RESULTS AND DISCUSSION

IV. RESULTS AND DISCUSSION

* Balance Sheet Assessing Fertilizer Nitrogen in a Sandy Soil:

Under green house conditions using wheat as a test plant, a trial was carried out for a precise evaluation of a comparative efficiency of the N fertilizers; namely Ca $(^{15}NO_3)_2 \cdot 4H_2O$, $(^{15}NH_4)_2SO_4$, and $(^{15}NH_2)_2Co$. As well as distribution of the fertilizer N among the above-ground plant parts "shoots"; below-ground parts (roots); and the soil was studied, (table 2).

Nitrogen concentration:

With all treatments, the highest N concentration (N %) was frequently found in the above-ground part of the plant, i.e., shoots followed by the below-ground part while remarkably the soil contained the lowest concentration. Comparing the N-sources, the highest N concentration found in the plants was obtained by use of urea whereas the lowest was recorded via calcium nitrate. This low concentration recorded in the plant

Table (2) : Fertilizer nitrogen balance sheet of different ^{15}N-labelled fertilizers applied at rate of 90 mg N/kg soil using the virgin desert sandy soil under wheat.

Considered material	^{15}N-labelled fertilizer	N (%)	Total dry weight/pot (mg)	Total N content (mg/pot)	Ndff[(a)] (mg/pot)	Ndff[(a)] %	Ndfs[(b)] (mg/pot)	Ndfs[(b)] %	(c) A-value (PPm)	Utilization of N-fertilizer (%)
Shoots	$Ca(^{15}NO_3)_2 4H_2O$	3.073	159.250	4.894	2.85	58.23	2.040	41.77	----	3.1663
	$(^{15}NH_4)_2SO_4$	3.252	116.125	3.776	2.11	55.94	1.66	44.06	----	2.3467
	$(^{15}NH_2)_2CO$	4.193	98.350	4.124	1.86	45.13	2.26	54.87	----	2.0677
L.S.D.	P = 0.05	0.041	3.245	0.093	0.07	0.08	0.06	00.07	----	0.0754
	P = 0.01	0.112	6.941	0.195	0.15	0.18	0.14	0.16	----	0.1623
Roots	$Ca(^{15}NO_3)_2 4H_2O$	2.173	59.650	1.296	0.58	44.53	0.72	55.47	----	0.6415
	$(^{15}NH_4)_2SO_4$	1.899	50.425	0.958	0.39	41.14	0.56	58.86	----	0.4378
	$(^{15}NH_2)_2CO$	2.466	37.300	0.920	0.29	31.24	0.63	68.76	----	0.3193
L.S.D.	P = 0.05	0.027	2.287	0.042	0.01	0.02	0.01	0.01	----	0.0121
	P = 0.01	0.098	4.324	0.087	0.02	0.03	0.02	0.02	----	0.0243
Whole plant	$Ca(^{15}NO_3)_2 4H_2O$	--	218.90	6.19	3.43	55.41	2.76	44.59	072	3.8110
	$(^{15}NH_4)_2SO_4$	--	166.55	4.73	2,50	52.85	1.23	47.15	080	2.7776
	$(^{15}NH_2)_2CO$	--	135.65	5.04	2.15	42.66	2.89	57.39	121	2.3890
L.S.D.	P = 0.05	--	3.05	0.21	0.06	0.07	0.06	0.06	3	0.0634
	P = 0.01	--	6.82	0.44	0.14	0.15	0.013	0.14	6	0.1423
Soil	$Ca(^{15}NO_3)_2 4H_2O$	0.00067	1000000	6.720	0.73	10.80	5.99	89.20	----	0.8062
	$(^{15}NH_4)_2SO_4$	0.00094	1000000	9.380	1.57	16.68	7.82	83.32	----	1.7384
	$(^{15}NH_2)_2CO$	0.00018	1000000	1.820	0.24	13.34	1.58	86.66	----	0.2697
L.S.D.	P = 0.05	0.000086	--	0.253	0.05	0.06	0.05	0.05	----	0.0526
	P = 0.01	0.000133	--	0.746	0.10	0.14	0.11	0.13	----	0.1346

	Recovery of N-fertilizer (%)	Loss of N-fertilizer (%)
$Ca(^{15}NO_3)_2 4H_2O$	4.614	95.386
$(^{15}NH_4)_2SO_4$	4.523	95.1771
$((^{15}NH_2)_2CO$	2.657	97.3433
L.S.D. P = 0.05	0.031	0.029
L.S.D. P = 0.01	0.072	0.063

(a) Ndff : Portiona of total N contained in the plant or in the soil that is derived from N-fertilizer.
(b) Ndfs : Portion of total N contained in the plant or in the soil that is native soil nitrogen.
(c) A-value : Amount of available native N calculated by the special equation (See Pag. No.)

tissue upon calcium nitrate was applied may be attributed to effect of N-dilution since dry matter yield reflected with this fertilizer was the highest. These data agree with findings reported by Lierop and Trran,(1980).

Dry matter yield :

Superiority of calcium nitrate, apply was assumed through its a promotive effect observed on amount of dry matter of wheat plant harvested which was followed by the practice of ammonium sulfate whose its dry matter caused was notably superior to that caused when urea was applied. In all cases, weight of the above-ground parts of the plant recorded was frequently greater than that resulted with the below - ground parts.

Nitrogen uptake, N-yields, contained :

With respect to N-uptake, viz., amount of total N uptaken by plant or/and that remaining in soil (N-yield) data obtained in table (2) and Figs. 1 and 2 show that the soil frequently contained a more N content than that contained by the whole plant;also, the above-ground

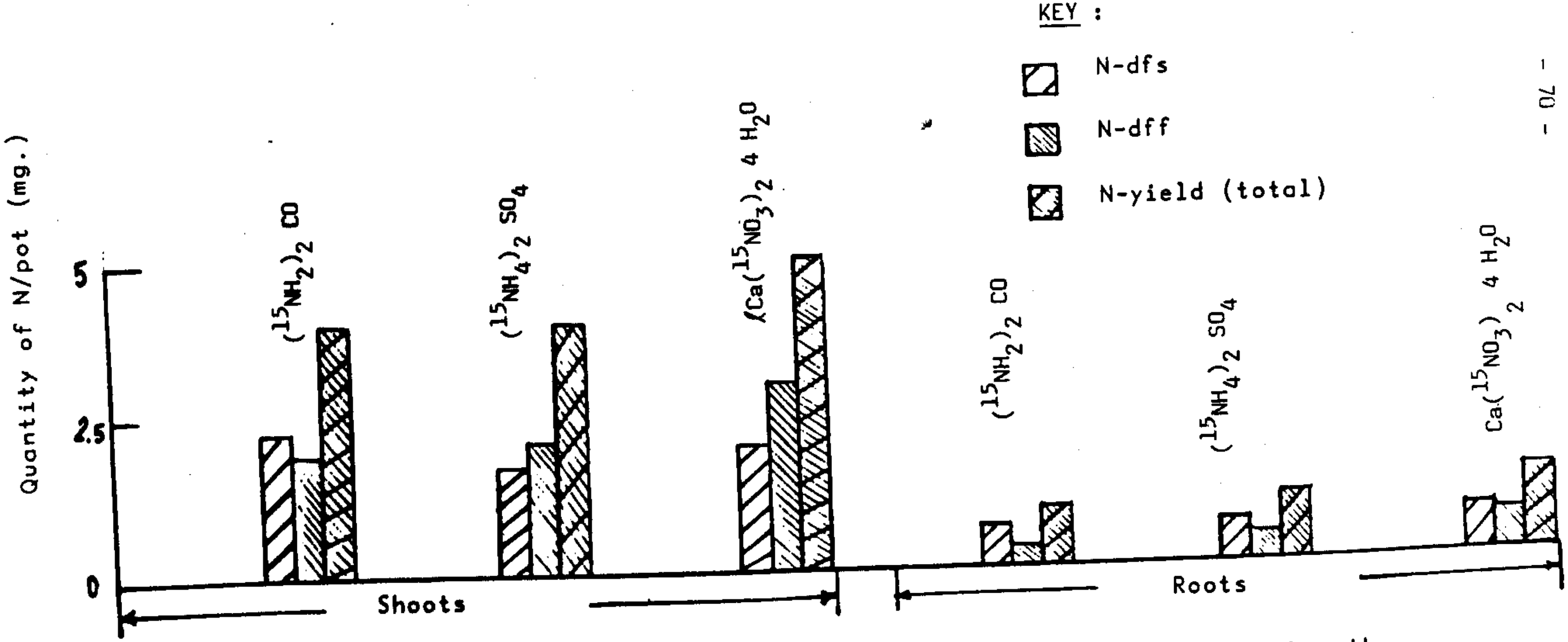

Fig. (1) : Amount of nitrogen found in the shoots and roots respectively using the ^{15}N - fertilizer tracer to the virgin desert sandy soil.

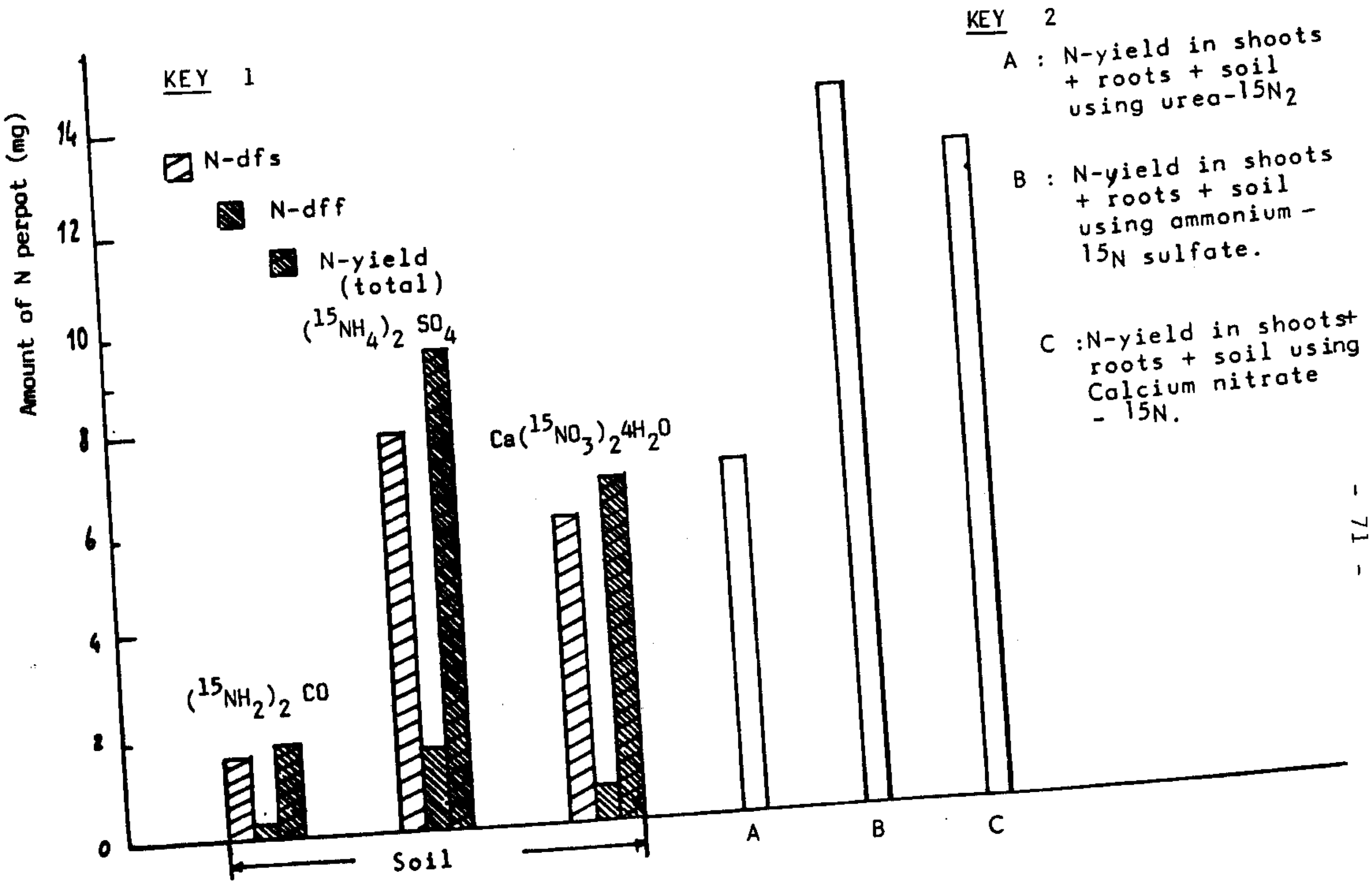

Fig. (2): Amount of nitrogen reflected in the soil and in the shoots, roots, and soil using the tracer of 15N-labelled fertilizer added to the virgin desert sandy soil.

parts of the plant contained a higher content of N comparatively to that contained by the below-ground parts. Regarding N-uptake in the plants (N-yield), calcium nitrate treatment showed more uptake as compared with the other two N-sources. In compare, urea gave higher N uptake amount in the above-ground parts than that did with ammonium sulfate. This is despite the slightly lower weight of the plant produced by urea. Therefore, the high percent of N concentration determined in tissue of the plant receiving urea, assumably, compensated that difference in weight observed later,consequently rendered N-uptake in the plant receiving urea higher than that remarked with the plant treated with ammonium sulfate.

Nitrogen contained in the soil :

Concerning amount of nitrogen remaining in the soil, it was greater with the soil treated with ammonium sulfate than that contained with the soil practiced with either calcium nitrate or urea which reflected the least amount. The lowest level of N-yield found with urea - treated soil is possibly due to the alkaline action of urea (Hauck, 1968b). It is worthy of note that the sandy soil used, specifically, is too weakly buffered media because of its a extremely dipression in each of organic matter or/and clay content. Under such conditions, buffering influence of fertilizer would,suggestly, be predominate and hence governs whole reaction. Subsequently, this would enable a considerable loss of N via NH_3 volatilization. However, Hauck and Stephenson, (1965a) and Nömmik,(1966), stated that most of N-fertilizers dissolve in soil to form an environment which is either acid, alkaline, or neutral depending on kind , amount, and solution or solid form of the material, and various soil factors. Supplementally, Hauck, (1968b) declared that urea, diammonium phosphate, and urea ammonium phosphate form alkaline solutions upon hydrolysis. Ammonium sulfate, ammonium nitrate, ammonium chloride, and mono ammonium phosphate form acid solutions. Therefore, it can be concluded that the alkaline physiological effect of urea in the media upon hydrolysis; the slight alkalinity of the soil itself; and the pronounced lack of buffering action of this sandy soil are possibly responsible factors likely causing altogether an extreme alkaline conditions,in turn leading to an intensive N-loss via volatilization as NH_3. Sub - squently, urea was thus the inferior while calcium nitrate was the superior. Since, ammonium sulfate furnish an acidic environment,therefore the level of N-yield contained in the soil with this treatment exceeded those contained with either calcium nitrate or urea with which N-yield contained was the least.

Isotope-derived criteria assessed :

Various "isotope-derived criteria" commonly used to evaluate a comparative availability of different nitrogen sources comprise %N-dff, percent N-utilization , and "A" value (see review, principles and guidlines) of applied fertilizer N. However, the first two values suggest that (as shown in table (2) and Figs. 3 and 4) calcium nitrate source was significantly most available N-carrier followed by ammonium sulfate, with urea being the least effective one. While, A-value data provide an integrated measure of availability of N in soil during

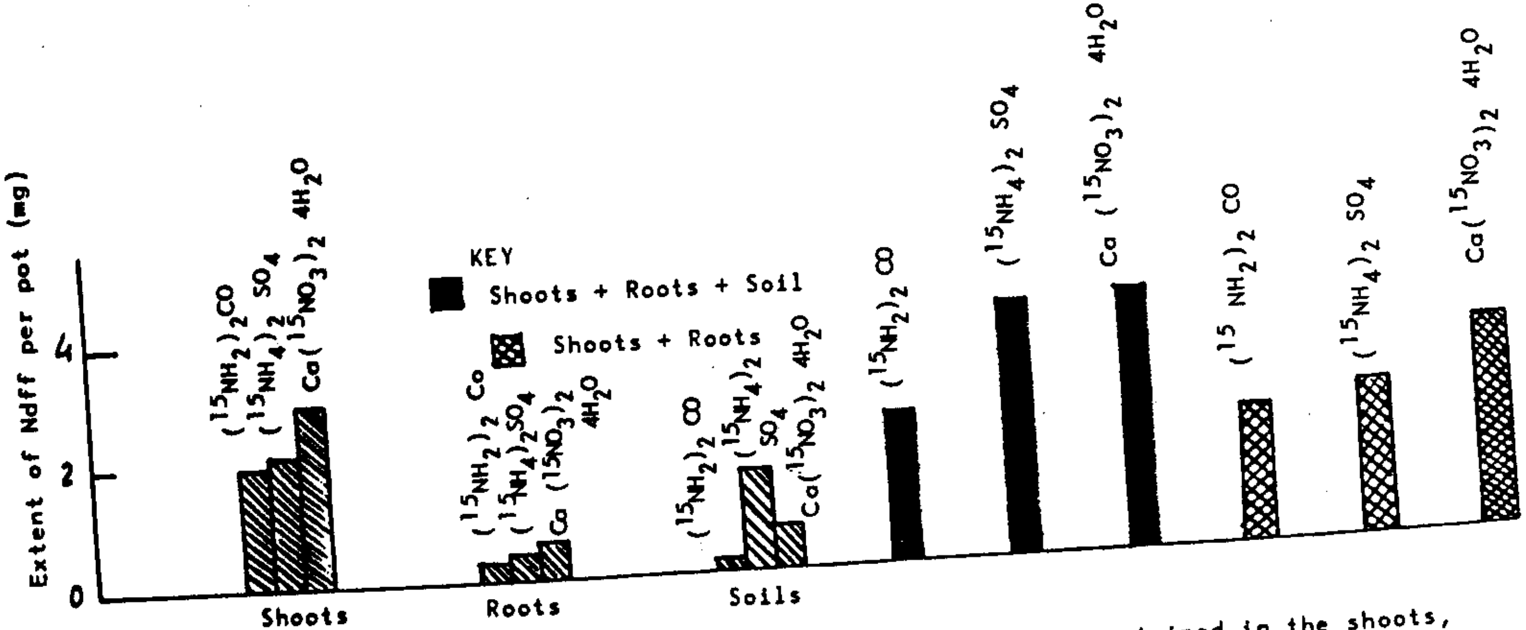

Fig. (3): Extent of nitrogen derived from the ^{15}N-labelled fertilizer; contained in the shoots, roots of wheat plant, and soil using the virgin desert sandy soil.

