-38-SUMMARY OF

REDUCE OF NITRATE LEACHING USING LOCALIZED COMPACTION AND IRRIGATION MANAGEMENT IN SANDY LOAM SOILS

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- SUMMARY

Because nitrogen application rate and irrigation amounts typically exceed plant requirements demand in Egypt, drainage to ground water or surface water can result in N movement out of the root zone especially in light textured soils, and this causes a lot of economical and environmental problems, therefore the management of irrigation water and fertilizer and physical properties of soil are important to reduce these problems.

5-1-Research Objectives

1- To reduce nitrate leaching to water recourses through the adoption of the improved nitrogen and water management practices.

2-Evaluating the effectiveness of localized compaction on NO^-_3 leaching reduction and improvement of nitrogen and water use efficiency in a corn field under different water regimes and different locations of the localized compaction.

3-Determination of soil nitrate vertical distribution (after crop yielding) as affected by localized compaction treatments.

4-Calculating compaction dependency and yield response under different water regimes, and different locations of localized compaction treatments.

5-Assessing the relationship between some of physical properties and localized compaction treatments.

To achieve these objectives, the following studies were carried out: field experiment was carried out in 2007 at EL-Boston region, in calcareous, sandy loam soil under furrow irrigation system. Split plot statistical design with two water application rates as a main plots (a) Field capacity= 100% of ET_C (I-1), and (b) at saturation (I-2). Nitrogen fertilizer was banded under four treatments of

localized compaction (LC) as sub main plots as fellows, (i): The control without compaction (LC-1), (ii): under the fertilizer band (LC-2), (iii): above the fertilizer band (LC-3), and (iv): both above and under the fertilizer band (LC-4).

For each irrigation treatment, 120 Kg of nitrogen /fed as ammonium nitrate 33.5 % was applied. The fertilizer was incorporated in depth of 5 cm. The N-fertilizer was splited in two equal doses (at planting and 30 days after planting). Soil samples were collected during the growing season and after harvesting. Plant samples were collected at tasseling.

5-2- The obtained results can be summarized as following.

1-<u>Effect of irrigation and localized compaction treatments:</u>

i-<u>Plant growth parameters</u>

Reducing amount of irrigation water to field capacity increased, leaf surface area/plant, plant height, number of leaves/plant, stem diameter, leaves dry weight, plant biomass production and total dry matter by 62.29, 18.46, 20.15, 12.87, 62.92, and 65.74 %, respectively in comparison to irrigation at saturation.

Under the irrigation treatments at field capacity there were no responses to localized compaction treatments, probably because leaching was limited by reduced irrigation at field capacity.

When irrigation was at saturation, plots that received LC-3 and LC-4, plant growth parameters increased significantly more than plots that received LC-1 and LC-2 plots. None of the individual Plant growth parameters were

significantly different between treatments LC-3 and LC-4. Under LC-2 treatments, the fertilizer band was completely subjected to water movements and this promotes nitrate leaching.

ii-<u>Yield component parameters</u>

By decreasing amount of irrigation water to field capacity, the grain yield, ear weight and ear tall, increased by 47.47, 46.69, and 19.55% respectively in respect to their levels at saturation treatments.

Under I-1 treatments there were no yield responses to localized compaction treatments, probably because leaching was limited by reduced irrigation.

When irrigation increased from I-1 to I-2, plots that treated with localized compaction the yield, ear weight and ear tall increased significantly. At LC-3 and LC-4 treatments plant growth parameters increased more than growth parameters in LC-1 and LC-2 treatments. None of the individual Plant growth parameters were significantly different between treatments LC-3 and LC-4 treatments.

Yield differences between treatments imply that there was difference in the amount of available nitrogen to the crop, attributed to differences in leaching of N fertilizer. It was assumed that The LC changes is the only factor that affected the physical properties, that leaded to theses results not the chemical or biological interactions between the fertilizer and the corn plants.

iii-<u>Nitrogen content, Chlorophyll (A) and (B) contents in leaves:</u>

By decreasing application of water at field capacity leaves nitrogen, Chlorophyll A, and Chlorophyll B contents, increased by 48, 45.8 and 67.8 % respectively, in regard to their levels at saturation treatments.

Under (I-1) there were no responses to localized compaction treatments, because N leaching was limited by reduced irrigation.

When irrigation increased from I-1 to I-2, plots that treated with localized compaction the yield, ear Weight and ear tall increased significantly. At LC-3 and LC-4 treatments plant growth parameters increased more than growth parameters in LC-1 and LC-2 treatments. None of the individual Plant growth parameters were significantly different between treatments LC-3 and LC-4 treatments.

iv-Nitrogen uptake

Nitrogen uptake (grain-N + Ash- N) increased by 59.49 %. By decreasing the amount of irrigation water from saturation to field capacity.

Under I-١ the N-uptake for the localized compaction treatments were 106.64, 102.45, 104.86 and 103.96 Kg/fed for LC-1, LC-2, LC-3, and LC-4 respectively. There were no significant differences between treatments under the same level of irrigation.

Localized compaction changed nitrogen uptake by -4.12, -1.61 and -2.51 for LC-2, LC-3 and LC-4, respectively in regard to their levels at control treatments. This can be attributed to the less water to leach nitrate out of root zone.

Under I-2, the nitrogen uptake for the compaction treatments were 55.46, 52.46, 82.05 and 84.31 Kg/ fed LC-1, LC-2, LC-3, and LC-4 respectively, in regard to their levels at control treatment. The increase in nitrogen uptake

as affected by localized compaction may be due to the deceasing of leached nitrogen.

