5. SUMMARY AND CONCLUSION

The aim of the present work was to study the effect of nitrification inhibitors N - Serve (NS) or dicyandiamide (DCD) on the efficiency of nitrogen fertilizers ; urea (U) or ammonium sulfate (AS). To achieve this goal , wheat was selected as an indicator plant . Plants were treated with ^{15}N enriched "U" or "AS" which was applied solely or in combination with NI . Another experiment was conducted using U or AS and NI in presence and absence of Azotobacter inoculation . The growth parameters, dry matter yield , nitrogen uptake , fractions of nitrogen uptake by soil , plant and air were computed to evaluate the N - balance by means of the tracer technique (^{15}N - isotopic dilution concept) . Also quantitfy the N_2 fixed via nonsymbiotic association . and fertilizer use efficiency (FUE %) were been computed .

A - **The first experiment** was conducted to elucidate the effect of N - source, NI and inoculation of wheat seeds with Azotobacter on wheat plants. The obtained results and conclusions of this experiment could be summarized as follows:

1 - Application of chemical fertilizers (AS or U) at a rate of 50 and 100 $kg.fed^{-1}$, either solely or in combination with nitrification inhibitor (NS or DCD) progressively increased significantly the dry matter yield of wheat , straw and grain as well as the total N - uptake over the control.

2 - Inoculation of Azotobacter increased dry weight of wheat straw by 79.5 and 83.7 g Pot^{-1} and grain by 66,5 69.7 g Pot^{-1} for U or AS respectively. However, values of increments obtained in uninoculation treatment were 68 and 70.4 g Pot^{-1} in straw and 55.2 and 57.2 g Pot^{-1} in grain for U or AS , respectively.

3 - The FUE values of wheat grain ranged from 25.9 % to 42.4 % following the order: AS > DCD > U + DCD > AS + NS > U + NS > AS > U . However , the FUE values of wheat grain were in the range of 22.7 to 41.9 .

4 - Values of the N_2 - fixed by wheat plants were 177.9 , 188 mg N Pot^{-1} in straw and 282.1 , 303.5 mg N Pot^{-1} in grain for U or AS , respectively.

5 - Inoculation of wheat seeds with Azotobacter increase N recovery by plant to range of 42.7 to 69.7 % , while plant recovery with uninoculated seedes was in the range of 37.5 % to 66.8 % , and followed the descending order:

AS + DCD > U + DCD > AS + NS > U + NS > AS > U

6 - Loss of N was reduced du to inoculation of Azotobacter from 54.1 % to 25.8 % . While losses reduced to 30.3 5 , and N - losses reached the lowest value (25.8) when AS was applied with DCD , in presence of wheat seed in inoculation with Azotobacter .

B. The second experiment was conducted to study the effect of N - fertilizers form , methods of N placement (surface or subsurface) and type of NI (DCD or NS) on wheat plants.

Results and conclusions of this experiment could be summarized as follows:

1 - Addition of 100 kg N.fed^{-1} as enriched U or AS either alone or combined with NI (DCD or AS) increased both dry weight of (wheat straw and grain) as well as N - uptake over the control.

2 - Application of AS with DCD gave the highest values when AS + DCD was applied on soil surface where subsurface application was more efficient in increasing dry weight of wheat plants , N - uptake Ndff and FUE.

3 - Application of ^{15}N labelled U or AS to subsurface increased dry weight of wheat straw to 76.5 and 79.3 $g.Pot^{-1}$ and wheat grain to 64.3 or 66.6 $g.Pot^{-1}$ for U and AS , respectively . The corresponding values increased only to 68 and 70.4 $g.Pot^{-1}$ in straw and 55.2 or 57.2 $g.Pot^{-1}$ in grain with surface placement of N - fertilizer .

4 - Fertilizer use efficiency (FUE) values were in the range of 20.7 % to 29.4 % in straw and 32.8 % to 51.6 % in grain in case of subsurface placement , while with surface placement were in the range of 14.8 % to 24.9 % in straw and 22.7 % to 41.9 % in grain following the order:

AS + DCD > U + DCD > AS + NS > U + NS > AS > U.

5 - Plant recovery of ^{15}N labelled U and AS ranged from 53.5 % to 81 % in case of subsurface placement . However, plant recovery in surface placement was in the range from 37.5 % to 66.8 % .

6 - The N loss from U and AS as affected by the method of fertilizer application and presence of N inhibitors ranged from 44.3 % to 15.1 % in case of subsurface placement , but were reduced due to surface placement from 60.5 to 30.3 % . These losses were drastically reduced (to 15 %) with surface placement and in presence of the inhibitor (DCD). Both methods of N fertilizer management , show significant effect on minimizing N - loss and increasing in plant recovery.

C. **The third experiment** was carried out to study the effect of times (splitting) of applied N , N - source and NI on wheat plants. The obtained conclusions could be summarized as follows:

1 - Application of nitrification inhibitor (DCD or NS) with N -fertilizer (U or AS) increased dry weight of both wheat straw and grain as compared to the absence of inhibitors.

2 - Values of total N - uptake , Ndff and FUE were maximized when AS was applied with DCD , inhibitor.

3 - Application of N - fertilizer either in presence or absence of nitrification inhibitor increased total N - uptake, Ndff and FUE when the N fertilizer rate was splitted into two doses added before sowing and 50 days later

4 - The FUE value ranged from 17.6 % to 27 % in straw and from 28.7 % to 46.3 % in grain in case of T_2 in the order:

AS + DCD > U + DCD > AS + NS > U + NS > AS > U

5 - Plant recovery of nitrogen ranged from 46.3 % to 73.4 % (T2) , but only from 37.5 % to 66.8 % with T_1 and from 34.2 to 58.7 % with T_3 treatment .

6 - The N loss from U or AS as affected by times (dosing) of applied N combiend with NI ranged from 51.6 % to 23.8 % in case of T_2 , but reduced at T_1 from 60.5 to 30.3 % and at T_3 from 63.7 % to 38.8 % . Application of N fertilizer in two equal doses T_2 always led to maximum reduction .

In conculsion , it may be stated that the most suitable , and probably economical treatments is that including the application of ammonium sulfate at a rate of 1600 mg. pot^{-1} in two equal doses i.e , before sowing and 50 days later in presence of DCD , N inhibitor and Azotobacter inoculation . The increments achieved in N - uptake by wheat straw and grain and wheat straw and grain yield due to this composited treatement amounted to 254 % , 282 % , 99 % and 130 % respectivily . The minimum rate of N loss occurred with application of AS + DCD as compared with the other treatments. Accordingly the above mentioned treatments , it could be primarily recommonded that achieving realtively higher wheat yield with minimum N loss and hence soil and water pollution.

However , further field investigations are nedded to support such recommendation.