Contribution of leucaena trees in sustainable agriculture in sandy soils using tracer techniques

Hussein Ahmed Abd El-Aziz

The Plurality of Africans and Arabs as general and especially in Egyptian countries are conforting two big problems: -First: - Increased population rate annually.Second: - Reduced agricultural productivity as a result of desertification, soil fertility deficiency and many other factors. So, the replacement of soil fertility through efficient fertilization policy application, particularly in our developing countries is very expensive processes even as sanitary and environmental problems or monetary. One of the major problems which is facing the farmers is supplying the plant with nutrients, specially N. The nitrogen fixing trees saves a large amount of N through biological nitrogen fixation so, NFT considered as one of the bestalternative source for N.The aim of the present work is to study the contribution of NFT to sandy soil under sustainable agriculture systems using 15N tracer techniques. Therefore, a set of experiments was carried out: -A)Lyzemeter experiments:-First to evaluate the response of NFT to N application with different levels (0,15,30kg N/fed) under inoculation with effective strain of Rhizobium. Second NFT were cultivated through three years 1995,1996 and 1997. Macro (N, P, K) and microelements (Cu, Fe, Zn, Mn).B)Field experiment to study the effect of Leucaena greenmanure on the dry weight and nutrient uptake of maize cultivated under alley cropping system.The obtained results can be summarized as follow: -A) The first experiment was conducted to elucidate the effect of N source with or without inoculation on Leucana grown a sandy soil.1- Combined chemical fertilizers and significantly increased the dry matt Leucaena trees by 30, 78 and 75% (in lea 57 and 63% (in branches) compared to c to uninoculated treatments in case (111-14)2SO4 application at rate 0,15 and respectively.inoculation r yield of es) and 22 , rresponding f NH4NO3 30kg N/fed.2-Inoculation treatment alone increased t e dry matter leaves by about 191 g/pot compared to ninoculated treatment where it was 115g/pot.3-With regard to inoculation the rate of 30kg N/fed the best either in presence (NI-141•103) or (NH4)2SO4 applied.4-Nitrogen and inoculation treatments ignificantly increased N uptake of leaves and branches of trees.5-NH4NO3 application increased N uptake f Leucaena leaf by about 2.6, 7.4, 9.2 g/pot i inoculated treatments compared to uninoculated trea ments when NH4NO3 was applied at rate of 0,15 an 30kgN/fed respectively.6-Nitrogen uptake was increased by about 3 , 4 and 3 folds when (NH4)SO4 was applied.7-The amount of N2 fixation in leaves increased (significantly) by about 1.16, 4.28 and 3.42 g/pot and 1.05, 2.61 and 2.38 g/pot in branches of Leucaena compared to uninoculated treatments when fertilized with 15NH4NO3 at rates of 0, 15 and 30 kg N/fed, respectively.8-Nitrogen fixation of Leucaena leaves (significantly) increased by about 1.16 , 3.33 and 3.05 g/pot in leaves and 1.05 , 2.75 and 2.35 g/pot in branch ones, compared to uninoculated treatments of (.15N144)2SO4application at rate 0 ,15 and 30 kg N/fed respectively.9-Inoculation of Leucaena with effective strains (DS158) of Rhizobium produced significantly higher N2 fixed values than uninoculated ones at all levels of applied n, except at 30kg N/fed.10-Phosphorus and Potassium uptake significantly increased by increasing the rate of applied N from zero to either 15 or 30kg N/fed as two forms of N sources.11-Inoculation alone increased P uptake in Leucaena leaves and branch by about 20 , 36. Increased P-uptake from 98 , 129% in leaves and 100, 135% in branches when rate of N applied at rate 15 to 30kg n fed as NH4NO3. Also when application of Ammonium sulphate P uptake of inoculatedALeucaena leaves and branches increased by about 105, 92 % in leaves and 157, 115% in branch when rate of N applied at rate of

