other but also modified from one measurement to another in most cases.In other words, the specific effect of P soil applied rate was more pronounced than that exhibited by zinc as the dry weight values of either the total plant or its individual plant organs i.e. leaves/stem and root were taken into consideration. On the other side the rate of response to the zinc soil added, level was more pronounced than that detected with phosphorus when both number of leaves per plant and plant height were the growth measurements concerned in this respect. In addition, both parameters of stem thickness and top/root ratio of mango seedlings showed relatively the same rate of response to the specific effect of soil applied rate of eitherphosphorus or zinc. B — Interaction effect (PXZn):It is quite evident from data obtained during both seasons of study that the different growth measurements of 6 month old seedlings were responded obviously to the various combinations between the four soil applied levels of both P and Zn. Such response (interaction effect) reflected directly the specific effect of each investigated factor (Zn/Plevel), whereas the highest values of the number of leaves per plant; plant height; stem thickness; leaves, stern, root and total plant dry weight were always associated with those mango seedlings received the highest soil applied level of both fertilizer elements i.e. (100 ppm P X 20 ppm Zn). Meanwhile, such superior P-Zn soil application treatments (100 ppm P X 20 ppm Zn) induced significantly the lowest top/root ratio. Nutritional status ”mineral composition”:The leaf, stem and root N,P,K and Zn contents in response to the specific and interaction effects of (4 P soil application rates X 4 Zn soil applied levels) were the nutritional status investigated in this experiment. A — Specific effect:The obtained results declared that N,P,K and Zn contents in all plant organs of 6 month old mango seedlings ”leaf, stern and root” were specifically responded to the soil application rates of each fertilizer elements investigated i.e. P or Zn. However, the four investigated nutrient elements (N,P,K and Zn) were not coincident pertaining the trend of their response to any applied fertilizer element. Since, contents of both N and K in various mango plant organs (leaf, stem and root) followed typically the same trend of response regarding the specific effect of soil applied rate of either P or Zn. The N,K percentages were significantly increased with raising the applied rate of Zn or P, and they reached their peak in either 100 ppm P or 20 ppm Zn treated seedlings.Nevertheless, both, P and Zn followed two conflicted trends regarding the specific effect of P or Zn soil applied rates on their

contents of variousmango plant organs. As for the P content it was significantly increased in all plant organs with raising P soil application rate while the trend took the other way around with the soil applied rate of zinc. On the other hand, however zinc content in various mango organs (leaf, stem and root) showed a positive relationship with the soil applied rate of zinc, but it responded negatively to the P soil added rate.In addition leaf was the richest plant organ in its N, P and Zn content, followed by the root, while the stem ranked last in this concern. Besides, changes in leaf content of the aforesaid three nutrient elements (N,P & Zn) regarding the response to P and/or Zn applied level was more pronounced and firmer than that observed in the two other organs (stem & root).On the other hand, with potassium content it was so worthy to be noticed that stem not only was richer than root in this concern but also and to great extent it having relatively the same leaf K%.B — Interaction effect (P soil added X Zn soil added):The specific effect of application rate from both P and Zn fertilizers reflected on the interaction effect of their various combinations on the nutritional status (N,P,K & Zn) content. Since, the (100 ppm P soil added X 20 ppm Zn soil added) resulted in the highest N and K contents in various plant organs. However, the highest value of P content was gained by (100 ppm P soil added combined with either 0.0 or 5 ppm Zn soil added), while with Zn the combination of soil application rate (0.0 ppm P X 20 ppm Zn) was the superior as it showed the greatest value of zinc content in various plaM organs (leaf, stem and root).V.11. Experiment, II: Growth and nutritional status of mango seedlings in response to various combinations between four levels of P soil added and Zn foliar application:V.II.1. Vegetative growth:A — Specific effect:Data obtained during 1997 and 1998 seasons declared that all studied growth measurements of 6 month old mango seedlings responded specifically to the investigated applied levels of each fertilizer element i.e., P soil applied rate and Zn concentration of the foliar spray solutions. However, the specific effect of investigated levels for each fertilizer element (P/Zn) showed a positive relationship with most parameters viz: number of leaves; plant height; stem thickness and dry weight of leaves, shoots, roots & total plant. Meanwhile, the top/root ratio was the unique growth parameters which negatively responded to the investigated levels of both P & Zn and its trend took the other way around as compared to the aforesaid seven measurements. Differences were significant as various levels of each fertilizer element were compared each other separately. On the other hand, the increase/reduction in different growth measurements resulted by raising the applied level/concentration of phosphorus/zinc, respectively did not equally happen at the same rate, while they varied not only from an investigated fertilizer element to another but also most measurements each reflected its own rate of response. Anyhow the response to phosphorus soil added was more pronounced than zinc sprays with the dry matter measurements of various organs (leaves, stem, roots and total plant), while the reverse was true with number of leaves andplant height, whereas the zinc was more effective. In addition no considered difference was detected between the effect of P & Zn on thestem thickness.B — Interaction effect (P soil added rate X Zn concentration of sprayed solution):Data obtained displayed that the various growth measurements i.e., number of leaves, plant height, stem thickness, dry weight of total plant and its individual organ (leaves, stem and roots), as well as top/root ratio were responded significantly to the interaction effect of different combinations between the four investigated levels of both phosphorus soil applied and concentrations of zinc in spray solutions. The greatest values of all investigated measurements except top/root ratio were detected by the P-Zn combination between the 100 ppm P soil added and spraying with 0.50% Zn solution. However, with the top/root ratio the reverse was true, whereas the (100 ppm soil added X foliar sprays with zinc solution at 0.50%Zn) was statistically the inferior and resulted in the lowest ratio,Nutritional status (mineral composition): A — Specific effect:Obtained results of the 2”d. experiment (P soil applied rate X Zn concentration in spray solution) declared that the N,P,K and Zn content in the three plant organs of mango seedlings responded specifically to the P soil applied rate and Zn concentration of zinc sprayed solution. Both N and K content responded positively to the investigated levels of each factor, whereas each of both N and K nutrient elements reachedstatistically its peak in various plant organs by (100 ppm P soil application X spraying with 0.50% Zn solution).As for the phosphorus and zinc content each was significantly increased with raising the applied level of its fertilizer source. On the other hand leaf, stem and root P content exhibited its minimum percent by those mango seedlings sprayed with Zn SO4 solution at 0.50% Zn