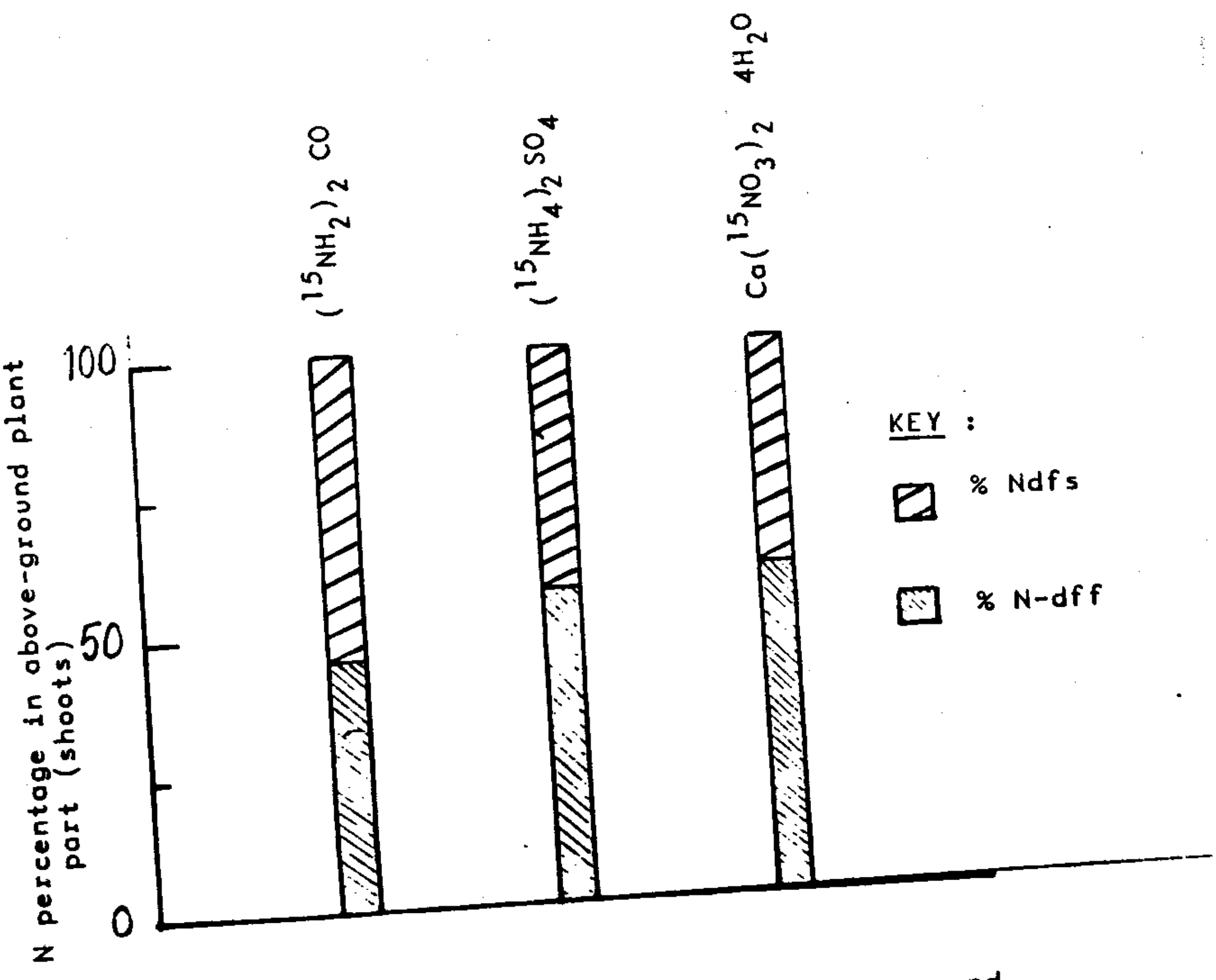

Fig. (4): The % Ndff appreciated in the above-ground part of the plant using the ^{15}N-labelled fertilizer practiced in the virgin desert sandy soil.

growth period. Available-N content in the soil "A-value" calculated for the whole plant treated with calcium nitrate was the lowest of the three N-sources practiced whereas "A" value in the case of urea was the highest of all (as shown in table (2) and Fig. 5).

Nitrogen utilization reflected using the fertilizer N&:

N-utilization of the applied fertilizer nitrogen was comparatively higher in the above-ground parts, table(2) and Fig. (6), than that assessed in the below-ground parts of the plant. Indoubtly, this reflects high mobility of nitrogen in the plant where it is translocated to the active meristematic tissues in the above-ground plant parts. These results are in agreement with those reported by Rennie and Rennie, (1973).

Nitrogen recovery of the fertilizer applied :

Percent of fertilizer N-recovery utilized by the plant along with the soil (Fig. 7) was comparatively greater in the case of calcium nitrate usage than that utilized with the other N-carriers added where the inferiority of urea became, decidedly, recognized.

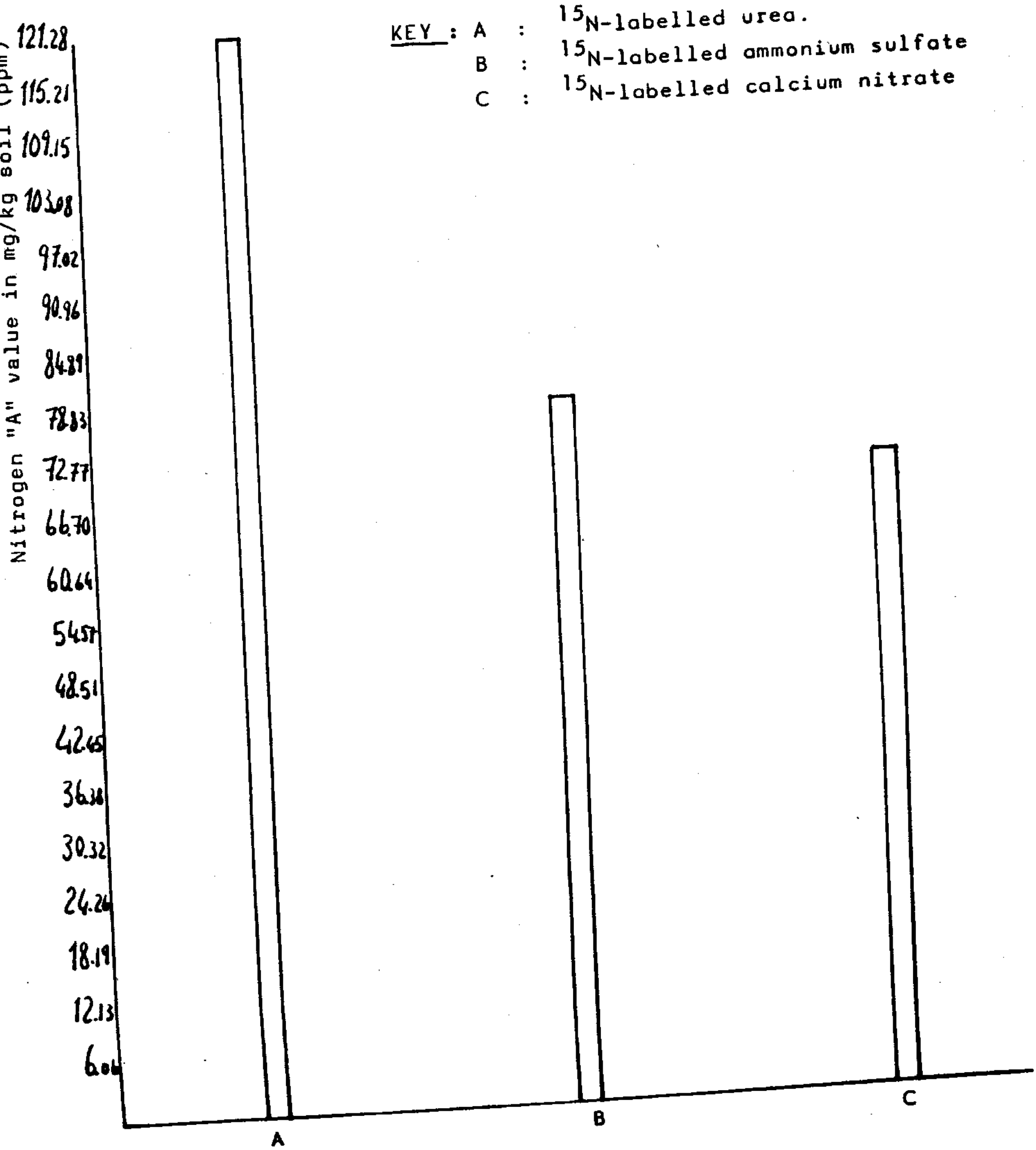

Fig. (5) : Calculated A-N value employing the ^{15}N-labelled carrier in the virgin desert sandy soil.

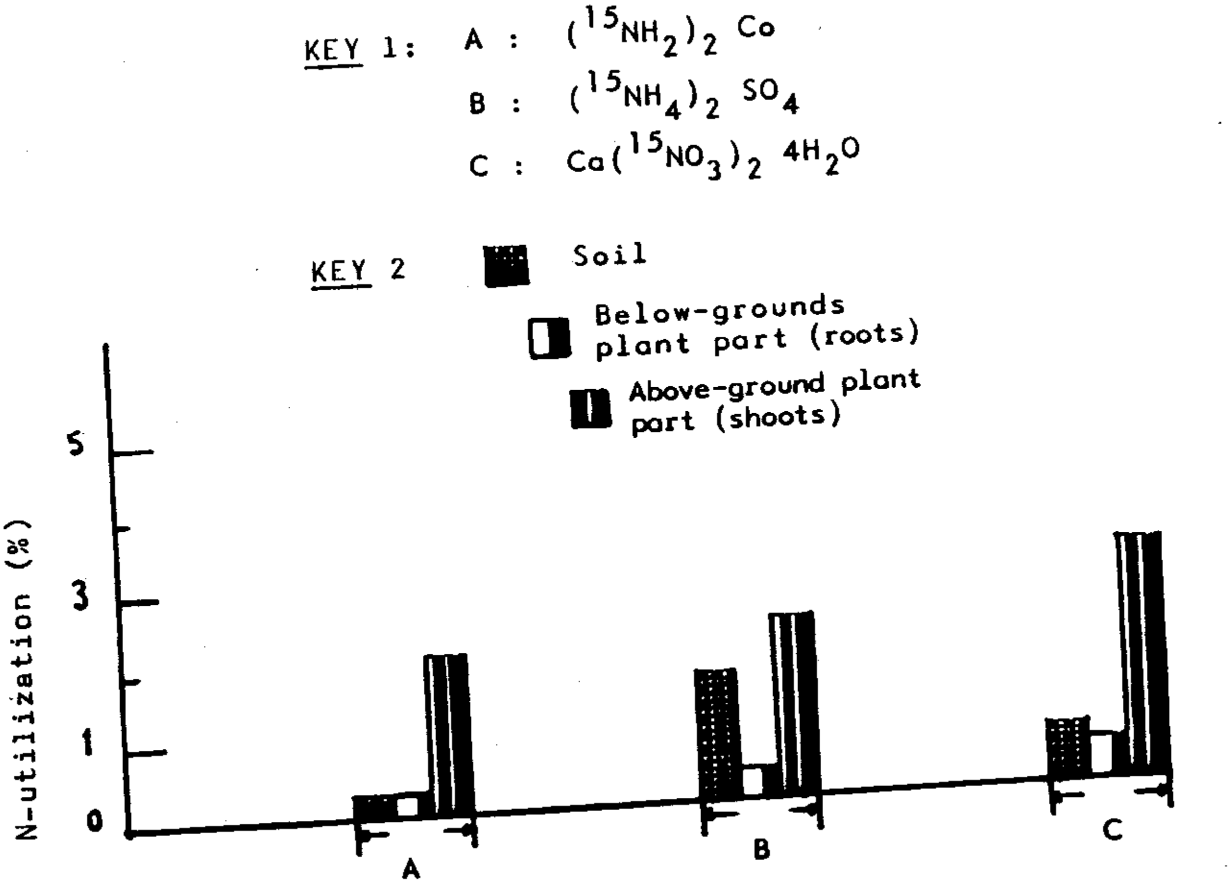

Fig. (6) : Percent of N utilization resulted in the shoots, roots , and soil using the ^{15}N-labelled fertilizer in the virgin desert sandy soil.

KEY 1: A : $(^{15}NH_2)_2\ CO$

B : $(^{15}NH_4)_2\ SO_4$

C : $Ca\ (^{15}NO_3)_2\ \ 4H_2O$

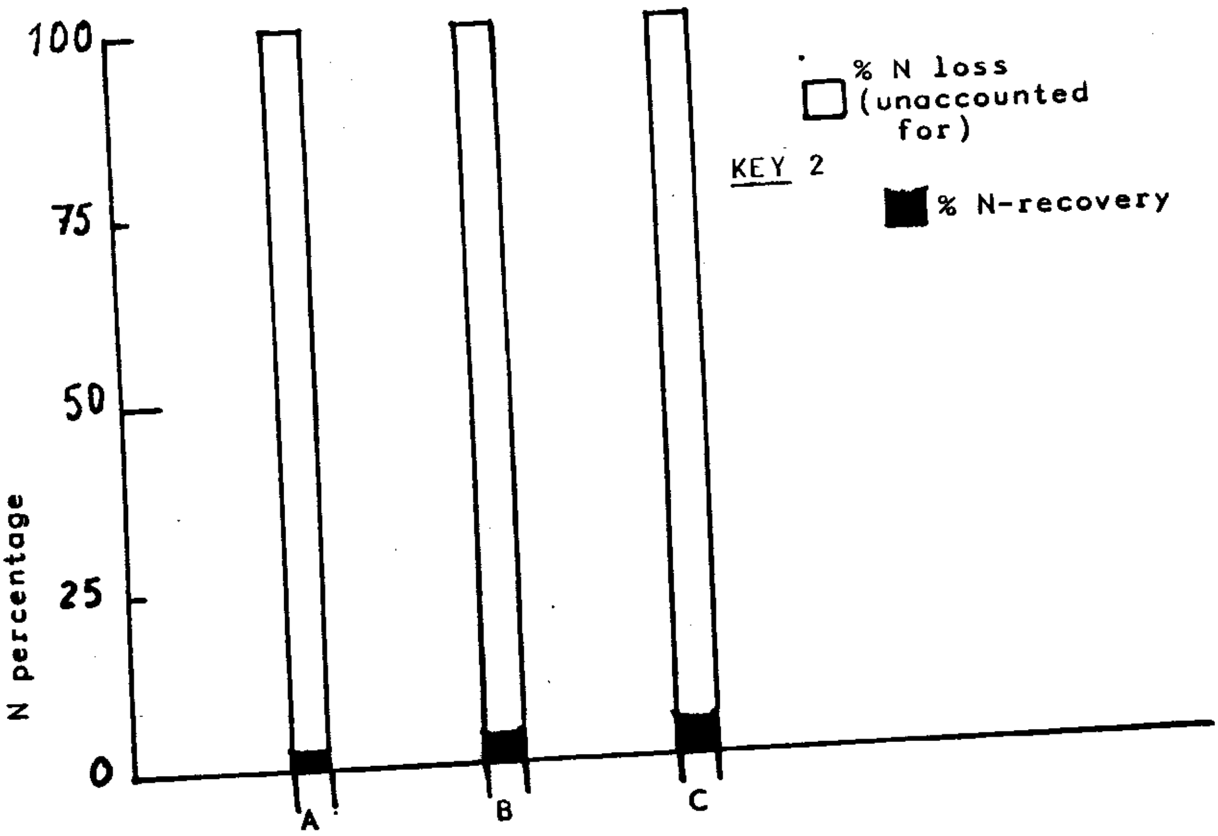

Fig. (7) : Percent of nitrogen recovery and nitrogen loss practicing the 15N-fertilizer tracer into the virgin desert sandy soil under wheat.

In agreement with these data; Rennie and Rennie, (1973); Dev and Rennie, (1979); and Lierop and Tran, (1980) stated that isotope criteria; viz; percent N in plant tissue derived from fertilizer (% N dff) ; "A" value; and uptake of fertilizer N by crop clearly indicate superiority of NO_3-N source followed by NH^+N then urea which was the least effective.

In addition, distribution of the applied N—source in the plant, i.e., the shoots, roots, and soil confirm, again, the superiority of calcium nitrate and the inferiority of urea as a N-source at the conditions under which the experiment was conducted. These results agree with those given by Rennie and Rennie, (1973) who pointed out that a comparatively low content of nitrogen utilized from urea by shoots and roots of barley plant confirm, under pot conditions experiment, inferiority of such fertilizer compared with NH_4^+-N or NO_3^--N fertilizer which was the superior.

Ultimately it may be concluded that for wheat plant grown in the pots containing the virgin desert sandy soil of Abou Zaabal, calcium nitrate was the most efficient N-source compared with ammonium sulfate and urea which was the least efficient N-source used.

Factors affecting NH_4^+-N sources performance:

On the basis of review reports in the literature, it may be suggested that such lower efficiency remarked with the NH_4^+-N sources compared with the NO_3^--N is probably due to some physiological and ecological factors.

Physiological factors impairing NH_4^+-N source efficiency:

i) p^H value of medium used :-

Epstein,(1972) stated that when either ammonium or nitrate is available as the sole source of nitrogen, the ion in question will commonly be the most rapidly absorbed ion present in the medium. Unless the medium is buffered or constantly renewed, absorption of ammonium tends to result in a lowering of the p^H of the medium while absorption of nitrate has the opposite effect. Under the conditions of the present experiment, the p^H value of the soil employed was alkaline (= 7.9 unit) whereby the nitrate became the most rapidly absorbed ion present in the soil comparatively with the ammonium.

ii) Effect of presence of NH_4^+ ion in media :

Many plants can utilize ammonium but suffer various impairments when only ammonium ions furnish nitrogen (Barker et al., 1966; Street and Sheat , 1958). Additionally, the structure of chloroplasts is affected under conditions of ammonium toxicity (Puritch and Barker, 1967). Otherwise ammonium, once absorbed, can immediately serve in the synthesis of amino acids and other compounds containing a reduced nitrogen. Absorption of ammonium therefore, causes a great demand for carbon skeletons and, if photosynthesis fails to keep pace, a depletion of carbohydrates would occur (Epstein,1972). He added that assimilation of ammonium is usually rapid and there is seldom much accumulation of free ammonium in tissue. In compare, he declared that nitrate nitrogen must be reduced before it is assimilated. The immediate demand for carbohydrate is therefore less than in the case of ammonium absorption, and there may be an appreciable build up of organic acids. Supplementally, he stated that proteins contain approximately 18 percent nitrogen absorbed mainly as nitrate.

Ecological factors retarding NH_4^+-N source efficiency:

Volatilization of NH_3 from NH_4^+-N sources applied is considerably the foremost of factors retarding performance of such N-sources, specially, in arid and semi-arid regions. However, volatilization of NH_3 in soils of arid and semi-arid regions can be regarded as a chain of events, the overall rate of which can be controlled by any one link in the chain represented by

$$NH_4^+ \longrightarrow NH_3 \text{ (aqueous)} \longrightarrow NH_3 \text{ (gaseous)}$$

(Vlek et al., 1981). Where, retention of NH_4^+ depends on soil cation - exchange reactions (Fenn and Kissel, 1976; Gasser, 1964), and soil moisture content (Ernst and Massey, 1960; Fenn and Escarzaga, 1976). Conversion from NH_4^+ in solution to aqueous NH_3 is an extremely rapid (first-order) process with a rate constant of 24.6 sec^{-1} (Emerson et al., 1960) and is thus rarely limiting. Concentration of NH_3 (aqueous) changes proportionally with ammoniacal N (Vlek et al., 1981), (Vlek et al., 1981). They added that TAN level in soil or soil solution varies with time due to soil N transformation (immobilization, mineralization,...), soil water dynamics (rainfall or evapotranspiration), and natural or anthropogenic ammoniacal input (deposition and fertilization).

Loss of N via NH_3 volatilization is therefore probable with the conditions under which the experiment was implemented. Owing to the contents appreciated clay fraction (2.5 %) and organic matter (0.1 %) were remarkably a severely deficient in such soil. Whereby the total ammoniacal N concentration (TAN) applied; equivalent to the 90 mg N/kg soil rate, was much more than that scarce extent assessed of both of the C.E.C (1.39 m.eq./100 g soil) and the moisture content (the field capacity 4:100 and the available water contained 1.8:100) of such soil, viz.,,the TAN added was much more the scarcely retention capacity noted with the sandy soil. Furthermore, the alkaline p^H of the sandy soil (7.9 unit) together with the scantily buffering potential of the soil were likely to prompt the p^H value in the soil up to p^H9 or more consequently NH_3-loss via volatilization was excessively(Vlek and Stumpe, 1978), particularly if urea is applied with which environment of media receiving it become alkaline as shown afore . Besides, the conditions of the present experiment involved an ambient temperature averaging 28°C and spells of dry wind which are common at Abou Zaable location. Since ammonium sulfate furnishs to an acidic environment in soil (Hauck, 1968 b), its N-loss from the soil would be thus less compared to that occurred with the urea.

Factors affecting NO_3-N source efficiency :

Remarkably, data show that a small part of less than 5% of the fertilizer nitrogen, in all cases, was recovered in the plant along with that remaining in the soil. On the basis of review of the literature, it may be attributed to that total absorption of N nutrient, i.e., NO_3-N and NH_4-N forms incur probably from some physiological factors which may occur in media of plant

was likely impaired because of , as reviewed later, an unabalance between the N added and the other nutrients spresent natively in such soil was probably occur ed.

Physiological and ecological factors diminishing $N\bar{O}_3$-N source efficiency :-

i. **Physiological factor :-**

As with chloride and other ions, presence of calcium in the medium is essential for unimpaired absorption of nitrate (Burström, 1954 ; Rao, 1972). Assumably, it may therefore be concluded that since the sand soil is deeply deficient in content of calcium , as shown in table (1), the $N\bar{O}_3$-uptake would thus be suspended

ii. **Ecological factors :-**

Denitrification of NO_3-N is the mechanism with which NO_3-N uptake by a plant is likely precluded . Nitrogen loss via denitrification channel is indoubtly inherent with the ecological conditions of soil under which NO_3^--N form to be normally either present natively or applied. On basis of review of the literature, there are some assumable reasons which under arid and semi - arid conditions may lead to loss of N from nitrate present in the soil via such a mechanism. However, Vlek et al.,(1981) reported that alkalinity of p^H of soil may affect effectively cycling of N via denitrification specially in arid zone. However, it is generally accepted that denitrification is reduced at low pH (Focht and Verstraete, 1977). Effects of temperature on rate of denitrification would be characterized demonstratively where 35°C at optipmum rates were observed (Bremner and Shaw , 1958; Stanford et al., 1975 b). Since the p^H of the sandy soil is rather alkaline (7.9 unit), besides the ambient temperature of the present attempt (averaging 28°C) was close to the temperature mentioned at which the denitrification mechanism would be at optimum rate. Other wise, denitrification would be enhanced by addition of crop residues (Vlek et al., 1981), decomposition of root material (Woldendorp,1962), and presence of exudates of living roots (Stefanson, 1972; Volz et al., 1976). Where,the are additional factors that would alter availability of C and concomitantly change rat of denitrification (Vlek et al.,1981). The authors added that organic C level, however, indirectly affect the rate of denitrification by altering soil respiratory activity and consequently the extent of anaerobiosis.

