

Effect of nitrogen and biogas fertilizers on maize and the following wheat yield

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Summary Two field experiments were conducted at the Research and Experiment Station of the Fac. of Agric., Moshtohor in 1996/1997 and 1997/1998 seasons. The aim of this study was to investigate the effect of Biogas sludge and nitrogen fertilizers on maize - wheat production under nitrogen levels. The soil was a clay texture having an alkaline reaction (pH 7.9). Organic matter content was 2.3%. The available N, P, and K were 27, 14 and 287 mg/kg soil, respectively. The preceding crop was Egyptian clover in both seasons. The first experiment aimed to study the effect of two Biogas sludge manure treatments (zero and 5 m³/fed) and four nitrogen levels (zero, 50, 100 and 150 kg N/fed) on tasseling and silking dates, growth characters, grain yield, yield components and chemical composition in the grain yield of maize. Also, nitrogen use efficiency and apparent nitrogen recovery in grains as well as organic matter, N, P and K percentages in the soil at maize harvest were determined. Biogas sludge is composed of 47.71% organic matter content, 1.43% N, 0.47% P and 0.72% K. pH value was 7.5 and it had an E.C. of 2.8 ds/m (in the saturation extract). Biogas sludge was added before planting. The experiment design was a randomized complete block with four replications. The plot area was 42 m² (14 x 3 m²) having 20 rows of 3 m length and 70 cm width. Maize C.Y. T. w. C. 310 was cultivated on June 1st and 12th for the 1st and 2nd seasons, respectively. Calcium super phosphate (15.5% P₂O₅) was applied through soil at a rate of 150 kg/fed. Plants were thinned to one plant/hill before the 1st irrigation and the distance between hills was 30 cm. Ammonium nitrate (N - N₂O₃ - 33.5% N) was used as the N source in both seasons which was applied in two doses, before the 1st and 2nd irrigation. The normal cultural practices for growing maize were used. The second experiment aimed to investigate the residual effect of fertilized maize (Biogas manure & N levels) on wheat production and quality under N fertilizer rates. Growth characters, grain yield, yield components, straw and biological yields, grain quality, NUE and ANR in grain of wheat were studied. The experimental design was a split plot with four replications. Every experiment included 32 treatments, which were the combination of eight residual effect treatments and 4 N levels of this study were as follows: A- Nitrogen levels: 1-Zero (control) 2- 30 kg N/fed. 3- 60 kg N/fed. 4- 90 kg N/fed. B- The residual effect of N levels: 1-Zero (control) 2- 50 kg N/fed. 3- 100 kg N/fed. 4- 150 kg N/fed. C- The residual effect of Biogas sludge: 1-Zero (control) 2- 5 m³ BS/fed. The eight residual effect treatments were arranged randomly in the main plots and the sub-plots were assigned to the four N levels. The sub-plot area was 10.5 m² (3.0 x 3.5 m²). Wheat cv. Gemaza 1 was cultivated on November 28th and 23rd in the 1st and 2nd seasons, respectively. Wheat was planted on rows 20 cm width. Ammonium nitrate (NH₄NO₃ - 33.5% N) was used as the N source in both seasons which was applied in two doses, before the 1st and 2nd irrigation. The normal cultural practices for growing wheat were used. Results could be summarized as follows: Part one: Maize crop: A- Effect of soil application of nitrogen: 1- Nitrogen fertilizer caused a significant decrease in the time of 50% tasseling and silking in both seasons. A higher N level (150 kg N/fed.) significantly decreased tasseling and silking dates. However, the difference between 100 and 150 kg N/fed. were not significant in both seasons. 2- Application of 150 kg N/fed significantly increased plant height, ear height, stem diameter, ear leaf area, L.A. 1. and fresh and dry weight of different plant organs at 80 days from planting in 1996 and 1997 seasons. On the other hand, number of dry leaves/plant significantly decreased with increasing N levels up to 150 kg N/fed. But, the difference between 100 and 150 kg

N/fed on most characters were not significant, 3- Grain yield components, namely, number of ears/plant, ear length, ear diameter, number of kernels/row, number of rows/ear, ear weight, kernels weight/ear, grain yield/plant, 1000 kernel weight and shelling percentage significantly increased with increasing N levels up to 150 kg N/fed. However, the difference between 100 and 150 kg N/fed in most characters were not significant. 4- Grain, straw and biological yield significantly increased with increasing N levels up to 150 kg N/fed. Application of 50, 100 and 150 kg N/fed significantly increased grain yield over the control treatment by 26, 52.7 and 54% in the 1st season and by 23, 47.2 and 49% in the 2nd season, respectively. The difference between 100 and 150 kg N/fed levels were not significant. 5- Application of nitrogen treatments caused no significant increase in N, CP, P, K percentage as well as total carbohydrate percentage in grains in both seasons. 6- Application of 100 or 150 kg N/fed caused a significant increase in absolute amount of N, P, K and total carbohydrate/fed as compared with the other N treatments. This increase resulted adding 150 kg N/fed was 57.0, 73.9, 105.0 and 42.2% in the 1st season and by 50.7, 58.0, 59.3 and 43.7% in the 2nd season compared with the control treatments. This result indicated that the rate of 100 kg N/fed is recommended for grain yield and its quality. 7- Application of 150 kg N/fed gave the lowest values of NUE and N recovery in grain. whereas, adding 100 kg N/fed produced the highest values of NUE and N recovery in both seasons. However, the difference between 50 and 100 kg N/fed was insignificant. 8- The results of organic matter and NPK contents in the clay soil of the experiment showed no significant effect as a result of adding N levels.