Localized compaction changed nitrogen uptake by -5.45, 48, and 51, for LC-2, LC-3 and LC-4, respectively in comparison to the control treatment.

2- <u>Water use efficiency</u>

Decreasing application of water to field capacity increased water use efficiency (WUE), water utilization efficiency (WUTE) and water biomass production efficiency (BPE) by 46.11, 43.299 and 57.45 % respectively in comparison to irrigation at saturation.

Under I-1, the WUE for the compaction treatments were 1.273, 1.234, 1.273 and 1.218 Kg/m^3 for LC-1, LC-2, LC-3, and LC-4 respectively. There are no significant differences due to localized compaction treatments.

Under I-2, the WUE for the localized compaction treatments were 0.723, 0.650, 1.040 and0.974 kg/ LC-1, LC-2, LC-3, and LC-4, respectively. The increasing in water use efficiency as affected by localized compaction may be due to yield increase as a result of decreasing N-leaching losses.

Under saturation conditions, localized compaction changed WUE by -10.09, 43. 84 and 34.71 % for LC-2, LC-3 and LC-4, respectively in respect to their levels at the control treatments.

Localized compaction changed WUTE by -7.14 %, 42.84 % and 31.71% for LC-2, LC-3 and LC-4, respectively in respect to their levels at the control treatments.

Localized compaction changed BTE by-6.38. 46.79 and 36.64 % for LC-2, LC-3 and LC-4, respectively in regard to their levels at the control treatments.

In general the higher water efficiency parameters were obtained under irrigation up to field capacity and LC free treatments (I-1&LC-1).

3- Nitrogen use efficiency

Decreasing application of water to field capacity increased nitrogen use efficiency (NUE), nitrogen biomass production efficiency (NBPE) and grain nitrogen accumulation efficiency (GNAE) by 47.43, 57.45 % and 47.45 %, respectively in respect to their levels at saturation treatments. This may due to leaching losses.

Under field capacity (I-1) treatments, the values of (NUE) for the localized compaction treatments were 32.25, 31.28, 32.23 and. 30.86 kg/kg for LC-1, LC-2, LC-3, and LC-4, respectively. There are no differences between localized compaction treatments, which attributed due to the absence of excess water to leach nitrate out of root zone.

Under saturation (I-2) treatments, the values of (NUE) for the localized compaction treatments were 18.43, 17.15, 26.35 and 24.68 kg/kg LC-1, LC-2, LC-3, and LC-4, respectively. The increasing in nitrogen use efficiency due to localized compaction may be due to the decreasing of leaching losses.

Localized compaction changed (NUE) by -10.68, 43.00 and 33.91 % for LC-1, LC-2, LC-3, and LC-4, respectively in regard to their levels at the control treatments. Localized compaction changed (BNPE) by -6.45, 46.42 and 38.45% for LC-1, LC-2, LC-3, and LC-4, respectively in regard to their levels at the control treatments. Localized compaction changed (GNAE) by-7.69, 38.64, and 30.77% for LC-1, LC-2, LC-3, and LC-4, respectively in regard to their levels at the control treatments.

In general the higher water efficiency parameters were obtained under irrigation at field capacity and LC free treatments (I-1 & LC-1).

4- <u>Compaction dependency</u>

Under I-1 the average compaction dependencies were -1.16,-3.64, 0.12, -3.59, -0.51, -6.11, 0.21, and 2.37% for number of leaves, plant diameter, plant height, leaves surface area / plant, total fresh weight, total dry weight, leaves fresh weight and leave dry weight, respectively.

Under I-2, the average compaction dependencies were 5.09, 7.15, 11.49, 28.67, 33.41, 26.14, 27.48, and 22.29 for number of leaves. plant diameter, plant height, leave area, total fresh weight, total dry weight, leaves fresh weight and leave dry weight, respectively.

Under I-1, the average compaction dependencies were 0.56, -1.17, -1.34, 0.01and -2.46 % for ear diameter, ear tall, ear weight, weight of 100 kernel and grain yield respectively. And under I-2 the average compaction dependency were 0.48, 8.07, 27.79, 0.46, and 23.32 for ear diameter, ear tall, ear weight, weight of 100 kernels and grain yield respectively.

On the other side the compaction dependency for the treatments in which compacted layer was under the fertilizer band (LC-2) was small, this suggests that the fertilizer band was completely subjected to water movements and this promoted nitrate leaching.

5- <u>Nitrate distribution-after harvesting – in soil profile:</u>

Under I-2 treatments the obtained pattern of nitrate distribution in the soil profile suggested that the transport was dominated by downward movement with water (i.e., preferential flow or mass flow).

Under I-2, comparing to control treatment, plots appeared that the water flow thought the banded fertilizers

was the less, while as in control treatments the NO^-_3 had moved deeper in soil. The reduction of NO^-_3 amounts in the middle of soil profile indicated more N-uptake by plant rather than leaching.

Under I-1, comparing to control treatment data showed little downward movement of the banded fertilizers. Nitrate levels were higher at 50-70 cm in soil profiles treated with the localized compaction, and sharp reductions of the surface layer 20-50 cm, regardless of compacted layer. These reductions suggest loss by plant uptake rather than leaching.

These data indicate that chemical applied using the LC reduced NO^-_3 movement at saturation compared with the control treatments.