Nitrate as a preferable N-carriers for Mediterranean region :

Ultimately, these eventual results obtained agree with those found by some workers. However, Vlek and Stumpe , (1978) denoted that irrespective of soil p^H, urea is lost from all soils because, upon hydrolysis, it serves as an effective alkaline buffer. While ammonium sulphate becomes less efficient as a source of N with increasing soil p^H and is inferior to urea in soils containing $CaCO_3$ as pointed out by Avnimelech and Laher (1977), Musa (1978),and Fenn and Kissel (1975). From the standpoint of NH_3 volatilization, fertilizers for the low rainfall areas of the Mediterranean should prefererably be nitrate carriers.

Utilization of Fertilizer N Applied at Various Rates to the Virgin Sandy Desert Soil under Wheat.

The calcium nitrate - ^{15}N N-source (table "3"):

Yield, N concentration, and N-uptake reflected:-

In so far as the calcium nitrate-^{15}N , the highest yield of the plant parts, i.e., shoots and spikes (grains) was caused by applying 30 mgN/kg soil. In contrast, the N % in the plant tissues was with this treatment the lowest. Since the yield harvested with this N-rate was the highest, the low % N observed in the plant tissues may be thus due to the N-dilution effect, viz., an enhancement of the plant growth (or volume) to be occurred and a consequent a low concentration of N to be caused. Considering the N-uptake (N-yield) results in which the rate of 60 mgN/kg soil gave the highest extent, this highest value may be referred to compensation act of that extent of the high N % remarked with 60 mg N rate.

Table (3) : Yield of dry matter; contents and uptake of nitrogen in wheat plant; and % N-utilization of fertilizer nitrogen applied as calcium nitrate -^{15}N tracer to a virgin desert sandy soil.

Rate of N mg N/kg soil		Dry matter yield g/pot	N Content (%)	N-uptake: Total mg/pot	N-uptake: Total (%)	Derived from fertilizer (dff) mg/pot	Derived from fertilizer (dff) (%)	Derived from soil (dfs) mg/pot	Derived from soil (dfs) (%)	utilization of fertilizer N (%)	"A-N" value mg N/Kg soil
0		2.241	1.117	25.03	100	--	--	25.03	100.0	-	-
30		4.552	0.917	41.74	100	28.51	68.3	13.23	31.7	19.000	14
60		3.356	1.678	56.32	100	42.74	75.9	13.57	24.1	14.240	19
90		1.853	1.289	23.89	100	19.16	80.2	4.73	19.8	4.26	22
L.S.D.	P=0.05	0.317	0.098	2.85	-	1.42	1.7	1.41	1.6	1.53	1
	P=0.01	0.651	0.235	4.79	-	2.93	3.2	2.89	3.0	2.98	2

Isotope-derived criteria caused :-

Regarding %Ndff data, it is apparent that always with the greater rates of the fertilizer application there were greater values of %Ndff reflected in the plant tissues, viz., there is a linear proportion between the increased amount of the fertilizer N added and N nutrient uptaken from the fertilizer by the plant in such soil. This can also be revealed by the smaller extent of Ndfs % found in the plant. As appertians N-recovery of the fertilizer N , i.e., N-utilization assessed using only the above-ground plant parts (shoots and spikes),is concerned,the results show that it was the highest when the rate was the lowest, namely, being 19% with 30 mg N/kg soil, 14.2% with 60 mg N, and 4.3% with 90 mgN. This reflects apparently a comparative highest efficiency of the rate of 30 mg N, and hence reveals a diminishing % N-utilization and yield harv-ested extents,viz.,the diminishing returns which were remarked obviously with the rates those were higher than the 30 mg N-rate applied (the first N unit added) to such soil. The highest A-N value was reflected with the highest N-rate applied, although the lowest yield and N-utilization were yielded with such rate.

The ammonium-^{15}N sulfate N-source (table "4") :

Yield and N-uptake :

As far to the ammonium -^{15}N sulfate, the greatest yield harvested was obtained with 60 mg N/kg soil followed by the yield obtained with 30 mg N, then the yield brought with 90 mg N.

Isotope-derived criteria :

The highest value recorded of the N-utilization of the fertilizer was upon using 30 mg N rate and the lowest was observed with the highest rate of the application. The diminishing values of the N-utilization and the yield harvested along with such inverse relationship, which was helded between the % Ndff and % N-utilization later, with the case of applying calcium nitrate, were , recognized here again (See Fig. "9").

Table (4) : Yield of dry matter; contents and uptake of nitrogen in wheat plant; and percentage N-utilization of fertilizer nitrogen applied as ammonium - ^{15}N sulfate tracer to a virgin desert sandy soil .

Rate of N mg N/kg soil		Dry matter yield g/pot	N Content (%)	N-uptake						utilization of fertilizer N (%)	"A-N" value mg N/Kg soil
				Total		Derived from fertilizer (dff)		Derived from soil (dfs)			
				mg/pot	(%)	mg/pot	(%)	mg/pot	(%)		
0		1.972	0.340	6.71	100.0	-	-	6.71	100.0	-	-
30		3.364	1.394	46.89	100.0	26.07	55.60	20.82	44.4	17.38	24
60		3.624	1.379	49.98	100.0	36.59	73.20	13.39	26.8	12.19	22
90		1.839	1.008	18.54	100.0	12.09	65.20	6.45	34.8	2.69	48
L.S.D.	P=0.05	0.387	0.089	2.54	--	1.31	1.36	1.40	1.47	1.31	1
	P=0.01	0.654	0.184	5.23	--	2.84	2.94	2.96	3.00	2.73	2

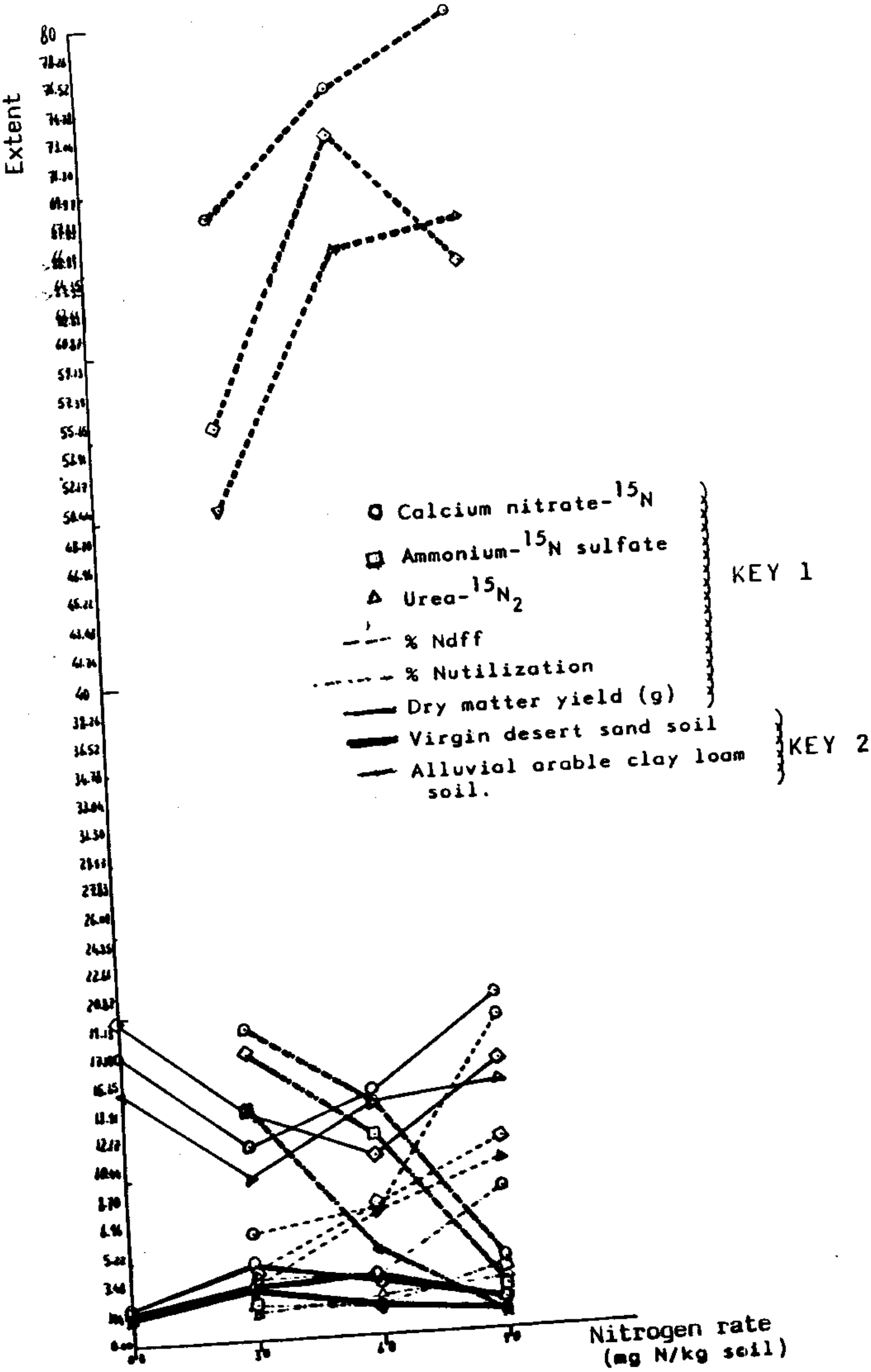

Fig. (9): Percent of Ndff and N-utilization, and total dry matter yield appreciated in the above ground part of the plant practicing the ^{15}N-labelled fertilizer int. each of the virgin desert sandy and alluvial arable clay loam soil.

while the greatest value of % Ndff was steadily reflected with the greatest N-rate applied to the soil. Also , as it was remarked before, that linear proportion which was helded previously between the A-N values reflected and the increased amount of calcium nitrate, is again confirmed here , but the extents of A-N values caused with using ammonium sulfate, in general, were exaggeratively higher than those were yielded with calcium nitrate N-source.

The urea-$^{15}N_2$ N-source (table "5"):

Yield and N-uptake :

As far as the urea , the highest yield was notably obtained with the first rate added of which i.e. 30 mg N/kg soil rate. whereas, the lowest was yielded with the highest rate of the fertilizer applied. The inverse proportion, remarked before, between the N-uptake extent contained by the plant and the enhanced N-rate, with the instances of applying each of calcium nitrate and ammonium sulfate, was, frequently, observed here as well.

Table (5) : Yield of dry matter; contents and uptake of nitrogen in wheat plant, and percentage utilization of fertilizer nitrogen applied as urea-$^{15}N_2$ tracer to a virgin desert sandy soil.

Rate of N mg N/kg soil		Dry matter yield g/pot	N Content (%)	N-uptake						utilization of fertilizer N (%)	"A-N" value mg N/Kg soil
				Total		Derived from fertilizer (dff)		Derived from soil (dfs)			
				mg/pot	(%)	mg/pot	(%)	mg/pot	(%)		
0		1.641	0.730	11.98	100.0	--	--	11.98	100.00	--	--
30		3.377	1.233	41.64	100.0	21.07	50.60	20.57	49.4	14.04	29
60		1.837	1.267	23.28	100.0	15.41	66.2	7.87	33.8	5.14	31
90		1.200	1.344	16.13	100.0	10.95	67.9	5.18	32.1	2.44	43
L.S.D.	P=0.05	0.332	0.090	3.12	--	1.13	1.16	1.12	1.14	1.02	1
	P=0.01	0.650	0.162	5.60	--	2.34	2.45	2.35	2.36	1.98	2

Isotope-derived criteria :-

As it was observed previously with the cases of calcium nitrate or ammonium sulfate, the linear proportions ; which were held formerly between either of the % Ndff value of the A-N value and the increased amount of the fertilizer , besides that reverse proportions which were held between the % N-utilization and either of the increased fertilizer amount or % N-dff values; were demonstratively confirmed here, as a similar frequent pattern applying the three N-sources in such soil, using urea as a N-source.

It is worthy of note that the A-N values caused using urea fertilizer were, generally, higher than those caused with either ammonium sulfate or with calcium nitrate with which the A-N values reflected were the lowest in such soil, observedly.

Reasons assumed to account for superiority of applying the lowest N-rate in the sandy desert soil :

In genera, the data obtained indicate decidedly and frequently the there is a retardation effect for the N-fertilizer uptake upon applying the fertilizer N in high rates. Thus, to develop the N-uptake of the fertilizer N added to the sandy soil at the conditions under which the experiment was exected, the fertilizer N rate added would be at 30 mg N/kg soil. On the basis of review of the literature, it could be concluded that the retardation of N - uptake by the fertilizer N applied at the rates higher than 30 mg N / Kg soil may be substantially due to those physiological factors inherent to that severe deficits in all of the nutrient elements present natively in the sandy soil (see table 1) that owing to the extreme shortage of both of the content of organic matter and clay fraction contained in such soil. And hence an unbalance in formulation of the native nutrient elements in the soil may occurred between N added by the fertilizer and the other nutrients contained in the soil when N of the fertilizer was applied in the high rate. This This imbalance suggested would be developed linearly if a progressed N-rate of the N-fertilizer was applied ascendingly. However, the excessive concentrations of N-rate added by the fertilizer may so reduce rate of absorption of the other nutrients that the plant becomes deficient in these nutrients, in turn the deficiencies of these elements in the cells of the plant will bring about derangements in its metabolisms (Epstein, 1972). Subsequently, the N-uptake of the fertilizer N applied would therefore be indirectly retarded, particularly , upon use the higher N- ratesin such soil.

An assumable resemblancy between the results reflected with the ascendingly N-rate applied and Mitscherlich assumption :

In the case of such sandy soil,although the applicae tion of N fertilizer may accentuate a physiological problem , as discussed before , which may be developed if an ascendingly N rate was applied, assumably no problems which normally inherented to other soils such as N-immobilization, N-fixation, ... etc. are possibly encountered in such soil. Presumably, N-mobility or N-kinetics in this soèl would be therefore absolute, specially upon use of nitrates.

The N-utilization extents and the yields resulted under conditions of this soil, as illustrated by Fig. (9), were dimnished when the amount of the fertilizer N was added ascendingly. This diminishing trend of these results of the N-utilization, N-uptake, and yield resemble law entitled "diminishing returns low" of Mitscherlich (1909).

Trend of returns of a yield harvested or a nutrient yielded applying an ascendingly unit of a nutrient added, when there are nearly no problems with which mobility or kinetics of the nutrient added may impair would follow the assumption of Mitscherlich according to Bray interpretation. And hence, the returns trend would be goverened, suggestely, by the physiological factors over by those of the ecologically . Considering that,as discaussed later,there are almost no ecological problems to suspend N - mobility in the sandy soil considered.The trend of the values of yield , N——— uptake , and N———

utilization reflected applying the increased N amount may therefore follow the diminishing returns law of Mitscherlich according to Bray interpretation in the case of such sandy soil.

Perspectively, owing to soil used through Mitscherlich attempt was also sandy,yield obtained with that attempt may subject to the influence of that physiological unbalancy which may held between nutrient considered,i.e., p nutrient and the other nutrients which were used. Where, using a higher unit of P ascendingly, the relation,or, trend of diminishing returns law was therefore obviously recognized, assumably.

Comparative efficiency of the three N-sources applied (Table "6"):

Using the mean value of the results obtained previously, N-application in the form of calcium nitrate gave the highest dry matter yield and, the total N-uptake, remarkably, followed by those gaven with ammonium sulfate, then those yielded with urea N-fertilizer. This indicates that calcium nitrate N-carrier, inducably, was the more readily available one applied for the plant used. This inference was confirmed when the highest N-amount uptaken from the fertilizer added by the , assessed isotopically , plant was that of calcium nitrate treatments and the lowest was that of urea. However, 10.1 % of the nitrate N-- source applied was utilized by the plant comparatively with those of 8.3% and 5.3 % induced in the case of ammonium sulfate and urea respectively. This higher utilization recognized of N applied in form of nitrate is, deducably, an indication to high efficiency of which.

Superiority of A-N value assessed in the sandy soil applying urea (table "6"):-

The highest amount of available N i.e., A-N value caused was being obtained with urea treatments,observedly. Despite such highest A-N value obtained, each of the yield, total N uptaken, and % N-utilization reflected applying urea was being steadily the lowest. This denotation instate consistently the inferiority of the efficiency of urea as N-fertilizer compared to the other fertilizers applied.

On the basis of review of the literature,this highest N-V value observed may, however, be due to some physiological, microbiological, and ecological reasons, whereby the added N applying urea was uptaken in the lowest extent, therefore, compared with those taken from applying the other N-sources. Consequently the highest available N amount deposited into the soil would be of that delivered by the urea fertilizer. However, this highest N amount delivered with urea might be deposited in the soil temporarily, then it may be , in further, lost via the volatilization channel mainly which is relevant with the ecological reasons which was discussed previously (see page No. 84).

i) Responsible physiological reasons :-

The severe deficits of the almost nutrient elements considered in the sandy soil that owing to the severe deficits in organic matter and clay fraction content may caused deficiencies of these elements in cells of the plant , specially when N of urea was added in the excessive concentration (e.g. 90 mg N/kg soil). Thereby, rate of absorption of the other nutrients might be reduced and in turn the plant may became deficient in such other nutrients, in a seq- uence the derangements of the metabolism of these nutrients would be occurred, Epstein,(1972). Indirectly the N-uptaken by the plant from applying the urea would be retarded, namely, no balance might be furnished between the excessive N concentration of the urea applied and those of the other nutrients pre- sent natively in such soil.

In presence of the too weakly buffering cap- acity of the soil resulted , suggestly, from that severe deficiency observed in the organic matter and clay content in such soil, with which the reasons inducing alkalinity such, as,the alkaline pH remarked of the soil (7.9 unit), the alkalinity observed (7.8

unit) of the irrigation water used , and that alkalinity action which is accentuated via the effective alkaline buffer of urea upon its hydrolysis may be effective (Hauck,1968b; Vlek and Stumpe,1978) wight be affect NH_4^+-N of urea effectively. Predictably,assumable conclusive p^H embbdyed with these circumtances might therefore be extremely alkaline and in turn the absorption of ammonium ion derived from the urea would be thus suspended intensively (Epstein, 1972).

Furthermore, when only ammonium ions furnish nitrogen many plants suffer various impairments (Barker et al., 1966; Street and Sheat, 1958), as well as the structure of chloroplasts is affected under conditions of ammonium toxicity (Puritch and Barker, 1967). Ammonium , once absorbed, can immediately serve in the synthesis of aminoacids and other compounds containing a reduced N , absorption of ammonium therefore causes a great demand for carbon skeletons and, if photosynthesis fails to keep pace, a depletion of carbohydrates would occur (Epstein, 1972).

ii) Responsible microbiological reasons :

Ammonia released from urea, in quantity, often would inhibit growth of Nitrobacter sp., there may be a tendency for nitrites to accumulate particularly in neutral or alkaline soils, in turn this accumulation of $N\bar{O}_2$ may produce some injury to plants (Broadbent et al., 1957; Aleem et al., 1957; Tyler and Broadbent, 1960). The comparatively high A values and low % Ndff for urea source of N would appear to be a reflection of slow hydrolysis and not volatilization of NH_4^+-N as has been frequently suggested in the literature (Rennie and Rennie, 1973).

Eventually, these reasons may be the responsible for impair the N uptaken by the plant applying the urea as a N-source in such soil, viz., the lowest values of yield, N-uptake, N-utilization induced practicing the urea were reflected suggestly because of presence of these reasons mentioned previously. And hence the highest quantity of N deposited in the soil, or the highest A-N value reflected upon apply the urea fertilizer was, therefore, resulted, presumably.

