Management of balanced fertilization for some crops in sandy and calcarious soils and its role in relieving drought and salinity conditions

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Moisture and nutrients in soils are the main factors to determine quantity and quality of crop yield in desert region. Deficit irrigation is practiced in many and and semi arid areas of the world, and increased demand on water supplies worldwide suggest that the practice must increase. Irrigation with high salinity water is one of the major environmental stresses that drastically affects crop productivity as well as crop quality. Application of fertilizer without sufficient water often is not profitable and at times can lower yields. Water requirements needed to produce a unit weight of a crop can be reduced by adequate nutrition. Because of the unbalance of applied fertilizer, shortage and saline irrigation water used during the past twenty years, use efficiency of both fertilizer and water are gradually declined. The integration use of compost with mineral fertilizers as a balanced fertilization lead to steady increase the crop production.Four field experiments were conducted to study the effect of balanced fertilization, with either mineral fertilizer alone or mixtures of mineral and organic fertilizers, on the productivity of some crops in sandy and calcareous soils. The experiments were carried out under stress conditions such as drought and salinity in two successive seasons. The experiments also dealt with evaluation of the concentration and uptake of some nutrients bythe studied crops. Three organic fertilizers were used in the proposed experiments of this study. These fertilizers were originally obtained from different three sources, i.e., town refuse (TR), crop residues of bean straw (CR) and farmyard manure of sheep manure (FYM). Theses organic residues were improved by addition of some nutrients and conditioners then composted until maturity to produce compost for the experiments. Drought stress experiments:Two field experiments were carried out on corn at Maryout Experimental Station and peanut at South Tahreer province during the summer seasons 2001 and 2002. These experiments were conducted under the following treatments:a)The three previous sources of prepared compost.b)Three rates of composts; 0, 15, and 30 m3 / fed. combined with two rates of mineral fertilizers included: (1) The recommended dose of NPK i.e. 120, 45 and 50, and as 33, 60 and 50 kg N, P205 and K20 / fed. for corn and peanut experiments, respectively. (2) Half of the recommended dose of NPK.c)Two irrigation intervals; 7 and 14 days, for corn experiment and two rates of irrigation water; the normal rate of irrigation requirement and 50 % (one half) of water requirement rate for peanut experiment. As well as control treatment (unfertilized soil).The first experiment. (Corn experiment):Results show the followings:1-The 7 days interval (adequate irrigation) increased (significantly) grain yields of corn by about 36 and 35 % in the first and second season, respectively as compared to the 14 days interval (deficit irrigation). However, the corresponding increase values for shoot mass were 20 % and 23 %.2-The application of 50 % of the recommended dose of NPK fertilizers (NPK-1) increased grain and shoot mass yields by about 46 and 36 % in the first season and by about 30 and 37 % in the second one, respectively over the control under deficit irrigation treatment.3-Addition of 100 % of the recommended dose of NPK fertilizers (NPK-2) increased (significantly) the grain yield as compared to NPK-1 treatment under adequate irrigation in both seasons, while under the deficit irrigation, the obtained grain yield with the NPK-2 treatment was slightly lower than that cbt9ined in case of the NPK-1 treatment.4-Under the deficit irrigation treatment the application rate of 30 m3 /fed. and NPK-1 was the superior for

both grain and shoot mass yields at both seasons.5-Under deficit irrigation treatment; both CR and FYM treatments increased (significantly) the grain yield as compared with TR treatment by about 14 and 13 % in the first season and by about 12 and 10 % in the second one, respectively. In addition the CR treatment showed the highest grain yields.6-Irrespective of irrigation regime treatments, the effect of all combined rates of compost with mineral fertilization were highly significant on yield (grain and shoot mass) as compared to mineral fertilization alone in both studied seasons.7-The highest shoot mass yield was recorded with 30 M3 /fed. of TR and NPK-2.8-The higher water use efficiency