concentration. In addition, Zn content was in negative relationship with the P soil applied rate.B — Interaction effect (P soil added X Zn sprays):Data obtained during both 1997 and 1998 seasons revealed that N,P,K and Zn contents in various plant organs of mango seedlings responded significantly to the interaction effects of different combinations of phosphorus soil application and foliar sprays with various zinc solutions. The highest leaf, stern, and root content of both N and K was gained by the P soil applied at 100 ppm and sprayed with 0.50% zinc solution. However, the P-Zn combinations between no zinc foliar sprays (0.0 Zn) and P soil application at 100 ppm or to great extent 50 ppm P exhibited statistically the highest phosphorus content in the different organs (leaf, stem and root) of mango seedlings. Meanwhile, zinc content in the three plant organs reached its peak by those (0.0 ppm soil added phosphorus X 0.50% Zn spray solution) treated seedling.Briefly, it could be safely concluded from both 1st. and 2nd.experiments that the highest rate of P soil added 100 ppm in combination with either the highest level of zinc soil application (20 ppm) i.e.,experiment I Or the more concentrated zinc spray solution (0.50% Zn) i.e., experiment II were significantly the most effective P-Zn fertilization treatments could be recommended for improving growth measurements of mango seedlings.Experiment, III: Absorption, translocation and utilization of Zn-65 foliar applied in mango seedlings:The following measurements in response to the specific and interaction effects of foliar application with 3 zinc concentrations combined with four P soil applied rates were investigated.V.III.1: Retained Zn-65 in treated leaves:The retained Zn-65 in treated mango leaves represented the major portion ”more than 80%” of the Zn-65 absorbed quantity. from the other side, the retained Zn-65 was significantly increased by raising either the concentration of the foliar applied zinc solution or the P soil added rate.V.III.2. Translocation of Zn-65 in mango seedlings:Data obtained, revealed that translocation of the absorbed Zn-65 within mango seedlings in both the upward and downward directions i.e., (leaves and stems above the treated leaves) and (roots and both leaves & stems below treated leaves), respectively was positively responded to Zn concentration and P applied rate. However, leaves showed higher total activity of Zn-65 i.e„ about two times as much as that in stems, but the rate of response (rate of increase in translocated-Zn-65) due to raising Zn concentration was more pronounced in rate as rather than leaves. This trend was true as the upward translocation was concerned.As ibr the downward translocation of Zn-65 i.e., activities in both leaves and stems below the treated leave as well as roots, it was clear that it followed the same trend previously detected with the upward translocation regarding the response to both Zn% and P applied rates. The highest activity of Zn-65 was found in stems followed by leaves and roots with ratios 1.87:1.23:1.00, respectively.On the other hand, the upward translocation of Zn-65 was markedly higher than the downward direction.V.III.3. Total absorption of Zn-65:The total absorbed Zn-65 by mango leaves (retained + translocated Zn-65) was significantly increased by raising either Zn concentration of solution used or P applied rate. However, P rate showed a slight interaction effect resulted in reducing the rate of increase in absorbed Zn-65 exhibited by raising the zinc concentration in solution used.V.I11.4. Utilization percentage of Zn-65 foliar applied:Utilization of zinc foliar application estimated as total absorbed percent of the total foliar applied Zn-65 as influenced by Zn concentration in solution used and , P applied rate was investigated in mango seedlings. Data obtained revealed that both measurements i.e., total absorbed Zn-65 and its utilization percentage followed two conflicted trends regarding their response to zinc concentration in used solution. Since the utilization % of Zn-65 foliar applied was gradually reduced by raising the Zn-concentration of the solution foliar applied, while the reverse was true with total absorbed zinc. On the other hand, both measurement of totalabsorbed value and utilization % of zinc foliar applied were in paralled positive relationship to the P soil applied rate.Generally it could be concluded that P-Zn fertilization treatments especially P soil applied at 50/100 ppm rates from one hand in combination with either 10/20 ppm Zn soil applied rates or Zn foliar sprays with 0.25/0.50% zinc solutions from the other could be safely recommended for applying the mango seedlings at the earlier stage of their development in nursery. Moreover, data dealing with absorption, translocation and utilization of zinc using its isotope (Zn-65) revealed therelative effeciency of zinc foliar application. Concluding remark:1-Phosphorus soil drench application and zinc application either as soil or foliar sprays all proved to be beneficial in improving growth and nutritional status of most nutrient elements in the three plant organs of mango seedlings.

However, the P soil added at 100 ppm in combination with zinc either as soil added at 20 ppm or foliar sprays with Zn SO4 solution at 0.50% Zn surpassed all other P-Zn combinations in exerting more stimulus effect in this concern.2-A judicious of fertilization treatments should be based not only on plant tissues analysis but also other limiting factors like as duration of experimental season must be taken into consideration.3-Accordingly, further study is needed to reevaluate the conflict between the negative and positive relationship of zinc content to P soil applied rate as data obtained from (1st. & 2nd experiments) and(3rd experiment) revealed, respectively.