In commentary, most of the problems encountered tentatively, in the tested were, frequently, originated from a sole caustive reason which was the severely deficit of the content of organic matter and clay fraction contained in the deserst sandy soil. In inference, this notion indicates decidedly to the necessary excessively acquisition to organic matter and clay additions for such type of soil. Perspectively, in no another real way, clay and silt fractions which, in the past, were solely comprised, through flooding of river Nile water must somehow be therefore furnished in future, as quick as possible, via the river Nile again for development the fertility of nearly all the soil types of Egypt, particularly such that desert sandy soil which represents approximately more than 95% of the entire Egypt's soils.

Utilization of Fertilizer Nitrogen Applied at Various Rates into an Arable Clay Loam Soil under Wheat :

The calcium nitrate-^{15}N N-source (table "7"):

Dry matter and N-uptake :-

Noticeably, in compare with treatment that receiving no nitrogen, the dry matter yield and N-uptake caused with the application of the fertilizer showed no increase except with that highest applied rate of 90 mgN/kg soil.

Conclusively, the application of 30 to 60 mg N/kg soil was, thus, not beneficial enough for the crop response, whereas the amount added of 90 mg N seemed enough for cause a somewhat possitive response (see Fig. 9). However, with such a greatest N rate, the dry matter yield and N-uptake reflected were exceeded those reflected with that treatment receiving no fertilizer by about 2.937 g/pot and 39 mg N/pot respectively.

N-immobilization as an assumable reason that affecting crop response :-

Suggestly, the probable reason for indicated pattern

Table (7) : Yield of dry matter; contents and uptake of nitrogen in plant; and % N-utilization of fertilizer nitrogen applied as calcium nitrate-^{15}N tracer to an alluvial arable clay loam soil under wheat .

Scaned plant parts	Rate of N mg N/kg soil		Dry - matter yield g/pot	N content (%)	N-uptake Total mg/pot	N-uptake Total (%)	Derived from fertilizer (dff) mg/pot	Derived from fertilizer (dff) (%)	Derived from soil (dfs) mg/pot	Derived from soil (dfs) (%)	utilization of fertilizer nitrogen (%)	"A—N" value mg N/kg soil
Straw	0		11.599	0.389	45.12	100	--	--	45.12	100	--	-
	30		7.139	0.228	16.28	100	00.18	01.10	16.10	98.9	0.12	-
	60		10.005	0.667	66.74	100	02.94	04.40	63.80	95.6	0.98	-
	90		14.100	0.858	120.98	100	22.74	18.80	89.24	81.2	5.04	-
	L.S.D.	P=0.05	0.187	0.068	3.45	-	0.72	0.75	0.76	0.78	0.69	-
		P=0.01	0.361	0.145	7.72	-	1.60	1.66	1.61	1.62	1.57	-
Spikes (grains)	0		6.081	1.459	88.72	100	--	--	88.72	100	--	-
	30		4.641	1.224	56.81	100	05.40	9.50	51.41	90.5	3.59	-
	60		4.912	1.447	71.08	100	07.68	10.80	63.40	89.2	2.55	-
	90		6.517	1.218	79.38	100	15.88	20.00	63.50	80.0	3.53	-
	L.S.D.	P=0.05	0.114	0.041	3.21	-	0.65	0.68	0.67	0.68	0.68	-
		P=0.01	0.231	0.089	6.95	-	1.33	1.40	1.39	1.41	1.35	-
Straw + grains (above - ground part)	0		17.680	0.914	161.60	100	--	--	161.60	100	--	-
	30		11.781	0.729	85.93	100	05.58	06.50	080.35	93.5	3.72	432
	60		14.917	0.929	138.53	100	10.62	07.70	127.91	92.3	3.56	719
	90		20.617	0.976	201.16	100	38.62	19.20	162.54	80.8	8.58	379
	L.S.D.	P=0.05	0.322	0.059	3.62	-	0.95	0.97	0.97	0.98	0.91	2
		P=0.01	0.741	0.141	7.92	-	2.12	2.18	2.20	2.21	1.93	4

of response, may be based on the effect of variable N-rates on N-immobilization activity which, under particular conditions, is sometimes taken place byl soil microflora. However, Walunjkar et al.,1959 and Allison, 1966 stated that immobilization of mineral N was found to be promoted in some cases of fertilizer addition to soils when energy materials are ample.

However , actually,the investigated soil was under maize plant for not only one season but for three continuously seasons. Since, cereal plant tissues normally have a wide C:N ratios (Allison, 1966).

Furthermore,in so far as the conditions observed of the current experiment,presence of the cultivated wheat residues and its decomposed roots debris may represent another source of such readily decomposable and C energy supplying also residues of that of wide C:N ratios. The C:N ratio appreciated (23:1), see table (1), of the investigated soil may, therefore, be narrower than the actual ratios which were dominant in the soil through course of the trial (Pinck et al., 1946 and Allison and Klein, 1962). Suggestly under such conditions and with the application of 30 to 60 mg N/kg soil, the C:N ratio dominant likely was, still, wider than 20:1 . With which the heterotrophic microflora grow so rapidly in turn oftenly all of the available mineral soil nitrogen, i.e., the native N and the applied may be utilized, or, immobilized by them . While with 90 mg N, the C:N ratio was likely become narrower than that of 20:1 and in turn nitrogen in form of ammonia, viz., net mineralization would be realized (Allison, 1966 ; Pinck et al., 1946; and Allison and Klein, 1962).

Assumably, with the 90 mg N-rate, amount of the total available N, viz., the native N and that applied N seemed, however, probably, adequate enough to N ---- N seemed, however, probably, adequate enough to N requirement needed by the soil microorganisms. Whereby the plant might, in further, utilize, without a competition of the soil microflora, rest of the available N which was not immobilized by the microflora and also that amount of available N mineralized by the microflora itself (Legg and Allison , 1959, 1961 and Legg, 1962, 1966) ; under this condition of C:N ratio narrower than 20:1 , the crop response and N-uptake caused with such high N-level were, therefore, rather a higher than those caused with the control treatment.

Isotope - derived criteria :

i) N-dff values :

With given N levels of 30 and 60 mg N/kg soil, while approximately 86 and 139 mg N were removed by the plant, still only a small fraction, i.e., about one-fifteenth and one-thirteenth respectively of them were of a fertilizer origin. With regard to N which was contained in the straw, the N extent uptaken with such two N-rates was noticeably involving a very small portion of N,i.e., nearly less than 5% that was derived from the fertilizer. While, with the greatest N-rate used, a significant portion of nearly one-fifth, i.e., 19% of that N taken up by the plant was notably derived from the fertilizer. Such highest rate, therefore, may be adequate enough to the plant whereby the plant likely could meet its needs of N under the adverse conditions such as the N-immobilization and possibly N-denitrification which may occurr in such heavy soil.

Comparing the three treatments receiving N with each other,the linear direct proportion which was remarked previously, with the instance of the calcium nitrate applied into the sandy soil, between the values reflected of Ndff and the increased N-rate applied is, also, remarked here with this instance of applying the same of fertilizer into the arable clay loam soil. However, that ascendingly increased application of the fertilizer N remarkably led to a ascendingly increase in the plant N which was demonstratively derived from the fertilizer , either in terms of the absolute amounts , or, in terms of the proportion of the uptaken N originated from the calciume nitrate -^{15}N applied. Notably, this observedly increase was recognized using both parts considered of the plant. In a compare, with the highest N-rate, a considerable N amount that was derived from the N of the fertilizer was notably uptaken by the considered parts of the plant, it was, however, reaching to nearly seven times as much of that N-amount derived from the fertilizer upon the lowest N-rate of the fertilizer application was procticed .

ii) N-utilization values:

Generally, the value induced of N-utilization; either in terms of the quantity or total of percentage; applying the calcium nitrate -^{15}N increasingly, into the tested soil was,remarkably, improved. Noticeably , this observation is, unlike that was recognized , afore, applying the same N-source into the sandy soil. However, the obtained data show that with the greatest rate of N-application, where 8.58 % of the N applied by the fertilizer was utilized by the plant, viz., the above-ground part of the plant; still, only, 3.72 and 3.52% of N-amount applied by the fertilizer were utilized by the same part of the plant with 30 and 60 mgN/kg soil rates respectively. Such a highest N-utilization reflected, using the greatest N-rate, may be attributed to an enough magnitude of N that might be occurred and hence those N-acquisitions needed by the soil micro-flora and the plant , when this N-level was applied; might be covered whereby a net N-mineralization for soil organic N was likely intiated, consequently. Subsequently, there were likely a somewhat amount of N which might be derived either from the soil, via the mineralization processe, or from the fertilizer added would be available to be uptaken by the plant, with which the plant could to cause a higher yield than that yielded with the control treatment.

iii) A-N values induced :

Noticeably, the data obtained exhibited that an inverse proportion was observed between the values of A-N reflected, and that of the increased amount of N applied by the fertilizer. In a contrary, this observation conflicts with that was remarked with the case of use such fertilizer in the sandy soil. This data, assumably, support the conclusion that, there was a linear direct proportion , decidedly , observed between the enhanced N amount applied to such a soil and the N-amount uptaken by the plant.

N-mobility and piriority of spikes of wheat plant for nitrogen fertilizer uptake :-

The data which belongs to the spikes, i.e., the part of the plant inside which grains normally are formed showed that whether the N-fertilizer was not applied or applied at the medium or at the highest N-rate, the spikes frequently claimed the most amount of the total N which is uptaken by the plant either from the soil N or from the N of the fertilizer added.

Furthermore,the spkes (grains) N content,which was derived from the fertilizer N,was regardly 3 to 30 times as much as that was contained by the traw part ofthe plant.

These findings incidate, thus , the usually apparent priority of the spikes to utilize the N - nutrient , which is either originated from the soil or that derived from the fertilizer N applied. This regard may be attributed to the mobility of N in the plant. However, protein N would be usually translocated to the active meristematic regions, viz., the spkes part of the plant.

Perspectively,the totally obtained results support the conclusion that a linear direct relationship was, tentatively, confirmed between the N-uptake from the fertilizer N and the increased N-amount added by the N fertilizer into such soil. This direct relationship observed may refer, mainly, to presence of some problems in such a soil such as the N-immobilization and dentirification which lead to oftenly a retardation effect for N-mobility in the soil and N loss as nitrogen oxides, suggestly. And hence the fertilizer N uptake in such a soil would be affected. The higher N-rate added, therefore, brought usually, a higher yields , as shown, where with this higher N-addition these ecosystems problems would be overcome, suggestly.

In contrast with that case of use the sandy soil, this soil was likely a fertile enough, namely, that physiological problem of disbalancy which was proposed to occurr in the sandy soil (nearly absolute poor of soil in all the nutrient contents) between N and the other nutrients when N was added in a higher rates (Epstein, 1972) would be disregarded with such soil.

Predictably,the N-amount of the fertilizer N utilized under this fertility status of the soil, by the above - ground part ofthe plant,was, therefore, a small, shown. On the same hand, this small N-amount utilized by the plant from the fertilizer may refer to the unknown of relation between the time of emergence of soil nitrogen and the time within which crop requirement of nitrogen depending on different growth stages , where the partial efficiency of absorbed N may differs at these different growth stages of the crop (Nishigaki, 1970). The author added that if the plant sample is taken and analysed for N-15 and total N (N-uptake) of the plants several times throughout the crop life, amount of the soil N utilized by the crop in each stage of growth can be determined, and hence the rate and time of nitrogen application can be consequently determined.

Suggestly, the remaining N-portion of 91.42 to 96.46 % of the N-fertilizer may be distributed among the following :-

i) Loss via the N-denitrification.

ii) Immobilized by the active bio-mass of such arable soil.

iii) Still in mineral forms, and thus remaining in the soil.

iv) Incorporated in the roots tissues of the plant.

Owing to some practical difficulties which were encountered throughout separation of the roots from the soil, the soil and roots were, however, not analysed for their total N-uptake and N-15 percentages.

Assumable factors retarding NO_3-N uptake :

Presumably, the N-denitrification and immobilization may be the foremost individuals of those ecosystematical adverse factors which, mainly, suspend the uptake of NO_3-N, which present either natively or applied, in such a clay loam alluvial arable soil. Noticeably,the N-immobilization problem was discussed before, see page No. 113 .

Denitrification reasons suggested under the conditions of the soil investigated :

In such a fine-textured soil, denitrification of NO_3-fertilizer applied to soils would be occured under conditions of anaerobiosis (Bartholomew, 1971).

He added that in cases of soil maintained at field capacity may be characterized by rather extensive portions of their total volume in anaerobic conditions. Otherwise, the fine-textured soils that have optimum conditions would be conducive to a high level of a biological activity and therfore a decrease in oxygen in soil would be occurred in turn that may bring about such a nitrate reduction (Bremner and Shaw, 1958). The fine-textured soil may affect movement of water which concomitantly influences the denitrification (Bremner and Shaw, 1958; Broadbent, 1965; and Allison, 1966); uptake of oxygen by roots and rhizosphere microflora that feed on root excretions would be taken place, therfore losses by denitrification may be occured (Woldendorp, 1962). Gaseous losses via denitrification occur quite commonly even in well-controlled green house experiments (Broadbent and Clark, 1965; Allison, 1966).

Otherwise, the observed alkalinity (8.4 unit) of the soil p^H and, also, the alkalinity p^H (7.8 unit) which was assessed of the irigation water that was used through the course of the experiment may effectively affect cycling of N via denitrification (Vlek et al., 1981).

Besides, the ambient temperature which was dominant through the present experiment was averaging 28°C with which an optimum rate of the denitrification may was occurred (Bremner and Shaw, 1958; Stanford et al., 1975 b), and an exponential increase of the denitrification rate would be occurred between 15°C and 30°C (Vlek et al., 1981).

Also , the denitrification may be accentuated by other agents such as, presence of crop residues (Vlek, et al., 1981), decomposed roots debris with which this process would be stimulated (Woldendorp, 1962), and presence of exudates of living roots (Stefanson, 1972; Volz et al., 1976). Since the presence of these materials in soils would alter availability of C and in turn alter the rate of the denitrification, however, the organic C level indirectly would affect the rate of denitrification by arouse respiratory activity and consequently aggravate the anaerobiosis (Vlek et al.,1981).

The ammonium -^{15}N sulfate N-source (table "8"):

Dry matter and N-uptake amount :-

With regard to the data of the dry matter yield, in a compare with the nil fertilizer-N treatment, there was no a positive response induced with any N-rate applied of those of the increased N fertilizer applications planned, observedly. However, the yield of each individual fertilized treatment was always, remarkably, lower than that was yielded by the nil fertilizer-N treatment (see Fig. "9"). Still, N-uptake caused with the highest N-rate applied was observedly higher than that caused by the treatment received no fertilizer.

Isotope-derived criteria :

i) Ndff values.

Noticeably, with those lower N-levels of 30 to 60 mg N/kg soil, the nitrogen which was assessed in the plant tissues was predominantly , that of the soil origin. Where, nearly 92% to 96% of such plant N was of that N derived from the soil, whereas a very little fraction induced of 4 to 8% was only derived from the

Table (8) : Yield of dry matter; contents and uptake of nitrogen in plant; and % N-utilization of fertilizer nitrogen applied as ammonium-^{15}N sulfate tracer to the alluvial arable clay loam soil under wheat .

Scaned plant parts	Rate of N mg N/kg soil	Dry - matter yield g/pot	N content (%)	N-uptake: Total mg/pot	Total (%)	Derived from fertilizer (dff) mg/pot	dff (%)	Derived from soil (dfs) mg/pot	dfs (%)	utilization of fertilizer nitrogen (%)	"A—N" value mg N/kg soil
Straw	0	12.604	0.235	29.62	100	--	--	29.62	100.0	--	-
	30	9.686	0.300	29.06	100	0.87	3.0	28.19	97.0	0.59	-
	60	7.226	0.282	20.38	100	0.88	4.3	19.50	95.7	0.30	-
	90	10.200	0.449	45.80	100	1.60	3.5	44.20	96.5	0.36	-
	L.S.D. P=0.05	0.178	0.072	2.93	-	0.24	0.27	0.30	0.34	0.19	-
	L.S.D. P=0.01	0.332	0.148	6.31	-	0.45	0.51	0.63	0.70	0.30	-
Spikes (grains)	0	7.141	1.117	79.77	100	--	--	79.77	100.0	--	-
	30	4.213	1.161	48.92	100	2.40	4.9	46.52	95.1	1.60	-
	60	3.689	1.244	45.89	100	4.41	9.6	41.48	90.4	1.46	-
	90	6.277	1.363	85.56	100	16.34	19.1	69.22	80.9	3.63	-
	L.S.D. P=0.05	0.103	0.05	4.32	-	0.59	0.61	0.60	0.66	0.49	-
	L.S.D. P=0.01	0.200	0.10	8.71	-	1.24	1.26	1.25	1.30	1.02	-
Straw + grains (above - ground part)	0	19.745	0.554	109.39	100	--	--	109.39	100.0	--	-
	30	13.899	0.561	077.98	100	03.27	04.20	074.71	95.8	2.18	684
	60	10.915	0.607	066.27	100	05.29	08.00	060.98	92.0	1.77	690
	90	16.477	0.797	131.36	100	17.94	13.7	113.42	86.3	4.00	567
	L.S.D. P=0.05	0.296	0.061	3.41	-	0.78	0.80	0.82	0.87	0.69	3
	L.S.D. P=0.01	0.631	0.131	7.61	-	1.70	1.74	1.78	1.82	1.31	5

fertilizer. Motably with the highest N-application, i.e., 90 mgN/kg soil the share of N that was derived from the fertilizer in theplant was increased to 18% .

Considerably, these obtained data indicate, again, the linear direct proportion between the nitrogen derived from the fertilizer, viz., the Ndff, and the enhanced amount of N applied . It is worthy of note that this linear proportion was, also, observed in the case of applying the calcium nitrate into such a soil.

ii) N-utilization

Remarkably, a relatively higher portion of that applied N was utilized by the plant when the N-rate added was a higher too where, with 30 to 60 mgN/kg soil, nearly about 2% of the N amount applied was utilized by the plant, while with the greatest rate of 90 mg N 4% of the N applied was utilized. Considerably these data confirm that linear direct proportion , which was observed afore, between the N used by theplant and the increased N applied.

iii) **A-N value :**

Notably, the data point out, again , to the inverse proportion between the A-N value and the increased N-amount applied using the ammonium sulfate; such this inverse proportion, however, was, observed, previously, when applying the calcium nitrate into such a soil. These data, therefore, support the conclusion of, in this a clay loam soil there is a linear direct proportion between the N used by the plant and the enhanced N amount applied using the N fertilizer.

These results reveal that the available N which was added by the fertilizer was increasinly used by the plant that when it was, applied increasingly into such soil. Therefore, it could be presumed that there were likely some difficultes peresent in such soil with which the soil N was not avilable enough to be used by the plant, although this soil seemed a fertile enough.

It is worthy of note that comparing those three treatments receiving the fertilizer with each other,the data show, a similar pattern to that was observed through applying the calcium nitrate into such soil. Where, the increased application of the ammonium sulfate enabled appreciably to enhance the plant N that was derived from the fertilizer, i.e., Ndff, either that in terms of the absolute amount or in percent (See Fig. 9). However, amount of N of the fertilizer found, using the isotope-derived criteria, in tissues of the plant receiving the greatest N-rate was about five and a half as much as N amount of the fertilizer absorbed by the plant receiving the lowest N-rate of the fertilizer.

N amount uptaken by spikes :

Notably as it was observed in the case of calcium nitrate applied in such soil, under all the contions of non fertilizer application and those with the increased fertilizer N application, the spikes, grains or yielded required most amount of N which was taken up by the plant from whether the N to be originated from the soil or from the other, source,or, the last source which to be derived from the fertilizer N added.

Inferiority of NH_4^+-N form relative to NO_3-N :-

It is worthy of note that, for once more again, that conclusive results obtained showed the superiority of the calcium nitrate in the case of the clay loam soil. Where such fertilizer was, as shown previously in the case of desert sandy soil, also the superior to the ammonium fertilizer. However, in a compare, only 2 to 4% of the applied N-rates of the NH_4^+ fertilizer were used by the plant while 4 to 9% of the applied N-rates of calcium nitrate were used. This remarked inferiority of the NH_4^+ fertilizer compared with the calcium nitrate suggests that the ammonium form was probably undergone some adverse difficults more in numeration and higher in extent than those occurred with the nitrate form. Thus , as a notion, there was no effect observed on the yield reflected upon the application of the ammonium form with any N-level applied. Predictably, it could be assumed that such difficults seem to be those physiological problems that were formerly discussed (see pag. No. 82), and microbiological and ecosystematical problems which, both, will be discussed as follows.