by corn grains was recorded by FYM at the rate of 30 m3/fed. combined with NPK-1 under either adequate or deficit irrigation in both seasons as compared to all treatments.9-Under deficit irrigation, the town refuse compost combined with mineral NPK treatments increased both the N concentration and N uptake by shoot mass over the other treatments, while the N uptake by grains was lower than that of most other treatments in both seasons.10-The rate of 30 m3 / fed. of CR combined with 50 % of mineral NPK dose showed the highest total N, P and K uptake by corn plant under deficit irrigation in both seasons. The second experiment. (Peanut experiment):1-The adequate irrigation increased (significantly) seeds and shoot mass yields of peanut by about 36 and 16 % in the first season and by about 54 and 19 % in the second one, respectively as compared to deficit irrigation.2-The application of NPK-1 induced increases of seeds and shoot mass yields by about 27 and 15 % in the first season and by about 20 and 13 % in the second one, respectively as compared to the control under deficit irrigation treatment.3-Addition of 100 % of the recommended dose of NPK fertilizers (NPK-2) increased the seeds yield as compared to NPK-1 treatment under adequate irrigation in both seasons. While under the deficit irrigation treatment, the effect of NPK-2 treatment on seed yield was slightly lower than that obtained in case of the NPK-1 treatment.4-Under the deficit irrigation treatment, the application of 30 m3 /fed. compost + NPK-1 was the superior for increasing seed yield. whereas the application of 15 m3/fed. compost + NPK-2 induced marked effects on seed yield under adequate irrigation in both seasons.5-Under deficit irrigation treatment; both FYM and CR treatments increased significantly the seed yield as compared with TR treatment by about 8 and 4 % in the first season and by about 7 and 4 % in the second one, respectively.6-Irrespective of irrigation intensity treatments, all the rates of compost combined with mineral fertilization gave highly significant effect on seed and shoot mass yields compared to mineral fertilization alone in both studied seasons.7-The combination of FYM compost with mineral NPK achieved the highest values for harvest index comparing with the other compost sources.8-At the rate of 15 m3 /fed. compost combined with 100 % of the recommended dose of NPK, gave a high increase in oil % under adequate or inadequate irrigation.9-All treatments of town refuse compost achieved the highestoil % either under adequate or inadequate irrigation.10-The combined effect of organic and mineral fertilization atthe rates of 30 m3/fed. compost + NPK-1 gave the highest oilproduction under deficit irrigation, whereas the rates of 15 m3/ fed. compost + NPK-2 showed the highest oil production under adequate irrigation.11-Under deficit irrigation, the application rate of 30 m3 / fed. of compost mixed with 50 % of mineral NPK fertilization increased the water use efficiency by seeds and shoot mass compared to the application rate of compost as 15 m3 / led. in both seasons.12-The rate of 15 m3 / fed. of crop residues or farmyard manure compost with 100 % of mineral NPK gave the highest total uptake of N and P compared to the town refuse compost under deficit irrigation water in both seasons.13-Under deficit irrigation the rate of 30 m3/ fed. of compost combined with 50 % of NPK recommended dose caused highest total K uptake by peanut compared to the other rates of treatments. The differences among composts effect on total K uptake were not clear. Saline water stress experiments:Two field experiments were carried out in two successive winter seasons during 2001/02 and 2002/03. The test crops were wheat and sugar beet at Ras Sudr Experimental Station. These experiments were conducted under the following treatments:a)The three previous compost sources.b)Three rates of composts; 0, 15, and 30 m3 / fed. combined with two rates of mineral fertilizers included : (1) The recommended dose of NPK as 90, 45 and 50, and as 90, 60 and 50 kg N, P205 and K20 / fed, for sugar beet and wheatexperiments, respectively (2) Half of the recommended dose of NPK.c) Two salinity levels of well water; 4876 and 8960 ppm as sources for irrigation. As well as control treatment (unfertilized soil). The third experiment. (Sugar beet experiment):Results show the followings:1-The fresh root