B- Effect of Biogas sludge (BS) :

- 1- Biogas sludge caused a significant decrease in tasseling and silking dates in both seasons.
- 2- Biogas sludge significantly increased plant height, ear height/stem diameter, ear leaf area, L. A. 1. and fresh and dry weight of different plant organs of maize in both seasons. But, its decrease number of dry leaves/plant.
- 3- Grain yield components, namely, number of ears/plant, ear length, ear diameter, number of kernels/row, number of rows/ear, ear weight, kernels weight/ear, grain yield/plant, 1000-kernel weight and shelling percentage significantly increased with applying 5 m³ BS/fed in both seasons.
- 4- Application of 5 m³ BS/fed significantly increased grain, straw and Biological yields in both seasons. Such increases in grain yield due to adding 5 m³ BS/fed over the check treatment by 9.4% and 9.6% in the 1st and 2nd seasons, respectively.
- 5- Biogas sludge did not significantly affect in N, CP, P, K and total carbohydrate percentages in grains of maize in both seasons.
- 6- Application of 5 m³/fed BS significantly increased absolute amount of N, P, K and total carbohydrate/fed in both seasons.
- 7- Adding 5 m³ BS/fed had no significant effect on OM% and NPK contents in the clay soil of the experiment.

C- Interaction effect:

- 1- There was a number of significant interactions between mineral N fertilizer and Biogas sludge on some of studied traits, plant height, ear height, ear leaf area and L. A. 1., fresh weight of leaves/plant, dry weight of stem/plant, total dry weight/plant, number of kernels/row, shelling %, grain and biological yields/fed and P uptake in grain in both seasons and fresh weight of stem/plant, total fresh weight/plant, dry weight of leaves and-139-Summary ears/plant, ear weight and the yield of N, K and total carbohydrates in grains/fed in 1997 seasons.
- 2- Generally, adding 100 or 150 kg N + 5 m³ Biogas sludge/fed level recorded the highest plant growth, grain yield and grain quality the control treatment (no N, BS) gave the lowest values.
- 3- It could be concluded that the rate of 100 kg N + 5 m³ BS/fed is recommended for grain yield of maize and its quality under the experimental conditions.

Part two: wheat crop:

A- Effect of soil application of nitrogen:

- 1- Application of 90 kg N/fed produced the highest values of growth characters, namely, plant height, number of tillers/m², flag leaf area, number of leaves/stem and dry weight of different organs plant at 90 days from planting compared with the other N levels in both seasons.
- 2- Number of tillers/m², number of spikes/m², spike length, spike weight, number of grains/spike and 1000-grain weight significantly increased with increasing N levels up to 90 kg N/fed in both seasons.
- 3- Application of 30, 60 and 90 kg N/fed significantly increased grain, straw and biological yield in both seasons. Applying 30, 60 and 90 kg N/fed significantly increased grain yield over the unfertilized treatment by 16.1, 31.4 and 40.3% in the 1st season and by 12.7, 24.6 and 32.2% in 1997/98 season, respectively.
- 4- Applying 90 kg N/fed caused a significant increase in harvest index (33.9, 37.4). However, the difference between 60 and 90 kg N/fed in both seasons was insignificant.
- 5- Nitrogen fertilizer levels significantly increased N and P percentages in grain and their absolute amount/fed as well as K uptake and total carbohydrate yield/fed in both seasons.
- 6- The

results indicated that the rate of 90 kg N fed is recommended for grain yield and its quality of wheat. 7- Application of N up to 90 kg/fed significantly decreased NUE and ANR in both seasons. However, the difference between 30 and 60 kg N/fed was insignificant. B- The residual effect of mineral N fertilizer: 1- All growth characters, namely, plant height, number of tillers/m², flag leaf area, number of leaves/stem, dry weight of different plant organs were not significantly influenced by residual effect of mineral N fertilizer treatments. 2- The residual effect of N treatments did not significantly affect number of tillers/m², number of spikes/m², spike length, spike weight, number of grains/spike, 1000-grain weight, grain, straw and biological yields as well as harvest index in both seasons. 3- The residual effect of 150 kg N fed treatment recorded the highest grain, straw and biological yield as well as harvest index compared with the check treatment. However, the differences among the residual effect treatments were not significant. 4- The residual effect of N treatments on N, P, K and total carbohydrate percentages in grains and their amounts wheat in grains were not significant. c- The residual effect of Biogas sludge on wheat: 1- All growth characters, yield components, grain, straw, and biological yield/fed as well as harvest index were not affected by the residual effect of Biogas sludge treatments. 2- Adding 5 m³ BS/fed on maize produced the highest values of NPK and total carbohydrate percentages in grains of wheat as well as the absolute amount of NPK and total carbohydrate content in grains of wheat. However, the difference between both residual effect of Biogas sludge treatment was insignificant. D- Interaction effects: 1- The residual effect of the interaction between mineral N fertilizer and Biogas sludge treatments on all studied characters of wheat were not significant in both seasons. 2- The effect of the interaction between the Biogas residual treatments and N fertilizer levels on wheat was not significant for all studied characters' under study except, K and total carbohydrate percentages in grain in one season only. 3- All studied characters except, total carbohydrates in grains in 1997/98 season was not affected by the interaction between the residual effect of N treatments and N levels on wheat. 4- All studied characters were not affected by the interaction between the residual effect (N+BS) and N levels on wheat in both seasons.