Assumable factors suspending uptake of NH_4^+-N by plant:-

The 2 to 4% of the applied N-rate of the ammonium sulfate which were used by the plant, indeed, represents a scanty share of that N-amount which was applied. This scanty N amount utilized is, assumably , due to two different groups of adverse problems which may retarded NH_4^+-N uptake throughout the course of the attempt. However, the foremost of such two groups is, perspectively, the microbio-ecological problems which were , previously, assumed by the A-N value measure (Paga. No. 84 , 111, 113). The second group is presumably that physiological problems which were discussed, earlier, (see page No.82). Otherwise, such this scanty N amount utilized is, suggestly, due to the undetermination for rate and time of the N application, before the experiment was conducted, because of the unknown relation between time of emergence of soil N and the time within which crop requirement for N to be depended on different growth stages (Nishigaki, 1970). Besides the soil used was , probably, a fertile enough with which N utilized extent was a scant.

The presumable microbio-ecological factors retarding NH_4^+-N uptake :-

Presumably, the 96 to 98% remainder N of the N applied by the fertilizer should undoubtly be destributed, throughout the course of the attempt, among a number of pathways which seem similar to those mentioned, previously, with regard to the nitrate fertilizer .

i) Microbiological factors :

Presumably, those factors which previously operated in such a soil and related to the immobilization - mineralization processes encountered with the case of calcium nitrate application (see pag. No. 113) may be, as well, applicable here. However, suggestly, the addition of the fertilizer N, again, might excite the activity of soil micro-organisms, consequently leading to an immobilization of mineral soil N comprising the NH_4^+-N of the fertilizer applied. Where, this may occurre upon use the rates of 30 to 60 mg N/Kg soil; while with the high rate of 90 mg N, under such conditions, tended to seem nearly a sufficient to provide both of the plant and the soil microflora with their N-requirements, assumably.

It is worthy of note that using the calcijm nitrate in such a soil at the highest N-rate applied, a positive response in the yield caused was observed comparably with that caused with the control treatment. This , therefore, indicates that a more immobilization intensity may occur to the NH_4^+-N than that was done to the NO_3-N, suggestly. This is probably due to a possible preference by soil microflora to NH_4^+-N (Jansson, 1955,1958, and 1963; Low and Piper,1957). Where, this preference may be encountered at all of pH levels, and it would be arised, specifically, with an increase in pH (Broadbent and Tyler, 1965). Considerably,under the conditions of the current experiment, the p^H assessed of the soil used (8.4 unit) and the irrigation water used (7.8 unit) were alkaline actually.

Moreover, immobilization of N would be arised when N addition was increased (Legg and Allison, 1959, 1961). Therefore, it could be accounted for that, each value of the yield, N-yield, %Ndff, and %N utilization reflected with the 60 mgN-rate, which was used throughout the two attempts of NH_4^+ and NO_3- fertilizer , was , observedly, nearly similar to that was reflected when the 30 mg N-rate was applied throughout the two attempts. Where , on the same hand, with increase of mineral N added into soils there is usually an increase in amount of N obtained, viz., N-uptake, Ndff and N utilization obtained in harvested crop and also an increase in N-immobilization occurred of amount of the added fertilizer nitrogen (Walker et al., 1956 ; Jansson, 1958; Walunjkar et al., 1959 Legg and Allison, 1959, 1961; Cady and Bartholomew, 1960a; Legg, 1962; Stewart et al., 1963a).

ii) Ecosystematical factors :

Beside these pathways mentioned later, the ammonium-N applied might be submitted to a nonbiological NH_4^+-fixation within the crystal lattice of expanding clay minerals and/or organic matter of soils, viz., soil colloids (Mortland, 1958; Allison, 1966). NH_4 may also be merely dissolved in soil moisture and under alkaline conditions ammoniacal N would be chemically retained in greatest amounts by the organic matter (Mortland, 1958; Overrein, 1972; Dev and Rennie, 1979). Since most productive soils contain a considerable organic matter, besides clay minerals, NH_3 volatilization is thus not likely a major reason of N-loss in such soils (Mortland, 1958).

However, increase in rate of N-fertilizer application would tend to increase N-mineralization of the immobilized N of the fertilizer applied and also enhance mineralization degree of organic matter (Filimonov and Rudelev, 1977), whereby it could be suggested that a somewhat net N-mineralization, throughout the two cases of NO_3 and NH_4^+ fertilizer applied, was likely occurred when the greatest N-rate of 90 mgN was applied.

Also, nitrogen loss via NH_3 volatilization mechanism is considered as an important individual of those problems impairing NH_4^+-N form uptake in soils. However, on the basis of review of the literature, there are some causative factors such as, the alkalinity of both of the irrigation water used (P^H = 7.8 unit) and of the soil investigated (P^H = 8.4 unit) (Vlek and Stumpe, 1978 and Vlek et al., 1981) that besides the other factors which in detail were discussed, formerly, (see page. No.84) effectively embolden such a mechanism.

In a compare with the nitrate case, possiblity of N-denitrification occurring to the applied NH_4^+ - fertilizer would assumably be less.

The urea-$^{15}N_2$ N-source (table "9"):

Dry matter and N-uptake amount:-

As it occurred with the experiment mentioned with the ammounium sulfate, comparably

Table (9) : Yield of dry matter; contents and uptake of nitrogen in plant; and % N-utilization of fertilizer nitrogen applied as urea-$^{15}N_2$ tracer to an alluvial arable clay loam soil under wheat in pots.

Scaned plant parts	Rate of N mg N/kg soil		Dry - matter yield g/pot	N content (%)	N-uptake: Total mg/pot	N-uptake: Total (%)	Derived from fertilizer (dff) mg/pot	Derived from fertilizer (dff) (%)	Derived from soil (dfs) mg/pot	Derived from soil (dfs) (%)	utilization of fertilizer nitrogen (%)	"A—N" value mg N/kg soil
Straw	0		10.815	0.668	72.24	100	--	--	72.24	100	--	-
	30		7.151	0.622	44.48	100	1.20	2.7	43.28	97.3	0.80	-
	60		8.325	0.314	26.14	100	1.88	7.2	24.26	92.8	0.63	-
	90		9.183	0.488	44.81	100	5.20	11.6	39.61	88.4	1.15	-
	L.S.D.	P=0.05	0.153	0.093	2.86	-	0.19	0.22	0.26	0.29	0.17	-
		P=0.01	0.302	0.201	6.24	-	0.40	0.43	0.61	0.67	0.39	-
Spikes (grains)	0		4.483	1.401	62.81	100	--	--	62.81	100	--	-
	30		2.717	1.119	30.40	100	1.31	4.3	29.09	95.7	0.87	-
	60		5.877	1.169	68.70	100	5.36	7.8	63.34	92.2	1.79	-
	90		6.013	1.389	83.52	100	8.10	9.7	75.42	90.3	1.80	-
	L.S.D.	P=0.05	0.106	0.08	5.01	-	0.46	0.50	0.56	0.60	0.36	-
		P=0.01	0.20	0.15	9.82	-	0.98	1.02	1.10	1.23	0.75	-
Straw + grains (above - ground part)	0		15.298	0.883	135.05	100	--	--	135.05	100	--	--
	30		9.869	0.759	074.88	100	02.51	03.40	072.37	96.6	1.70	852
	60		14.202	0.668	094.84	100	07.24	07.60	087.60	92.4	2.40	729
	90		15.195	0.845	128.33	100	13.30	10.40	115.03	89.6	2.97	775
	L.S.D.	P=0.05	0.201	0.082	3.14	-	0.63	0.68	0.70	0.76	0.40	3
		P=0.01	0.397	0.180	6.31	-	1.31	1.39	1.43	1.51	0.82	6

to the blank treatment, no clear response in the yield observedly, was resulted when the urea fertilizer was applied at any N-rate planned. However , compared to the yield caused with the blank treatment, a less yield was remarked particularly at those N-rates of 30 and 60 mg N/kg soil.

Also, compared with the blank treatment, no positive response relating with the uptake of N induced by the application of such fertilizer, was observed. Considerably where as with no previous case presented, the urea did not give any N uptake extent over than that caused with the nonfertilized treatment.

Isotope - Derived Criteria:-

i) Ndff value :-

Noticeably, at all of N-levels of the urea addition, the main bulk of the plant nitrogen which was taken by the plant through the trial was of that of soil origin. Wheren about 90 to 97% of such a plant N was , using the ^{15}N-tracer technique, derived from the indigenous N leaving 3 to 10% that was derived from the N of

the urea fertilizer applied.

In similarity with that observation which was previously noticed in such a soil, applying each of the NO_3 and NH_4^+ fertilizers, the Ndff values caused by adding the urea fertilizer into the soil ascertained that a linear direct proportion was held between the N of the fertilizer N uptaken by the plant and the increased N-amount planned. However, with the Ndff values of the urea, such values indicated, frequently, that there was, inducedly, a linear direct proportion observed, between the N amount uptaken by the plant from the urea and the increased amount of N of the urea added.

ii) N-utilization values:

Notably, as it occurred with the other previous N-sources applied into this alluvial soil, where, a very small fraction of the N that was derived from the N of the urea fertilizer was observedly utilized by the plant, namely, the above-ground part of the plant. Whereas, only between less than 2 to about 3% of the N applied of urea was utilized. Other wise, such N-utilization values assessed confirmed, frequently, that linear direct proportion,which was observed previously in the cases of the NO_3 and NH_4^+ fertilizers, between the N amount of the fertilizer used and the increased amount of the N practiced into such alluvial soil.

iii) A-N values :

Remarkably, as it was observed with the previous other N-sources applied in this alluvial soil, the A-N values induced through applying the urea , support the frequent conclusion of that linear direct proportion between the N used and the increased N added was also observed here. However, tentatively, a linear direct proportion was noted between the amount of the N utilized and that increased amount of the urea fertilizer applied.

It is worthy of note that, in a compare with the three treatments receiving the urea fertilizer with each other, the results show, as it was shown previously in the other cases of the N-sources applied into this soil, that the increased application of the urea led to rise the plant N that was derived from the urea conseq- uently increase the value obtained of the N-utilization and, in turn decrease the value induced of the A-N, assum- ably. However, the amount of N derived from the urea fertilizer which was, isotopically, assessed in the plant receiving the highest N-rate was about five times as much as that was assessed in the plant receiving the lowest N-rate.

Assumable problems embarrassing N-uptake of urea :-

Conclusively, these results obtained indicated frequently to that inference which was deduced afore with the cases of the other N-sources used that this clay loam alluvial soil tested incurred, mainly, from some problems which were possibly of those caused by the adverse conditions of the soil investigated which may be called the "microbio-ecological problems". However, under the increased application using the urea, the amount of N utilized by the above-ground part of the plant, was generally, a very scanty, viz., less than 2-3% . Besides the proportions which were before observed between either the value of the N-utilization or of the A-N and the increased amount of N added, were a linearly direct and reversely one, respectively.

And therefore, it could be diagnosed that the problems which embarrassed the N-uptake by the plant were not mainly of those of physiological plant problems, but were of the microbio-ecological problems. However, if these problems were mainly of those of the physiological plant problems, the proportions, reflected between the values of A-N or of N-utilization and the increased amount of the N applied, into this alluvial soil, would be in contrast with the real observations noticed, namely, a direct linear and a reversely one have to be resulted respectively, as it was observed, formerly throughout the cases of applying the different N-sources into the desert sandy soil, but the real proportions obtained were, indeed, a reversely and a direct linear one respectively.

Thus , as discussed formerly (See Page No.82), such that increased amount of N-which was applied in the desert sandy soil may , physiologocially, decreased uptake of other nutrient elements by the plant from the sandy soil tested ; consequently the gap , or , the disbalancy between the N amount uptaken and the amounts of the nutrients uptaken increased in the plant cell, whereby some physiological disturbance may occur in the cell metabolism processes (Epstein, 1972). In turn, assumably, each of the value of the N-utilization and A-N reflected were, therefore, decreased and increased, respectively, when the N was increasingly applied to the sandy desert soil, and hence the proportions occurred between either the A-N value caused or the N-utilization and the increased amount of N applied would be, therefore as shown, of that of a reversely linear and a directly linear one, respectively.

Furthermore, in a compare among the different N-source applied into this alluvial soil, it might predict, on the basis of those mentioned above, that the N-uptake of the urea practiced was possibly affected by a number of problems which, in general, were presumably the most, while, in the case of N-uptake of calcium nitrate, such a number of problems predicted were the least. Thus , as shown, the N-utilization extent caused by the urea was observedly the least compared to that caused with either the ammonium sulfate or the calcium nitrate which caused the most extent of the N-utilization. In paradox, the A-N value reflected with the urea was,in general, the greatest; whereas it was the least with the case of calcium nitrate. However, the amount of the N uptaken which was derived from the urea was the least, compared to that which was derived from the ammonkum sulfate or the calcium nitrate which caused the greatest value of Ndff. Notably, these assumptions are, indeed, identical to those obtained results.

It is worthy of note that, as shown with each case of the fertilizer N used, such a number of problems suggested could be overcome when the rate of the N applied into such alluvial soil was increased.Therefore, as shown, a linear direct proportion was observed between the N-utilization obtained and the increased amount of N applied, while a reverse proportion was remarked between the A-N value caused and the same increased amount of N applied This, assumbly, confirms the later suggestion that those presumed problems which retarded the N-uptake of the fertilizer N added were mainly of the eco-microbiological problems which belongs, normally, with soil ecology and microbiological conditions.

The N-uptake of the urea, presumably, was affected almost with all of those problems which later affected the N-uptake of both of the other N-sources used plus some specific problems which normally are reflected , when urea to be applied. Where, the urea N-uptake, was possibly, suspended by that problem called "biological immobilization" which, as discussed earlier, affects usually the N-uptake of each of calcium nitrate, applied into such soil (see Page. No. 113° and ammonium sulfate (see page; No. 134). Besides, those problems affect, only, the NH_4^+ fertilizer N-uptake which were named "non-biological immobilization" (See Page.No.137) and ammonia volatilization (See page.No. 84), Furthermore that problem titled "denitrification" assumably, affected such N-uptake of the urea but in a minor extent. Other wise, the results obtained suggested that the urea N-uptake was affected by these difficults in extent a more intensive than that affected the N-uptake of the other N-sources particularly the No_3-N source.

Suggestable problems suspending, specifically, N-uptake of urea :-

On the basis of review of the literature, urea, upon its hydrolysis, serves as an effective alkaline buffer (Hauck, 1968 and Vlek and Stumpe, 1978). However, the alkalinity of fertilizer N may increase the biological NH_4-immobilization (Broadbent and Tyler, 1965). Moreover under such alkaline conditions, ammoniacal N would be chemically adsorbed in greatest amounts by organic matter (Mortland, 1958). Otherwise, in a compare, a relatively strong retention (non-biological NH_4^+ fixation) of urea may be taken place in humus whereas NO_3 would be retained to only a minor extent (Broadbent et al., 1958; Overrein, 1972; Rennie and Rennie, 1973; & Dev and Rennie, 1979). Furthermore, such an ammonia released from urea, upon hydrolysis, in a quantity often would inhibit growth of *Nitrobacter sp.*, whereby there may be a tendency for nitrites to be accumulated particularly in neutral or alkaline soils, in turn this accumulation of NO_2 may produce some injury to plants (Broadbent et al., 1957; Aleem et al., 1957; Tyler and Broadbent, 1960). Moreover, a slow hydrolysis of urea and not volatilization of ammonium, as has been frequently suggested in literature, would be the problem which led to that comparatively high A values and low % Ndff of it (Rennie and Rennie, 1973).

Evaluation of the efficiency of the Different Nitrogen Sources in the Alluvial soil :

Conclusively, the results obtained for each plant part considered of the spikes and the straw using the clay loam alluvial soil pointed out that, using the increased N-rate of each of the different N-sources applied, the 90 mgN/kg soil of the calcium nitrate was the most efficient treatment applied, while the 30 mg N/kg soil of the urea was the least efficient one. On the same hand, the calcium nitrate was the most efficient N-source used, whereas the urea was the least efficient one (See table 10); Also , the 90 mg N/kg soil was the best N-rate practiced, while the 30 mg N/kg soil was the badest one. On the other hand, a direct linearly proportion was, always, observed between either the total dry matter yield or the total N-uptake, i.e., N-yield or the Ndff or the N utilization reflected and the increased N-rate applied, while a reverse linearly proportion was, always, observed between the $A-_N$ value reflected and such increased N-rate applied . Besides , a consistently reverse linearly proportion was , always, remarked between the $A-_N$ value resulted and the N utilization resulted. It is worthy of note that the plant exhibited an evidently preferability to uptake , always , that nitrogen originated from the

Table (10): Comparative efficiency of fertilizer nitrogen of tracer forms; Calcium nitrate-^{15}N, ammonium-^{15}N sulfate, and urea-$^{15}N_2$ applied to wheat the alluvial arable clay loam soil . (means of three rates of 30, 60, and 90 mg N/kg soil).

N-source	Yield of dry matter	Yield of N in plant (N uptake)						utilization of fertilizer N	"A-N" value
		Total		Derived from fertilizer (dff)		Derived from soil (dfs)			
	g/pot	mg/pot	(%)	mg/pot	(%)	mg/pot	(%)	(%)	mg N/kg soil
Calcium nitrate -^{15}N	15.772	141.87	100	18.27	12.9	123.60	87.1	6.10	405
Ammonium-^{15}N sulfate	13.764	91.87	100	8.83	9.6	83.04	90.4	2.94	565
Urea-$^{15}N_2$	13.089	99.35	100	7.68	7.7	91.67	92.3	2.55	719

soil. Where, always as a shown, the amount of nitrogen which was uptaken by the plant from the soil, i.e., Ndfs was extremely much more than that amount of nitrogen uptaken from each N-fertilizer, i.e., Ndff that was added, obviously. Consequently, in a general, the N-utilization value was notably a low, applying each of the N-sources tested.

Owing to the NO_3-N source, as shown, was the more preferable to be uptaken by the plant than that observed in case of the NH_4^+-N fertilizers. Therefore, it could be predicted that the NO_3-N form originated from the soil was likely the most nitrogen form uptaken preferablly by the plant from the soil which, as described formerly, contained each of NO_3-N and NH_4^+-N that was derived from either the soil or from the N-fertilizer added. While, as shown, the least N form of those were uptaken by the plant was quantitatively that NH_4^+-N form which was derived from the NH_4^+-N fertilizers added, particularly that was derived from the urea fertilizer applied.

The calcium nitrate as the most preferable N-carrier used and the 90 mg N/kg soil as the best N-rate applied :

i. Dry matter and N-uptake amount :

With the increased N-rate which was applied for each of N-source applied, in a compare with the blank treatment, the 90 mg/N/kg soil of the calcium nitrate fertilizer was the only exception observed at which the dry matter magnitude yielded was significantly a higher than that magnitude yielded with the blank treatment. Regarding the N-uptake amount yielded, the 90 mg N/kg soil, i.e., the highest N-rate planned of each of the calcium nitrate andthe ammonium sulfate, also, could produce a higher magnitude than that produced with the blank treatment, where the magnitude yielded in presence of the calcium nitrate was more than yielded in presence of the ammonium sulfate (Figs. 8,9).

ii. Isotope - derived criteria induced :

With the increased N-rate which was applied for each N-source used, the highest extent reflected of each of the Ndff and N-utilization was that extent which was reflected when the 90 mg N/kg soil of the calcium nitrate was applied into such soil, whether considering the spikes part or the straw. While, the lowest magnitude of the A_{-N} value was also remarkable with applying such treatment, considerably.