15 to 30 kg N/ ed.12- Application of chemical fertilizer NO3) and(NH4)2SO4 combined inoculation Mere a s ed P-uptake in Leucaena leaves and branches by abo 219 , 485% in leaves and 365 , 667% in branches wh n N applied as NH4NO3, and also when (NR4)2SO4 w s applied P-uptake increased by about 167 , 369 n leaves and 316, 539% in branches with N at rat- 15,30 kg N /fed.13-K-uptake increased by about 55 , 116 % and 105% compared to uninoculated treatment w en NH4NO3 was applied at rate of 0,15 and 0kg N/fed, respectively, and also increased 55 , 75' and 68 % for the same previous treatments respecti ely.14-Inoculation and fertilization nitrogen with 30 kg N/fed application were the best treatments eve NH4NO3 or 0`11-14)2SO4 were applied.15-Application of nitrogen fertilizer co bined with inoculated treatments increased micronu Tents uptake from Leucaena trees.b) The second experiment was conducted to study the Soil nutrients availability as affected by Leucaeni growth for three years (1995,1996,1997).The results and conclusions of this experiment would be summarized as follows:16-Nitrogen Phosphorus and Potassium content compared to fallow soil (Pfl) increased with the age of the tree, where the values were in 1998, the largest ones in (1995-1998).17-The three periods of growth the percent of nutrients at different depth and adjacent to the trunk were nearly stable. Faraway the trunk, the concentration differed according to the depth where it was reduced and the lower values were in (Pf4) and 90 cm depth.18-Cu content nearly stable at the first three depths from 0-45 cm while the concentration from 45-60 and 75-90 cm nearly the same at P12 and Pf4 respectively, it is very different for the two depths at P13 where it was 6.72 and 4.88ug/soil respectively. In 1996 and 1995 the concentration of Cu in top layer from (0-15cm) was very high and it is gradually decrease with increasing the distance from trunk. But the absolute of Cu content are very closed at 1995 in the two depth 15-30 and 30-45 cm for P12, P13 and Pf4 and 30-45 for PC.19-Iron content of soil under Leucaena growing at three growth ages (1995-1997). Iron content increased from year to the other, but the general trend is decreasing these values with depth.20-Mn concentration appears more permanent than Zn where the concentration did not greatly change from depth to another in the same profile and same agewhile Zn concentration differed in different depths but the change was very slight.C) The third experiment was carried out to study the effect of green manure (prunnings) of Leucaena trees on Maize yield in alley cropping system.The obtained conclusions could be summarized as follows:21-Green manuring 100kg N/fed combined with 20kg N/fed as (NH4)2SO4 significantly recorded higher grain yield and straw of maize over green manure alone or ammonium sulphate alone. In this treatments the yield of grain was 6.01 kg /plot and in straw 12.91 kg/plot.22-Application of Leucaena prunnings alone, the maize grain yield and straw was 4.55 and 10.01kg/plot respectively. In contrast addition of nitrogen, maize grain yield was 5.66 kg/plot and straw 12 kg/plot.23-N-uptake of grains as well as straw was significantly higher in case of green combined with nitrogen fertilizer as form (NH4)2SO4 than green manure alone and also nitrogen fertilizer alone.24-The amount of nitrogen transfer from Leucaena to maize ranged from 5.09 to 7.65 kg N/fed.25-P-uptake and K-uptake of maize indicate that combined fertilizer 100 kg green manure + 20 kg (NH4)2SO4 and 80 kg green manure +40 kg (NH4)2Sa4 are the bestresults than (NH4)2SO4 only or green manure only, even in case of grain and straw yield.26-Incorporation of green manure before transplanting maize produced significantly more micronutrients uptake from grains and straw.27-Green manuring 100 kg N/fed combined with 20 kg N/fed as ammonium sulphate recorded significantly higher macronutrients uptake of maize over green manuring alone or ammonium sulphate alone. In this treatments the increase in micronutrients was Fe 480.5, Mn 291.25, and Zn 391.55 lig /plot in grain of maize except the Cu where the treatment of application of (NH4)2SO4 alone increased Cu at 83.36 ug /plot.28-Application of Leucaena prunnings and no applied nitrogen fertilizer the micronutrients of maize grains were Fe 155.91, Mn 184.28, Zn 328.08 and Cu 23.92 jig /plot in grains and in straw the micronutrients Fe 630, Mn 714.91, Zn 672.6, and 212.39 lag /plot.29-Application nitrogen and no application of Leucaena prunnings maize of micronutrients in grains Fe248.74, Mn 234.49, Zn 346.9 and Cu 88.36 jig /plot and in straw the micronutrients Fe817.28, Mn 833.9, Zn 874.25 and Cu 137.811g /plot.Agro-economic and Environmental impact of Leucaena trees:-Leucaena is one of the fast growing tropical tree species capable of producing large biomass. Leucaena grows best in tropics in tropics and subtropics where annual rainfall is 600-1700mm. However, it withstands large differences in rainfall sunlight, salinity,

and terrain, as well as periodic inundation, fire, windstorm, slight frost and drought (tiller and Wilson,1991). Compared to other NFTs, Leucaena is a promising candidate for sandy soils as it is characterized by longer tap root and high rate of annual leaflet DROP amounting to 1.2 ton dry matter and 30kg N ha-1. The strong, deep root system allows Leucaena to combat erosion, tolerate drought and, once established, it can survive in areas with only 600mm annual rainfall but it does not tolerate extended flooding. All parts of the plant are edible to animals, including leaves, young stems, flowers, young and mature pods and seeds (Dhamothiran et al., 1991). Irrespective of Leucaena varity, juvenile leaves are characterized by high crude protein and digestible dry matter. While dry matter, crude fat, crude fiber and calcium showed a positive association with pod age,crude protein and nitrogen free extracts displayed an inverse relationship. It is thus indicated that feeding young pods would be more desirable than feeding mature ones.The seeds had the highest amount of crude protein and lowest amount of crude fiber.from the economical point of view, it is of special interest to discuss the difference between the application of chemical fertilizer (N) and Leucaena green manure as N source. The dataclearly showed that all the studied parameters of plant development were in favour of Leucaena green manure.The price of ton from $(NH_4)_2SO_4$ = 402 LEIn our experiment,The number of trees = 130 treeThe number of trees/fed = 4333 treeEvery tree gives us = 5 kg green manure /monthThe activated period foreyery trees/year nearly the hot and warm month = 8 monthSo every tree gives us = 40kg greenmanure /yearThe production of feddan from green manure/year = 173333 kg= (17ton/fed)The amount of N =150kg N/fedThe amount of $(NH_4)_2SO_4$ which added /fed = 40 kg N/fed=20 kg N /fedThe price of 40 kg N/fed = 40 LEThe price of 20 kg N/fed = 20 LEThe price of say 100kg green manure may be nothingBesides to that, Leucaena can soil erosion is a major problem resulting in declining crop yields due mainly to the loss of soluble nutrients and organic matter as the soil is washed or blown away. Trees help to slow this process in several ways. They provide additional soil cover, particularly when prunings are added back to the soil in the form of mulch. These mulches,like other green manure’s increase the nutrient status of the soil, can help to suppress weeds, and in time can gradually improve the soil structure due both to effects on aggregation of soil particles and on the stimulation of biological activity in soil. The maintenance of deep rooting systems in the soil can help to close up nutrient cycles as the trees act as ”nutrient pumps” (Nye and Greenland, 1960), reducing losses by leaching and returning nutrients to the soil in leaf litter (Giller and Wilson, 1991).