yield of sugar beet was adversely and significantly affected by irrigation water salinity in both seasons. The higher water salinity level (S2) reduced the fresh root yields by about 12 % and 9 % at the first and second season, respectively as compared to the low level of saline water (Si).2-The application of 50 % of the recommended dose of NPK fertilizers treatment (NPK-1) increased roots and leaves yields by about 51 and 63 % in the first growing season and by about 60 and 40 % at the second one, respectively as compared to the control under Si treatment. Similar trends were shown under S2.3-Addition of 100 % of the recommended dose of NPK fertilizers (NPK-2) increased root yield as compared to NPK-1 treatment under either S1 or S2 treatments in both seasons.4-Under S1 or S2 treatments, the CR treatment increased significantly the root yield as compared with FYM and TR treatments in both seasons.5-The highest (significant) root yield was due to the rate of 15 m3/fed. of CR + NPK-1 treatment and followed by the rateof 15 m3/fed. of CR + NPK-2 treatment in both seasons. Under both of the FYM and TR composts, the rate of 30 m3/fed. + NPK-2 markedly influenced and showing more root yield with compared to the other rates during the two studied seasons.6-Irrespective of irrigation water salinity treatments, all the combined rates of compost mixed with mineral fertilization high significantly induced fresh root yields compared to mineral fertilization alone in both the studied seasons.7-The combination of organic and mineral fertilization at the rates of 15 m3 /fed. of CR mixed with NPK-1 treatment showed the highest sugar yield under S1, whereas the rates of 15 m3/fed. of CR mixed with NPK-2 treatment gave the highest one under S2 in both seasons.8-The rate of 30 m3 / fed. of CR compost combined with either 50 % or 100 % of mineral NPK dose achieved the highest total N, P and K uptake by sugar beet plant under either S1 or S2 in both season. The fourth experiment. (Wheat experiment):Results show the followings:1-The higher water salinity level (S2) significant reduced grain yield by about 16 % and 15 % at the first and second season, respectively as compared with the low level of saline water (S1). Similar tends were shown in the case of straw yield.2-The application of 50 % of the recommended dose of NPK fertilizers treatment (NPK-1) markedly increased both grains and straw yields by about 71 and 72 % in the first growingseason and by about 73 and 64 % at the second one, respectively as compared to the control under SI treatment. Under S2 the similar trends were shown.3-Addition of 100 % of the recommended dose of NPK fertilizers (NPK-2) increased significantly the grains yield as compared to NPK-1 under Si treatment, while an inverse and significant effect occurred under S2 treatment in both seasons.4-Irrespective of irrigation water salinity, all combined rates of compost mixed with mineral fertilization were highly significant effect on grains and straw yields compared to mineral fertilization alone in both the studied seasons.5-Under the S1 or S2 treatments, The rate of 30 m3/fed. compost + NPK-1 treatment was the superior one for increasing both grain and straw yields compared to the other treatments in both seasons.6-Under Si or S2 treatments, the CR treatment increased significantly the grain and straw yields as compared with FYM and TR treatments in both seasons.7-The lowest grain yields value was obtained by the rate of 15 m3/fed. TR + NPK-1 treatment in both seasons.On the light of the obtained results, it can be recommend that:1-Application of 50 % only of the recommended dose of NPK is of higher positive effect on crop production more than the full dose (100 % of that NPK), when the crops were subjected to increasing rates of water stress either by drought or salinity, exception in the case of sugar beet crop, where the inverse effect was occurred.2-Under all experiments and conditions, all the combined mineral and organic treatments gave significantly increases of crop production as compared with mineral fertilization alone.3-Application of 30 m3 / fed. of crop residues or farmyard manure, combined with the 50 % of the recommended dose of mineral NPK treatment, could be the preference rate for achieving the best of balanced fertilization and increasing the productivity of corn and peanut crops under drought stress.4-Application of 15 m3/fed. and 30 m3/fed. of crop residues compost with addition of 50 % of the recommended dose of NPK is the ideal rates for achieving increases in productivity of sugar beet and wheat crops, respectively when the crops were exposed to increasing rates of irrigation water salinity up to 8960 ppm.5-The results demonstrated that the balanced fertilization is one of the major practice should be considered in desert soil reclamation.