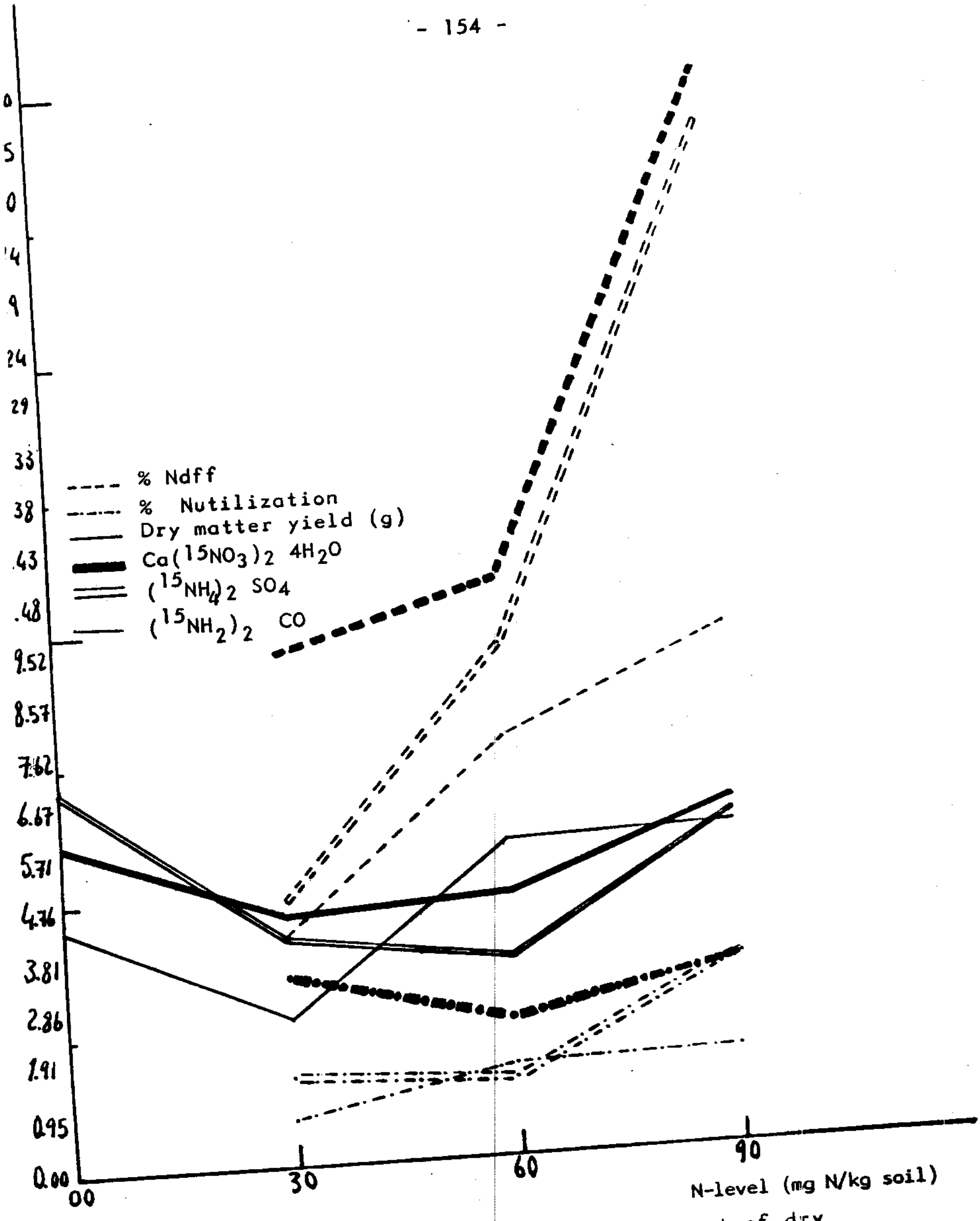

Fig. (8) : Percent of Ndff, N-utilization, and amount of dry matter yield assessed in the spikes of wheat supplied with ^{15}N-labelled source to the alluvial arable clay loam soil.

Superiority of the calcium nitrate and the inferiority of urea as an applicable N-source (Table 10)/.

Using the mean of each of the appreciatively values resulted of the three different N-rates used of each N-source applied, the data, showed apparently the superiority of the calcium nitrate and the inferiority of the urea. Where, the highest extent of each of the dry matter yielded or the N-uptake yielded or the Ndff or the N utilization value reflected was occurred when the calcium nitrate fertilizer was used, while the lowest extent of each of these values refelected was occurred using the urea fertilizer .Furthermore, applying the calcium nitrate, the highest value of $A-_N$ was induced, whereas the lowest value of $A-_N$ was observed when the urea was employed (Fig. 10).

Supremacy of the N-rate of 90 mg N/kg soil comparatively to the other N-rates applied :

Considering the results caused applying the increased N-rate for each N -spurse used, the 90 mg N/Kg soil was frequently the supreme N-rate applied comparing with each of 60 or 30 mg N/kg soil, tangiblly . Where applying the 90 mg N/kg soil of each of N-source employed , the value of each of the dry matter yielded or the N-uptake or the Ndff or the N utilization was a higher than that value caused applying either the 30 or the 60 mg N/kg soil. While, a higher $A-_N$ value was reflected when the 30 or the 60 mg N/kg soil was practiced comparatively to that value of $A-_N$ caused practicing the 90 mg N/kg soil.

The direct and inverse linearly proportions recognized:

Noticeably, applying the increased N-rate for each N-source employed, there was, always, a direct linearly proportion recognized between each of the dry matter quantity yielded, the N-uptake, the Ndff, and the N utilization reflected and the increased N-rate applied, while an inverse linearly proportion was, always, recognized between the $A-_N$ value reflected and the increased N-rate applied. Where, an obvious inverse linearly proportion, specifically, was being recognized between the $A-_N$ value reflected and the N-utilization reflected.

Consequently, it could be recommended that, with the conditions under which the experiment was conducted, the higher N-rate, i.e., 90 mg N/Kg soil seemed a more useful N-rate used, for attain a higher yield than that seemed with a lower N-rates, i.e.,30 or 60 mg N/kg soil used.

Conclusively, it could be diagnosed the following:

i) The N-uptake occurred by the plant, in such alluvial soil, was in somewhat affected by influence of some difficults, suggestly. However, (a) applying the increased N-rate for each N-source employed, the total dry weight yielded, except using 90 mg N/kg soil of the calcium nitrate, was being frequently a lower than that yielded with the blank treatment, observedly . (B) also, the total N-uptake yielded, except using 90 mg N/kg soil of each of the calcium nitrate and the ammonium sulfate, was being a lower than that yielded with the blank treatment. (c) Both of the Ndff value and N-utilization were rather a low.

ii) These difficults were primarily of those to be relevant with the soil which were called "microbio-ecological problems" (Pags. No. 88,113, and 134), assumably. Since, a) with each N-source applied, was being obviously, a direct linearly proportion remarked between the N-utilization reflected and such that increased N-rate applied, observedly. However, comparatively to the case of applying such that increased N-rate in the sandy desert soil and when these assumed difficults were primarily of those to be relevant with the plant physiology reasons which were called "physiological difficults" (Pags. No. 82 and 88), the proportion reflected, in that cases, between N-utilization and

such increased N-rate was a reverse linearly.
b) besides, there was being an ascending increase (returns) noticed between the value of Ndff caused and such that (returns) was being noticed, in the case of the sandy desert soil,between the Ndff value caused and such that increased N-rate applied. () with the increased rate of N-application of each N-source used in such alluvial soil, the Ndff and N-utilization value caused were being increased linearly, while Ndfs and A_{-N} value caused were being decreased linearly, or, a wider ratio of Ndfs : Ndff was being recognized when the lower N-rate was used while such ratio was being a narrower (in favour of N uptaken from the fertilizer) applying the higher N-rate used, with which, observedly, the A_{-N} value calculated was being lower than that A_{-N} value calculated with the lower N-rate applied.

iii) These difficults might affect uptake of the available nitrogen either that was derived from the soil or the other that was derived from the fertilizer, presumably Scince, a) the ratio of Ndfs : Ndff was being a narrower,as remarked in the case of the alluvial soil, than that was recognized with the case of the sandy soil. b) the A_{-N} value reflected using the alluvial heavy soil was being,however in a quantity, a much more than that value reflected using the desert sandy soil.

iv) Biological immobilization was probably a substantial constitutent of such micro-ecological problems. Since, a) the total dry weight or the N-uptake, i.e., N-yield yielded, except applying the 90 mg N/Kg soil of each of the calcium nitrate and the ammonium sulfate respectively, being under than that magnitude yielded with the blank treatment , when applying the increased N-rate for each N-source used. b) Each value of the total dry weight, N-uptake yielded, the Ndff, and the N-utilization reflected when applying the 60 mg N/kg soil for each N-source employed was, noticeably in extent, close to that value reflected upon applying the 30 mg N/kg soil for each N-source employed, observedly. However, with increase of mineral N added into soils there is usually an increase in amount of N obtained, namely, N-uptake, Ndff and N utilization obtained in a harvested crop and, also, an increase in N-immobilization of the added N amount was observed in soil (Walker et al., 1956; Walunjkar et al., 1959; Jansson, 1958; Legg and Allison, 1959; 1961; Cady and Bartholomew 1960 (a);Legg 1962; and Stewart et al.,1963 (b). c) the dry matter or the N-uptake or the Ndff or the N utilization reflected, applying the 90 mg N/kg soil of each N-carrier used, gave a higher extent than that reflected applying either the 30 or 60 mg N/kg soil, whereby it could be suggested that beside the N requirements of the plant, there was another N requirement needed by the soil microflora. Where , the highest N-rate, i.e., 90 mg N/kg soil, specifically in the case of calcium nitrate , seemed enough to cover such two N-requirements needed, while the other two N-rates did not seem as so, suggestly. d) regarding with the conditions under which the experiment was executed, it could be concluded that such soil seemed to be a fertile enough (See table "1"). Where it was characterized with a rather wide C:N ratio, viz., 23:1, a relatively high content of organic matter, i.e., 3.75 %, a high content of the total native N, i.e. , 0.104 %, or, 1040 mg N/kg soil , and a somewhat high pH value (8.4 unit), beside the alkalinity (pH 7.8 unit) of the irrigation water used, thereby optimal conditions would be furnished in such heavy alluvial soil for a heavy biological immobilization activity.

Considerably, the other microbio-ecological problems and the biological N-immobilization of each N-fertilizer applied into such heavy alluvial soil were in details, discussed previously.

Ultimately, from such this diagnosis, it could be concluded that although this heavy alluvial soil was a fertile enough, still it likely incurred some problems, whereby the dry matter yield and the magnitude of the available N uptaken from either the soil N or the fertilizer N were affected.

Assumable resemblancy between the results reflected applying the increased N-rate and Liebig assumption :

Assumably, the presumed soil problems, i.e., the eco-micrological problems discussed later were likely the responsible cause which might conduce to interpret the occurrence of that discernible direct linearly proportion which was remarked between each of the total dry weight, total N-uptake, Ndff, and N utilization reflected and the increased N-rate of each N-source practiced into such heavy alluvial soil. Noticeably, this direct linearly proportion reflected is a resemble to the trend which was brought by Liebig results (1829) that is entitled with "the limiting factor law of Liebig".

However,in a complicance with the Bray interpretation, it could be assumed that the nitrogen considered in such soil was probably the limiting factor of the N-uptake concomitantly with growth of the plant. Presumbly, the soil problems called the eco-micrological problems may retard mobility or kinetics of the nitrogen element in such heavy soil, particularly the urea-N which brough, however, the most plainely linear proportions observed comparatively to the other brough by NH_4^+-N or NO_3-N which gave relatively the lowest, besides they may reduce the N content in the soil. Therefore, under such conditions, the available N content becomes in a minor content to that which is normally demanded by the plant growth. And hence' the N element becomes the limiting factor of the plant growth. Whereby any addition of the N element, under such conditions, would give a direct linear response of the plant growth. Thus, when applying the increased N-rate of each N-fertilizer practiced into such soil,the direct linear proportion which was observed between the total dry weight or the total N-uptake or the Ndff or the N-utilization reflected and the increased N-rate applied was, present (Figs. 8,9), as inference. Consequently , it could be assumed that the trend of the results obtained resembles, or , follows the trend that is called "limiting factor of Liebig assumption".

It also could be predicted that the soil which was used by Liebig was probably underwent some problems which could , in turn, affect negatively mobility or/and content of the nutrient element investigated by him , whereby the trend of the results of his law resembles the trend of the results of such present experiment carried out.

Plant distinct preferability, or, performance to uptake of nitrogen originated from the soil and the tangible low N-utilization reflected upon applying each N-source:

When applying the increased N-rate of each N-source used in such alluvial soil, the nitrogen extent uptaken by the plant which was originated from the soil, i;e., Ndfs, always , was a supremely much more than that nitrogen extent uptaken by the plant which was derived from the N-fertilizer applied , i.e., Ndff, evidently. Consequently, the N-utilization reflected, was comprehensively, a tangibilly low in extent, observedly,while $A\text{-}_N$ value reflected was in general, discernibilly a high.

This may be attributed, however, to that enough fertility seemed of such alluvial soil used (Table 1) . However, the soil contained, evidently, an enough magnitudes of each of the organic matter, viz., 3.75% and the total N determined, viz., 0.104 %, thereby the available nitrogen presented natively in the soil used was likely furnished in an adequatly content for the plant N-requirements. Otherwise, the fertilizer N added was probably diluted deeply with such significant native soil N content, viz., N pool determined . Considerably, that low extent of N-utilization caused, may also be referred to unknown relation between time of emergence of soil N and the time within which crop requizement of nitrogen depending on different growth stages, where the partial efficiency of absorbed N may differ at these different growth stages of crop (Nishigaki, 1970). Presumably, the nitrogen of each source added was possibly underwent some problems, with which the fertilizer N was deeply lost (Pags. No. 84,90,113,133 and 143). On the same hand, Bartholomew,(1971) stated that the important and the ultimate objective of all this reasrch on nitrogen is better use of nitrogen resource in crop production. To achieve such an objective we must first understand crop needs for nitrogen and the natural processes which influence and/or control availability of the nitrogen to crop plants. When we understand the availability and use process then we can begin to exercise a measure of control over these processes. Considerably, such this low N-tilization extent observed, resembles , approximately, that extent obtained in

Tunisia by Kick,(1980), Conclusively, Bartholomew,(1971) stated that the important challenge to present day agronomists is to devise ways of inducing and/or permitting the plant to make a much greater use of the available nitrogen added into the soil. Suggestly, the Fertilizer-N added was likely retained into the organic matter content and crystal latice of the clay fraction, especially the NH_4 N fertilizer, which were in a highly content (see table "1").

In a commentary, owing to such obvious preference or, performance of the plant to uptake, always, that nitrogen orginated from the soil, as shown tentatively,where always, the extent of the nitrogen uptaken by the plant which was derived from the soil, i.e., Ndfs was, recognizablly, a supremely a much greater than that extent of the nitrogen uptaken by the plant which was derived from each N-source applied, i.e., Ndff. Whereby it could be appreciated that organic matter and clay and silt fractions furnished naturally, as it was habituated at Misser (Egypt) before the time of the high dam construction, are also, as did comment with the case of the sandy desert soil previously, vital elements, as inference, for development the fertility of such alluvial arable soil. However, if such soil will be somehow again supplied with such natural organic matter and clay and silt fractions. Expectantly, the total nitrogen uptaken and the plant growth would be enhanced.

Evaluation of the Efficiency of the Different Nitrogen Sources in the Two Soils :

It is worthy of note that considering each part of the spikes or the straw of the plants grown on the alluvial arable clay loam soil which was respectively treated with the various N-rates of each of the different N-source applied, the eventually ultimate results obtained exhibited,a recognizablly preference, or, performance of the plant to uptake, always in a supreme amount the nitrogen of that was naturally originated from the soil, viz., the native N, while in case of using the sandy virgin desert soil the opposite was the true. The N-utilization extent reflected in both soils used was, comprehensively, a relatively low. Always, a direct linearly proportion was recognized between the Ndff extent reflected and the increased N-rate applied of each of the N-source added into each soil used, while an inversely linearly proportion was recognized between the Ndfs extent reflected and the increased N-rate applied. The phenomenon of "nitrogen mobility" in the plant was consistently recognized throughout the results obtained of the three experiments consummated. Besides such obvious preference , or, ability of the plant to uptake always the nitrogen naturally derived from the soil, which was a constant pattern over the results obtained using the alluvial soils. The preference of the plant to uptake,always, the NO_3-N relatively to the NH_4^+-N was also definitely recognized as another constant pattern which was held over the results obtained by the three attempts conducted. Subsequently,it could be assumed that NO_3-N originated naturally from the soil was likely the most nitrogen form uptaken from the alluvial one,while the NH_4^+-N derived from the N-fertilizer was the least form uptaken,particularly that NH_4^+-N which was derived from the urea fertilizer applied. Eventually,over the three trials executed,the calcium nitrate was consistently, always, the superior N-source, followed by the ammonium sulfate, whereas the urea was the inferior one. A reversely proportion was, obviously, remarked always between the dry matter or the N-uptake, i.e.,N-yield or the Ndff or the N-utilization value reflected and the $A-_N$ value reflected. Frequently,a reversely proportion was recognized between N concentration,i.e.,N content % reflected in the considered plant tissue and efficiency of the N-resource applied, that possibly be called "nitrogen dilution effect";whereas a direct proportion was always recognized between extent of each of the plant total dry matter or the plant N-uptake (N-yield) or the Ndff value reflected in the plant or the N utilization reflected in the plant and efficiency of the N-source applied. Considerably, a direct proportion abviously was always recognized between the N-yield,i.e., N-uptake or particularly the total dry matter, i.e., yield magnitude yielded and the N-utilization extent reflected.

In a compare between the two soils used, generally, the plan of the increased N-rate which was applied was undoubtly not useful in the case of sandy desert soil, while it was clearly useful in the case of the alluvial one. Where,the 30 mgN/kg soil was, definitely,the best N-rate practiced in the sandy desert soil, whereas the 90 mgN/kg soil was the best N-rate practiced in the alluvial soil. Considerably, the NO_3-N form was, as discussed later, preferablly uptaken in a much more extent than that NH_4^+-N form was done in both soils, noticeably. The calcium nitrate observedly was , however, the most efficient

N-source applied into both soils, followed by the ammonium sulfate,then the urea which was the least efficient N-source applied. Conclusively,the 30 mgN/kg soil of the calcium nitrate,in the sandy desert soil was, demonstratively,the best treatment applied to attain the highest N-uptake and plant growth magnitudes while the 90 mgN/kg soil of the urea, in the sandy desert soil, was the least treatment applied. However, in the alluvial soil,the 90 mgN/kg soil of the calcium nitrate was the best treatment applied, while the 30 mgN/kg soil of the urea was, noticeably, the least treatment applied. Although, generally, greater yielded magnitudes of the total matter yielded and the total N-uptake, i.e., N yield (Ndfs plus Ndff included in the plant tissue) yielded were, remarkably, reflected when the alluvial soil was used; nevertheless , generally, a greater extent of the fertilizer N applied was demonstratively uptaken when the virgin sandy soil was used. However , with each N-source applied, magnitude of either the total dry matter or the total N-uptake yielded , using the alluvial soil, was exaggeratively greater than that,yielded using the virgin desert sandy soil. Whereas, using the sandy virgin desert soil , either value of the Ndff or N utilization reflected was definitely greater than that value reflected using the alluvial soil, besides, the A-N value reflected, using the clay loam alluvial soil, was excessively much greater than that value reflected using the sandy virgin desert soil (See Fig. 9).

Preference,or,efficiency of the plant to uptake the nitrogen originated fromm the soil and the low N-utilization reflected :

When applying any N-rate practiced of any N-source added into the alluvial soil used and considering any part of the plant, the nitrogen extent uptaken which was derived from the soil used, i.e. Ndfs, was,always, exceedingly, a much greater than that extent of the nitrogen uptaken which was derived from the fertilizer applied, i.e.,Ndff,recognizably. Assumably, this may be referred to unknown related between time of emergence of soil N and the time through which crop requirement for nitrogen depending on different growth stages, where the partial efficiency of absorbed N may differ at these different growth stages of the crop (Nishigaki, 1970). On the same hand, Bartholomew, (1971) stated that to attain a better use of nitrogen resource in crop production,one must first understand crop needs for nitrogen and the natural processes which influence and/or control availability of the nitrogen to crop plants. Otherwise, the fertilizer-N added, into the alluvial soil, was likely retained by that highly content of the appreciated organic matter and crystal latice of the clay fraction (table 1); besides it might be more susceptible to belost by the eco-biological problems, mentioned formerly, than N originated natively from the soil.

Predictively, uptake of fertilizer N may be depended on a relativity that to be held among content of available native, N.,i.e., available soil N present in soil and contents of other essential available nutrient elements, especially contents of those nutrients entitled "macro - nutrients" present in soil used. However, depending on plant needs for the other nutrients and nitrogen which also may depend on a plant short and stage of plant growth, if such content of the available native N is balanced, or or rather less, relatively to the contents of the other available nutrients. With this instance, the fertilizer N application , assumably, have predictly to be zero, or in a minor extent. Suggestly, the balance among total available N content (Ndfs plus Ndff included) and the contents of the other available nutrients would be thus kept, or rendered (reformed) again, the relatively, or, formulation of the nutrient elements present in the soil which, in this case, would proporely cover whole nutrients needs for the plant growth, as shown in the case of using the virgin desert sandy soil. Where , under such conditions, if an excessive fertilizer N is added, to such soil, an out of balance , suggestly, would be occurred with which the absorption of the other nutrients would be retarded in turn each of N-uptake and plant growth extent yielded would be indirectly retarded (Epstein, 1972). Thus, in the case of the virgin desert sandy soil, when the increased N-rate was applied, namely, 40,60, and 90 mgN/kg soil and using the different N-resources applied, the ranged magnitudes of the total dry matter reflected were approximately 3.4-4.6, 1.8-3.6, and 1.0-1.9 g/pot respectively; the ranged magnitudes of the total N-uptake were 41.6-46.9, 23.3-56, and 16.1-23.9 mgN/pot respectively; and the ranged extents of the N utilization resulted were 14-19, 5-14 and 2-4.3% respectively. While with the proposed instance, when the content of available N present in soil is deeply under the content should be present to cause the balancy proposed; the application of the fertilizer-N proposed, thus, have to be, assumably, added in a highly addition up to that extent with which the formulation,or, the relativity of whole available nutrients, implicating available N nutrient, may be reformed once again in such soil, as shown in the case of using the alluvial clay loam soil. Thus, when the increased N-rate, namely, 30,60,and mg N/kg soil of the three diffeerent N-resources was applied into the alluvial clay loam soil, the range magnitudes of the total dry matter reflected were 9.9-13.9,10.9-14.9 and 15.2-20.6 g/pot respectively; the ranged magnitudes of the total N-uptake resulted were 74.9-85.9, 66.3-138.5, and 128.3-201.2 mgN/pot respectively, and the ranged extents of the N utilization resulted were 1.7-3.7 - 3.7, 1.8-3.6, and 3-8.6% respectively.

Eventually, it could be induced that although the sandy virgin desert soil was difficient in contents of all the nutrient elements, owing to the difficiency observed in the soil in each content of the organic matter and the clay fraction contained, see table (1), nevertheless content of the available native N present in the soil was suggestly, close to that proposed content of the native available N which, presumably, have to be present to cause the balance proposed. Thereby the relativity among content of the available native N and contents of the other available native nutients would be balanced up, namely , the formulation held among content of the available native N and contents of the other available native nuttients seemed nearly balanced up. Therefore, the lowest N-rate applied, brought out, the highest extents of the results obtained. While, in instance of the alluvial clay loam soil, the relativity held in such soil, was probably unbalanced up deeply, whereby the highest N-rate applied, brought out the highest extents of the results obtained.

Suggestly, such deep unbalance assumed using the alluvial soil may be referred to those problems suggested previously, pags. No. 84, 90, 113, 134, and 143 which retards deeply the nitrogen mobility (kinetics) and

N-uptake by the plant in such soil. Whereby,assumably, dontent of available native N relatively to the contents of the other available nutrients present in such soil was deeply less than that proposed pattern of available N content that have to be contained in the soil, under such conditions, to keep the formulation,namely, the relativity among content of the native available N and the contents of the other available nutrients to be balanced up.

Although such soil seemed, according to their total contents of essential nutrients elements contained in the soil, enough fertile; nevertheless owing to content of the available N nutrient was likely affected negatively by those problems impairing available nutrient N content in such soil thus an out of balance was probably accentuated among content ofthe available N and the other essential nutrient elements present in such soil. Thereby the higher N-rates applied could, assumably, over come successfully such these problems and gave always higher results than those were given when the lower N-rates were applied into such soil. Whereby a direct linear proportion therefore , was , always observed between the increased N-rate of each N-source applied into such soil and either the total dry matter reflected or the total N-uptake or the Ndff or the N-utilization reflected. Therefore, a constant trend, viz., a direct linear proportion was always kept when the increased N-rate of each N-resource was applied into such soil (Fig. 9). Considerably, such this trend obtained was similar to that trend entitled "limiting factor law" obtained by Liebig (1829).

In case of the sandy virgin desert soil, a although the soil seemed not fertile enough (Table 1), relatively to that enough fertility observed in case of the alluvial one, still, presumably, its content of available N nutrient was rather less than that proposed content of available N at which relativity of formulation occurred in such soil among available N content and contents of other essential nutrients would be balanced up, namely predicted disbalancy in such soil was assumably limited. Thereby, the lower N-rates of each N-fertilizer applied gave always, higher results than those were given when the higher N-rates were applied. Where the lowest N-rate gave the highest results as shown in Fig. 9 , and the higher N-rates gave always lower results than those were given when the lower N-rates were applied, where the highest N-rate gave the lowest results as shown in Fig. 9, where, suggestly before applying the fertilizer-N, proposed slight gap occurred, assumably, among available N content and contents of the other nutrient; which in this instance would be in favour of contents of the other nutrients; would be presumably a more wide that when the higher N-rate of each N-fertilizer was applied into such soil. Whereby, assumably, proposed ratio between the available N content and the contents of the other nutrients would be in favour of the content of available N nutrient. Assumably, in the case of applying the highest N-rate of each N-source applied, widest gap would be occurred, in favour of content of the available N. Thereby, according to Epstein,1972, the most effect for retarding absorption of the other nutrients contained in the soil in turn the most effect for retarding uptake of N yielded and plant growth would be, consequently, occurred,when the highest N-rate of each N-fertilizer was applied. Therefore, applying the increased N-rate of each N-source into such soil, a constant pattern of a reverse proportion was always remarked between the increased N-rate applied and either the total dry matter or the total N-uptake or the N-utilization reflected,and hence a constant diminshing trend, even when considering the Ndff values reflected, was always observed, which is similar to that trend entitled "diminishing returns law" obtained by Mitscherlich (1909).

Direct proportion recognized between the Ndff values reflected and the increased N-rate of each N-resources applied into both soils :

Recognizably, when the increased N-rate of each N-resource applied into either the sandy desert virgin soil or the alluvial soil was practiced, a constant pattern of a direct proportion between the Ndff value reflected and the increased N-rate applied was apparently recognized. Considerably,in case of the sandy virigin desert soil, such a direct proportion induced was remarkably of that may be called "diminishing direct proportion" , still such a direct proportion observed, in case of the alluvial soil, was of that may be called "linear direct proportion", namely, the direct proportion observed in case of the alluvial soil was much more linear than that direct proportion observed in case of the virgin desert sandy soil used, remarkably. Where, in the case of the sandy desert soil, ranged values of the Ndff reflected using the increased N-rate of 30,60,90 mg N/kg soil of the different N-resources applied were 50.6-68.3, i.e., 21.1-28.5; 66.2-75.9, i.e., 15.4-42.7; and 65.2-80.2%, i.e. 12.1-19.2 mg N/pot respectively; whereas, in the case of the alluvial soil, were 3.4-6.5, i.e., 2.5-5.6; 7.6-8.0, i.e., 7.2-5.3; and 10.4-19.2%, i.e., 13.3-38.6 mg N/Pot respectively, Evidently. This may be attributed, assumably, to that increased unbalance occurred among content of available N nutrient and contents of other available essential nutrients contained in the soil, which in detail was discussed later see Page. No. 102, which was likely being accentuated in favour of content of N nutrient when the increased N-rate was applied into the sandy virgin desert soil. Consequently, according to Epstein (1972), a decreasingly uptake of the other essential nutrients was probably being occurred; in turn the uptake of the fertilizer N applied, i.e., Ndff was therefore, as observed, in a diminishingly direct proportion with such increased N-rate applied. While, before applying such increased N-rate into the alluvial soil, unbalance, assumably, might be occurred in such soil, Page No. 173, in favour of contents of other essential untrients. Still applying such increased N-rate, such proposed unbalance occurred would assumably being adiminished untill state of balancy up agein, in favour in content of available N nutrient present in such soil. However, presumably, available content of nutrient N contained in the soil before applying the increased N-rate applied, which was assumably extenuated by problems, see page.No. 174, specially those of soil problems named "micro-ecological problems" which were likely compensated progressively when such increased N-rate was applied. Consequently, the Ndff values reflected were also, therefore, in a linearly direct proportion with the increased N-rate applied.

Nitrogen mobility in the plant as a phenomenon recognized using both soils :-

Demonstratively,over the results obtained throughout the three attempts executed using either the sandy virgin desert soil or the alluvial clay loam soil,nitrogen mobility in the plant was recognized obviously. However, in attempt of balance sheet of the fertilizer N applied using the virgin sandy desert soil, each of the three fertilizers range values of the N concentration,i.e., N content % (4.2-3.1), the total N-uptake,i.e., N-yield mgN/Pot (4.9-3.8), the Ndff%(58-45), and the N utilization % (3.2 - 2.1) appreciated in the above - ground part, i.e.,shoots of the plant was always higher broadly than range values of N concentration % (2.5-1.9), the total N-uptake mgN/pot (1.3-0.92), the Ndff% (44.5-31.2), and the N utilization % (0.6-0.3) appreciated in the under-ground part, i.e., roots of the plant, observedly. On the same hand; in case of the alluvial soil used and regarding, for example, the most efficient N-rate applied in such soil, viz., 90 mgN/kg soil; each range value of the three fertilizers added of the N concentration , i.e., content % (1.4-1.2), the total N-uptake, i.e., N-yield mgN/pot (85.6-79.4), the Ndff % (20-9.7) and the N utilization % (3.6-1.8) appreciated in the spikes part of the plant was dominantly higher than the range value of the N concentration % (0.9-0.5), the total N-uptake mgN/pot (121-45), the Ndff % (18.8-3.5), and the N-utilization % (5-0.4) appreciated in the straw part of the plant tested.

Preference of the plant to uptake the NO_3^--N and the ascendancy of calcium nitrate recognized in both soils:

Observedly, whether the sandy virgin desert soil or the alluvial clay loam soil used , the calcium nitrate was consistently the ascendant N-source applied, followed by the ammonium sulfate then the urea which was the descendant one. However; regarding the mean values obtained using the sandy desert soil, table (6) , or the alluvial soil , table (10) ; the calcium nitrate, in both soils, observedly brought out the highest extents of the yield of dry matter, the total N-uptake, the Ndff, and the N-utilization reflected comparing to those brought out by either the ammonium sulfate or the urea which brought out the lowest extents reflected. Where, the plants treated with the calcium nitrate gave yields of dry matter of 3.3 and 15.8 g/pot;totals of N uptakes; i.e., yields of N of 40.7 and 141.9 mg N/pot; values of Ndff of 74.2%, i.e., 30.1 mgN/pot and 12.9%, i.e., 18.3 mg N/pot; and N utilization of 10.1 and 6.1% of each of the virgin sandy desert soil and the alluvial clay loam soil respectively. Whereas, the plants treated with the ammonium sulfate gave yields of 2.9 and 13.8% g/pot, totals of N-u take of 38.5 and 91.9 mg N/pot; values of Ndff of 64.8%, i.e., 24.9%mg N/pot and 9.6% ; i.e., 8.8 mg N/pot and N utilization of 8.3 and 2.9% of each of the virgin sandy desert soil and the clay loam alluvial soil respectively. While, the lowest values resulted either in the sandy virgin desert soil or the alluvial soil;were being brought out with those plants treated with the urea fertilizer.

On the basis of review of the literatures, this may be due to preference of the plant to uptake the NO_3-N applied, owing substantially to those plant physiological factors pointed out for the influence of pH value of medium used (Epstein, 1972), the various impairments occurred when only ammonium ions furish nitrogen (Barker et al. , 1966; Street and Sheat 1958), the impairment of chloroplasts structure under conditions of ammonium toxicity (Puritch and Barker, 1967), and the great demand for carbon skeletons when ammonium ions to be absorbed because of immediately synthesis of amino acids and other compounds containing reduced nitrogen (Epstein, 1972), see pag. No. 82 , besides those micro-ecological problems affected performance of NH_4^+-N sources applied to soils, Pags.No. 84,133,143 and 148.

Reversely proportion remarked between the value reflected of the yield or the Ndff or specially the N utilization and the A_{-N} value reflected :

$$A_{-N} \text{ value} = \frac{\%\ \text{Ndfs}}{\%\ \text{Ndff}} \times \text{ rate of N}$$

fertilizer application (mg N/kg soil), see pag. No. therefore, when extent of fertilizer N uptaken by plant, i.e. Ndff is relatively more than that extent of soil N uptaken by plant, i.e., Ndfs, in a sequent, N-utilization value induced would be relatively high, because of % utilization of applied fertilizer N =

$$\frac{\%\text{Ndff X yield of N in plant, i.e., N-uptake (mg/pot)}}{\text{Rate of fertilizer N application (mg/kg soil)}} .$$

see pag. No. 18 . Subsequently, in such this case according to the A_{-N} value formula mentioned above , the $A-_N$ value induced would be relatively low and vica versa, suggestly. Whereas, in such this case, each of extent of yield and N-yield, i.e., N-uptake induced would be relatively high, as well. Where , for example, regarding the experiment of balance sheet of fertilizer N of the different fertilizers applied, observedly, each of extent of the total dry matter, the N-yield, i.e., N-uptake, the Ndff, and the N-utilization reflected when the calcium nitrate was applied were 218.9 mg/pot, 6.19 mg N/pot, 55.41% and 3.8 successively, whereas the A-N value reflected was 72 ppm. While, when the urea fertilizer was applied, 135.7 mg/pot, 5 mg N/pot 42.7 %, and 2.4% were successively reflected, whereas the $A-_N$ value reflected was 121 ppm.

Reversely proportion observed between the nitrogen concentration determined in the plant tissue and the efficient use of the fertilizer N applied :

A reversely proportion, over the results obtained of the three experiments conducted particularly those which were conducted using the virgin desert sandy soil, was observed between each extent of the total dry matter, the total N-uptake, the Ndff, and the N-utilization reflected in both soil specially in case of using the virgin desert sandy soil. However, regarding the experiment of fertilizer N balance sheet of the three fertilizer practiced , the N concentration percent, determined in tissue of the above ground part of the plant when applying the calcium nitrate, was 3.1; each extent of the total dry matter, the total N-uptake,i.e. N-ield, the Ndff, and the N utilization reflected of such part of the plant were successively 159.3 mg/pot, 4.9 mg N/pot, 58.2%, and 3.2%. Whereas, applying the ammonium sulfate and regarding the same part of the plant , the N concentration percent was 3.3, the other extents reflected were 116 mg/pot, 3.8 mg N/pot 55.9%, and 2.4% successively. Upon applying the urea and regarding the same plant part , the N concentration percent was 4.2, the other extents reflected were successively 98.4 mg/pot, 4.1 mgN/pot, 45% , and 2.1 %. Furthermore, applying the increased N-rate of the three fertilizers applied into the virgin desert sandy soil, the lowest N concentration percent was occurred when the most efficient N-rate of the fertilizer added was applied and vica versa. For example, when applying the 30 mgN/kg soil of calcium nitrate, which gave the highest extents of each of the dry matter, the N-uptake, the Ndff and the N utilization, the percent of N concentration was 1.2, whereas with the 90 mgN/kg soil of calcium nitrate, which gave the lowest results, the precent of N concentration induced was 1.3, observedly. Moreover, in such same experiment, when the most efficient N-source applied, which gave the highest extents resulted of dry matter, N-uptake, Ndff, and N utilization, was used the lowest N concentration percent was observed and vica versa. Where; using the calcium nitrate, for example, at 30 mgN/kg soil; the percent of N concentration reflected was 0.9, while the percent of N concentration was 1.2 when the urea, viz., the least efficient N-source applied at the same rate was applied, observedly.

Noticeably, such observation of the reversely proportion between the percent of nitrogen concentration determined in the plant tissue and the efficient use of the fertilizer N applied was in the case of using the virgin desert sandy soil more apparent than that appeared using the alluvial clay loam soil.

This was likely due to that deficit of the soil in the soil N, see table (1), because of that lack of both of the organic matter and clay fraction contained in the virgin desert sandy soil. Whereby the total N-uptake of the plant was mainly deliveredfrom that of fertilizer N source , as demonstrated with the results obtained. Consequently, the efficient use of the fertilizer N applied in such soil would furnish best results, as inference. Considering that, as shown by the results obtained,the lowest N concentration percent was observedly resulted when the best treatment, in such soil, of 30 mg N/kg soil of calcium nitrate; which realized the highest result obtained of each of the dry matter, the total N-uptake, i.e., N-yield, the Ndff, and the N-utilization, was applied. While, the highest N concentration percent was observedly resulted when the inferior treatment, in such soil, of 90 mgN/kg soil of urea; which realized the lowest results obtained for each of the dry matter, the total N-uptake, the Ndff, and the N-utilization ;

was applied. Furthermore, the lowest N concentration percents were remarkably resulted when the best N-rate in such soil, of 30 mg N/kg soil, which realized the highest results obtained relatively to those realized with the other N-rates applied, of the three N-sources used was practiced; whereas the highest N concentration percents were remarkably resulted when the inferior N - rate of 90 mgN/kg soil was practiced, observedly. Moreover, the lowest N concentration percents were usually resulted when the most efficient N-source,i.e., the calcium nitrate was, observedly, applied, whereas the highest N concentration percents were usually resulted when the least efficient N-source,i.e., the urea was applied.

Assumably, the reversely proportion observed, in both soils, between the N concentration determined in the plant tissue and the efficient use of the fertilizer N applied may be attributed to that may be called "nitrogen dilution effect". However, presumably, the highest plant growth, i.e., volume would be occurred when all essential nutrient elements are uptaken from the soil in enough quantities and in a balance qualities. Consequently, nitrogen concentration, in such conditions assumed, would be, relatively to the other possible conditions, the lowest in the plant tissue , namely, the nitrogen nutrient element would be diluted in the plant tissue till to the highest degree, suggestly. Therefore, when the efficient fertilizer N use was managed into the soil, consequently the whole essential nutients would be uptaken in enough quantities and in a balance qualities, whereby the highest extents of each of the dry matter, the N-uptake, the Ndff, and N-utilization would be occurred, assumadly. Subsequently, the lowest N concentration percent,or, the highest degree of nitrogen dilution would be remarkeds inducively, and vica versa.

Recognizable comparative aspects betwéen both soils used:

Noticeably, the results obtained of the three experiments conducted revealed recognizably aspects of difference in the result items reflected of both soils used. However, discernible differences of each of

the total dry matter, the total N-uptake, the Ndff, the N utilization, and the $A-_N$ value reflected were apparently recognized.

Total dry matter and total N-uptake

In a compare between the two soils used, the virgin desert sandy soil gave recognizably lower magnitudes of each of the total dry matter and the total N-uptake considered comparatively to those were given by the clay loam alluvial soil, when applying the increased N-rate of each N-source used. Where, regarding the tables (6) and(10), the magnitudes of the total dry matter and total N-uptake yielded applying the calcium nitrate, the ammonium sulfate, and the urea into the virgin desert sandy soil were successively 3.3, 2.9, and 2.1 g/pot and 40.7, 39, and 27 mgN/pot; while, when the alluvial soil was used, 15.8, 13.8, and 13.1 g/pot and 141.9, 91.9, and 99.4 mg N/pot were successively yielded, observedly. Furthermore, regarding the most efficient treatment, i.e., 30 mgN/kg soil of the calcium nitrate applied into the desert soil, the magnitudes of the total dry matter and the N uptake yielded were respectively 4.6 g/pot and 41.7 mgN/pot, whereas they were 1.2 g/pot and 16.1 mgN/pot respectively when the least efficient treatment, i.e., 90 mg N/kg soil of the urea was applied. while; using the alluvial soil, these magnitudes, when the most efficient treatment, i.e., 90 mgN/kg soil was applied, were respectively 20.6 g/oot and 201.2 mgN/pot, whereas they were 9.9 g/pot and 86.9 mgN/pot respectively when the least efficient treatment, i.e., 30 mgN/kg soil was applied in such soil.

Assumably, such preeminence recognizdd of magnitude of each of the total dry matter and the total N-uptake yielded using the alluvial soil may be referred to that supereminent fertility observed of such soil, table (1) , which shows supremely greater contents of the essential nutrient elements contained in the alluvial clay loam soil comparatively to those contents contained in the virgin sandy desert soil. However, for example reservoir of the native nitrogen, i.e., the soil N which was contained in the arable alluvial clay loam soil was noticeably 28 times of that contained in the virgin desert sandy soil. Where, demonstrativ-ely, the total native N which was reserved in the all-uvial soil was 0.104%, whereas it was only 0.0037% re-served in the sandy desert soil. Owing to, the organic matter content which was contained in the alluvial soil was 3.75% , while it was only 0.1% contained in the sandy desert soil; moreover content of the clay fraction which was reserved in the alluvial soil was 36 % , while it was only 2.5% reserved in the sandy desert one.

Isotope-derived criteria

i. Nitrogen derived from the fertilizer N applied (Ndff)

Recognizably, in a paradox, values of the Ndff reflected using the virgin sandy desert soil, always,were supereminently greater than those values reflected using the arable alluvial clay loam soil. For example, regar-ding the tables of (6) and (10), the Ndff values refle-cted, applying each of the calcium nitrate, the ammonium sulfate, and the urea in to the desert sandy soil,were successively 74.2, i.e., 30.14; 64.8, i.e., 24.9; 58.5%, i.e. , 15.8 mg N/pot; while, in case of using the alluvial soil they were 12.9, i.e., 18.3; 9.6,i.e.,8.8; and 7.7%, i.e., 7.7 mgN/pot successively, evidently. Furthermore; regarding the most efficient treatment, i.e., 30 mgN/kg soil of the calcium nitrate applied into the desert sandy soil; the Ndff value reflected was 68.3%, i.e. , 28.5 mgN/pot whereas regarding the least efficient treatment, i.e., 90 mgN/kg soil of the urea applied into such soil; the Ndff value reflected was 67.9%; i.e., 11.0 mgN/pot; while; regarding the most efficient treatment, i.e., 90 mgN/kg soil of the calcium nitrate applied into the all-uvial soil, the Ndff value caused was 19.2%, i.e., 38.6 mgN/pot whereas regarding the least efficient treatme-nt, i.e., 30 mgN/kg soil of the urea applied into such alluvial soil, the Ndff value caused was 3.4%, i.e.,2.5 mgN/pot , observedly. Moreover, the greatest Ndff value reflected, which was reflected applying the treatment of 90 mgN/kg soil of the calcium nitrate, when the sandy desert soil was used was remarkably 80.2%, i.e., 19.2 mg N/pot, while when the alluvial soil was used 19.2%, i.e., 38.6 mgN/pot was the greatest value reflected of the Ndff (which was reflected applying the treatment of

90 mgN/kg soil of the calcium nitrate). Also , the lowest Ndff value reflected, when the 30 mgN/kg soil of the urea was applied, using the desert sandy soil was 50.6%, i.e. ,21.1 mgN/pot, while using the alluvial soil 3.4%, i.e., 2.5 mgN/pot was the lowest Ndff value reflected, which was reflected when the treatment of the 30 mgN/kg soil of the urea was applied.

ii. Utilization of the fertilizer nitrogen applied (N-utilization):

Remarkably, always, the N-utilization percents reflected using the virgin sandy desert soil, were exceedingly greater than those percents were reflected using the arable alluvial clay loam soil. Because of, the Ndff values reflected using the desert sandy soil, always, were supereminently greater than those values were reflected using the alluvial soil, as mentioned later, however % utilization of applied fertilizer N =

$$\frac{\text{\%Ndff X yield of N in plant (mg/pot)}}{\text{Rate of fertilizer N application (mg/kg soil)}} .$$

see pag. No. 18 . However, for example regarding the tables (6) and(10) the N-utilization percents induced applying the calcium nitrate, the ammonium sulfate, and the urea into the virgin desert sandy soil were successively 10.1, 8.3, and 5.3%, while using the arable allvial clay loam soil, they were 6.1 , 2.9 , and 2.6% successively. Furthermore, regarding the most efficient treatment practiced into the desert sandy soil, i.e., 30 mgN/kg soil of the calcium nitrate, the N-utilization percent induced was 19% ; while regarding the most efficient treatment practiced into the alluvial soil, i.e., 90 mgN/kg soil of the calcium nitrate, the N-utilizat percent induced was 8.6%. As well as; regarding the least efficient treatment practiced into the desert sandy soil, i.e., 90 mgN/kg soil of the urea,the N-utilization percent reflected was 2.4%, while regarding the least efficient treatment practiced into the alluvial soil, i.e., 30 mgN/kg soil of the urea, was 3.4%.

Presumably, such that higher value of the fertilizer N uptake, viz., the Ndff and N utilization reflected using the virgin desert sandy soil comparatively to that value reflected using the alluvial soil may be due to that deficit of the sandy desert soil in the native nitrogen, i.e., the soil N, owing to those deficits in both the contents of the organic matter and the clay fraction contained in the desert sandy soil, See table (1), whereby the fertilizer nitrogen was likely a priming source for that total nitrogen which was uptaken by the plant. However, beside those examples mentioned later and with that wide ratio of Ndfs: Ndff which always was observed in favour of the Ndff value when the desert sandy soil was used; however using average value of each of the values reflected of the Ndfs and Ndff of table (6) for example, the ratio averaged obtained was 34.2% : 65.8% with which it could be diagnosed that the plant was undergone some difficults upon it's uptake to that soil N. Assumably, these difficults were probably that deficit of such soil for enough content of the native N reserved, as mentioned afore. While, in the case of using the alluvial soil, the Ndfs:Ndff observed , also, was always a wide; but, in a contrary, in favour of the Ndfs value reflected.

Where ; for example, using average value of each of the values reflected of the Ndfs and Ndff of table(10), the ratio of the Ndfs:Ndff was 89.9% : 10.1%, whereby it could be diagnosed that the plant was undergone a much more degree of impairment upon it's uptake to the fertilizer N comparatively to that degree occurred upon it's uptake to the soil N. Where , suggestly,the up-take of available N either that was present natively in the alluvial soil or that was added within the fertilizer application would be impaired by those soil problems called "micro-ecological problems". Pages. No. 84, 90, 113,134 and 143, nevertheless the N-uptake of the fertilizer N was likely retarded in a much more extent than that extent occurred for the N-uptake of the soil N. Considerably, the fertilizer N was likely more susceptible to be lost by effect of those soil problems, and/or the time and quantity of the fertilizer N applied were likely not parallel to time and quantity of N-requirements of the plant which would depend on stage of the plant growth and emergence time and quantity of the soil N (Nishigaki, 1970 and Bartholomew, 1971). Therefore, the extent of the fertilizer N-uptake, when the alluvial soil was used, was deeply less than that extent uptaken of the fertilizer N whent the desert sandy soil was used.

Considerably, such results mentioned later were similar to those observed by Lierop and Tran, (1980) who reported that a priming effect was observed on a sandy loam and a sandy soils, both severely deficient in native N, when the N-fertilizer was used, but proportion of fertilizer N absorbed by oats and wheats was decreased on a silt loam soil, which had a larger supply of soil N, than that required for attaining maximum yields.

iii. $A\text{-}_N$ value :

Noticeably, in a contrary, the $A\text{-}_N$ value caused when the arable alluvial clay loam soil was used, always, was exaggeratively greater than that $A\text{-}_N$ value caused using the virgin sandy desert soil, Fig. No. (10). **For example, regarding tables (6) and(10), the $A\text{-}_N$ value caused when each of the calcium** nitrate, the ammonium **sulfate,and the urea was applied** into the desert sandy

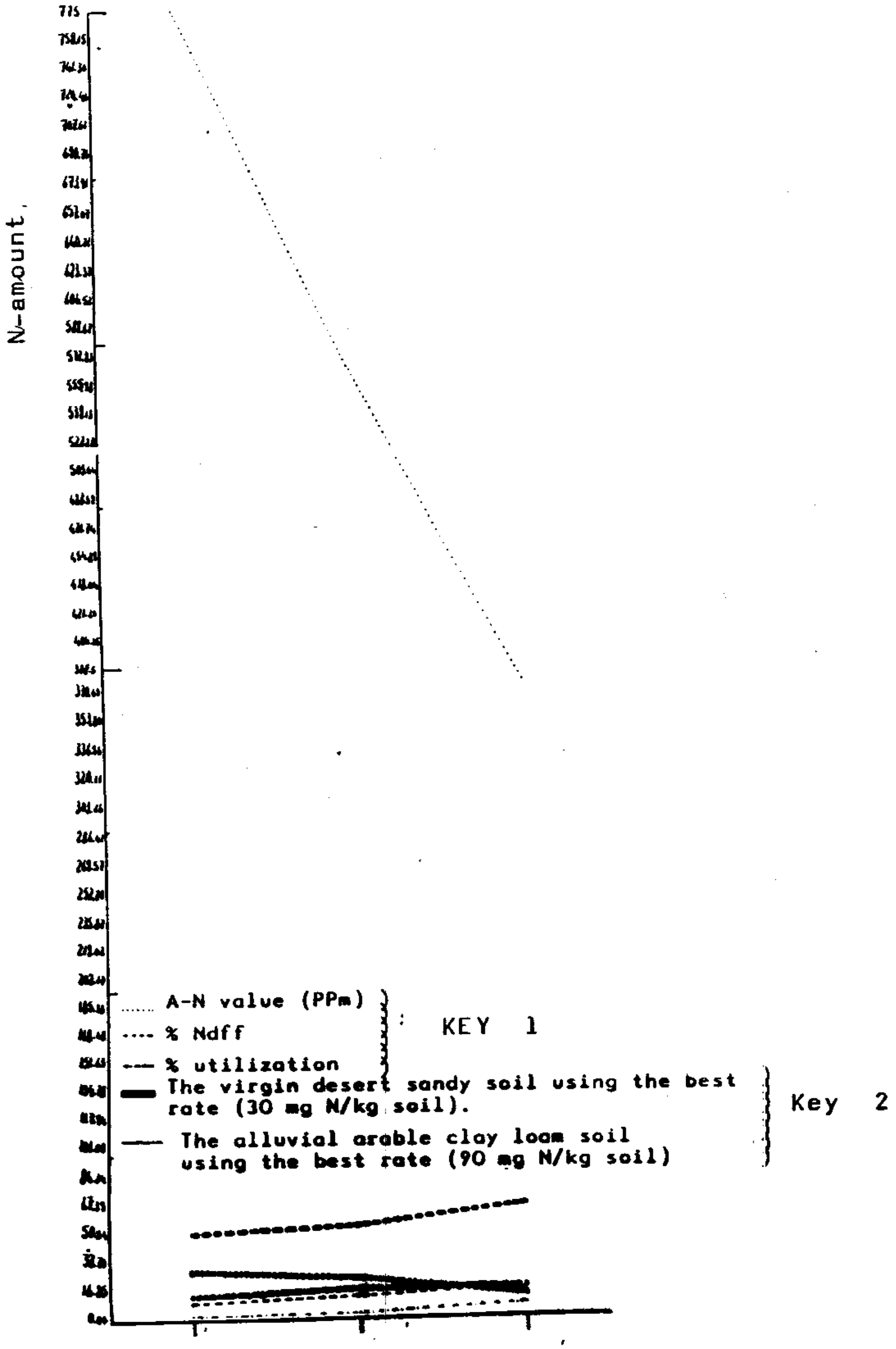

Fig.(10): Percent of Ndff, N-utilization, and extent of A-N value assessed in the above ground part of the plant applying the ^{15}N-labelled fertilizer into each of the virgin desert sandy and alluvial arable clay loam soil at the best rate recognized in each soil.

soil was respectively 21, 33 , and 43 mgN/kg soil while, using the alluvial soil,it was 405, 565 , and 719 mgN/kg soil respectively. Where, using average value of each A_{-N} values of the tables(6) and (10), the averaged A_{-N} value using the desert sandy soil was 32.3 mgN/kg soil, while, using the alluvial soil, it was 563 mgN/Kg soil. Furthermore , regarding the most efficient treatment applied into the sandy desert soil, i.e., 30 mgN/kg soil of the calcium nitrate, the A_{-N} value caused was 14 mgN/kg soil; while regarding the most efficient treatment applied into the alluvial soil, i.e.,90 mgN/kg soil of the calcium nitrate, the A_{-N} value caused was 379 mgN/kg soil. Whereas; regarding the least efficient treatment applied into the sandy desert soil, i.e., 90 mgN/kg soil of the urea, the A_{-N} value caused was 43 mgN/kg soil; while regarding the least efficient treatment applied into the alluvial soil, i.e., 30 mg N/kg soil of the urea, the A_{-N} value caused was 852 mgN/kg soil. Noticeably, the absolutely greatest A_{-N} value reflected, i.e. 852 mgN/kg soil of the three experiments conducted was that least efficient treatment applied into the alluvial arable clay loam soil, i.e., 30 mgN/kg soil of the urea which gave the least extent of each of the total dry matter, the total N-uptake, and the N-utilization reflected in the alluvial soil, while the absolutely lowest $A-_N$ value of the three experiments conducted, i.e., 14 mgN/kg soil was reflected when that most efficient treatment was applied into the sandy desert soil, i.e., 30 mgN/kg soil of the calcium nitrate which gave the highest extent of each of the total dry matter, the total N-uptake, the N-utilization reflected in the sandy desert soil.

Ideally,nitrogen comprised in entire plant, namely, spikes, shoots, and roots should be considered when $A-_N$ value to be calculated, see pag.No. 17 . Considering the later two current experiments, the $A-_N$ values assessed were calculated restrictively for the above ground parts, viz., spikes plus shoots of the plant, while roots of the plant was not considered, noticeably. Remarkably, but, throughout the calculations of the $A-_N$ values assessed within the former experiment of the fertilizer N balance sheet, roots of the plant was considered, Assumably, on the basis of what mentioned afore, it could be predicted that A_{-N} value was likely dependent primarily on sort of the soil used, extent of the N-rate applied, and form of the N-source added. However,effect of the soil sort was observedly the most effective factor of which, whereas the form of the N-source used seemed, assumably, the least effective one. However, accurately, states of the contents and balance of the essential nutritent elements persent in each soil sort would be the most effective factor which predominantly would control the second factor of the extent of the N-rate applied and in late would control the factor of the form of the N-source added to the soil used.

Consequently, it could be assumed that state of contents and balance of the essential nutrient elements present in the soil used would govern the A_{-N} value caused, suggestly. However, as mentioned previously, see pag. No. 196; utilization of the fertilizer N applied would be controled by the content of N,or, extent of balance among the N and the other nutrients present in the soil used. However, as mentioned later, see Page. No. 184 ; there a reversely proportion was observed always between the $A-_N$ value and the N-utilization value, where there was a reversely proportion also observed between each of the total dry matter and the total N-uptake and $A-_N$ value. Because of as discussed previously , see Page. No. 173 ; the assumably gap, viz., the unbalance occurred presumably, in the desert sandy soil, among content of N and contents of the other nutrient elements was, assumably, smaller than that gap occurred in the case of the alluvial soil , whereby , as shown and discussed formerly, the smallest N-rate applied, i.e., 30 mg N/kg soil into the sandy desert soil seemed suggestly enough to render an about balance state among N and the other nutrients in the soil while each higher N-rate i.e., 60 and 90 mgN/kg soil applied seemed excessively higher than that N content which should be added to make the balance to be rendered again. Thus,as observed formerly, the highest N-utilization value was brought out by the smallest N-rate applied in the sandy desert soil, while the lowest N-utilization value was brought out when the highest N-rate was applied. Because of, the lowest state of absorption of the other nutrients would be with appliying the highest N-rate in turn the highest disturbancy state for metabolism of the plant cell would be with such highest N-rate applied (Epstein, 1972). Considering that, there was a reversely proportion observed always between the A_{-N} value reflected and the N-utilization value reflected, therefore the smallest N-rate applied caused the smallest A_{-N} values reflected, while the highest N-rate applied caused the highest A_{-N} value reflected.

Therefore, it could be concluded that, in the case of the sandy desert soil, because of amount range of the N-rates applied, viz., 30-90 mgN/kg soil would not only be enough to render the state of balance among the nutrients present in the soil but also would be more than that amount would be demanded to bring such balance again; but in the case of the alluvial soil, such amount range of the N-rates applied was, deeply,under that actual amount of N nutrient which should be added to assumalby bring out state of balance again among the nutrients present in such soil. However, as discussed previously, see pag. No. 171 ; although such alluvial soil seemed in a state of fertility, i.e., the total nutrients quantities, see table (1), were higher greatly than that seemed with the desert sandy soil, still the N-uptake by the plant using the alluvial soil, assumably was retarded by those presumed problems that were called "micro-ecological problems" mentioned previously,Page No. 84, 90;113,134 & 143;in a much more degree than the degree assumed when the sandy desert soil was used. where under the conditions of such sandy desert soil, such assumed degree of the N-uptake retardation was likely nil. Subsequently, as mentioned afore, the extent of the presumably gap, viz., the presumably unbalance occurred in the sandy desert soil among content of available nutrient N and contents of the other nutrients was, presumably, narrower, viz., a lower than that presumably extent occurred in the case of the alluvial soil. with which assumable relativity supposed between content of N untrient uptaken and contents of the other nutrients uptaken when the sandy desert soil was used was, assumably, close to or applicable to that assumable actual relativeity at which the balance would be brought out and nearly the metabolism disturbance in the plant cell would not be occurred.while supposable relativity using the alluvial soil, assumably, was deeply under such assumable actual relativity, consequently a somwhat metabolism disturbance may suggestly be occurred in the plant cell using the alluvial soil, or, the suggestable degree of the metabolism disturbance occurred in the plant cell using the sandy desert soil presumably, was deeply lower than that degree occurred using the alluvial soil (Spstein, 1972). In a sequent, the N-utilization value reflected when the sandy desert soil was used, always was higher, as observed, than that N-utililation value reflected using the alluvial soil. The $A-_N$ value caused using the sandy desert soil, therefore, was always lower than that $A-_N$ value reflected when the alluvial soil was used. However, suggestly, the portion of the fertilizer N added which was not utilized by the plant would consequently be remained in the soil used which is called the "$A-_N$ value".

a) Unrealist of $A-_N$ value as an index of available soil nitrogen :

Assumably, the portion of the fertilizer N added that was not utilized by the plant and hence it was remained in the soil used, viz., the A-N value. It may be subject to different and significant N-loss mechanisms and biological transformations, whereas by those $A-_N$ values reflected, assumably, would not be regarded as an actual index of available soil N. Where, on the same wise, Rennie and Rennie (1973) reported that N balance sheet data would suggest that A values can not be regarded as an index of available soil N specifically where the fertilizer standards are subject to significant and different biological transformations, with which significant amounts of the fertilizer N are lost, unrealistically high A values will result.

Even so, presumably, on the basis of that extent of the balance occurred in the soil used among content of available N and contents of the other nutrients, the influence of each factor, suggested before, see pag. No. 203 ; of the N-rate applied and the form of the N-source added on $A-_N$ values may be interpreted as following. However, the N-rate applied with which the assumable gap occurred in the soil used between content of available N and contents of the other nutrients become as narrow as possible; this rate would, assumably, bring out a lowest $A-_N$ value, and vica versa, cbmparatively to the other N-rates applied. Where, as discussed afore, the 30 mg N/kg soil which was applied in the sandy desert soil brought out, observedly, the highest values reflected of the N-utilization and hence it brought out the lowest $A-_N$ values reflected comparatively to the other N-rates applied. Whereby it could be assumed that there was, probably, a gap occurred which would become at the narrowest state when the 30 mgN/kg soil, i.e. , the smallest N-rate was applied comparatively to the other N-rates applied. Where , in the case of the alluvial soil, it could be assumed that the 90 mgN/kg soil was the rate with which a presumably gap occurred, because of those assumed soil problems, see pag. No. 171 ; would be renddered to the narrowest state occurred comparatively to those states occurred when the other N-rates were used. where , observedly, the 30 mgN/Kg soil gave the highest N-utilization values reflected and the lowest $A-_N$ values caused in the alluvial soil used, Fig. (10). Also, assumably, the form, viz., NO_3 or NH_4^+ of the N-source applied with which the presumable gap, viz., unbalance, proposed , become as narrow,i.e., low as possible; this form assumably, as well, would bring out a lowest $A-_N$ value, and vicaversa, comparatively to the other form of the N-source applied. Where, observedly in both soils, the NO_3 form of the calcium nitrate which was applied brought out the highest N-utilization values reflected and hence it brought out the lowest $A-_N$ values reflected comparatively to the NH_4^+ form of each of the ammonium sulfate and the urea which were applied. where the NH_4^+ form of the urea applied, as recognized, brought out the lowest N-utilization values reflected and the highest values observed of the $A-_N$ reflected (Figs. 5 and 10). However, observedly in both soils, such lowest $A-_N$ values, i.e., highest N-utilization values which were occurred when the NO_3 form was applied and the highest $A-_N$ values, i.e., lowest

N-utilization values which were occurred when the NH_4^+ form was applied , Figs. (5) and (10), may be referred to that preference of the plant to uptake the NO_3-N, owing primarily to those plant physiological factors; mentioned previously, see pag. No. 82 . Therefore, conclusively, the treatment of the 30 mgN/kg soil of the calcium nitrate which was applied into the virgin sandy deserts soil gave, absolutely, the lowest A_{-N} value, i.e., the highest N-utilization value reflected comparatively to those treatments which were applied into such soil. whereas the treatment of the 90 mgN/kg soil of the calcium nitrate which was applied into the arable clay loam alluvial soil gave, absolutely, the lowest A_{-N} values, i.e., the highest N-utilization value reflected comparatively to those treatments which were applied into such alluvial soil.