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ABSTRACT

The nitrogen balance for a clay loam and a sandy loam soil cropped with cotton was determined in pot and lysimeter experiments. Nitrogen added in seeds, fertilizers, irrigation water and insecticides and that removed by plants and in leachate and nitrogen content of the soils before sowing and after the harvest were all determined and used to draw up the nitrogen balance sheet.

The obtained results indicated significant nitrogen losses from the soil-plant system in both lysimeter and pot experiment. The loss in nitrogen, as percent of initial soil nitrogen plus added nitrogen, was 10 % and 16 % for the clay loam and sandy loam soil in the pot experiment, but 5 % and 10 % respectively in the lysimeter experiment. Nitrogen removed by cotton plants was higher in the pot than in the lysimeter experiment. The amount of nitrogen found in the leachate from lysimeters was less than 0.1 % of the added nitrogen and initial soil nitrogen.

INTRODUCTION

Studies on crop utilization of soil nitrogen revealed that not all of the nitrogen present was recovered by the crop (Mac Vicar et al, 1950, Henzell and Norris, 1962, Martin and Skyring, 1962, Jansson 1963, Allison 1955, 1965, Legg and Allison 1967, Legg and Stanford 1967). According to Allison (1965), recoveries of nitrogen released from or added to the soil, in harvested crops, were usually less than 50% . Large quantities of soil nitrogen may be lost in drainage water and/or to air in the forms of ammonia, elemental nitrogen and its oxides (Allison 1965, Broadbent and Clark 1965).

In lysimeter experiments, gaseous losses of nitrogen were estimated as 15 % of the added nitrogen but from 1 to 40 % in pot experiments (Allison 1955, 1965). Denitrification is considered as the most probable cause of such losses. The present work is an attempt to draw nitrogen balance sheets for some Egyptian soils in pots and lysimeters cropped with cotton.

MATERIALS AND METHODS

Two different soils were used i.e. a clay loam from Behera governorate and a sandy loam from Kalubia governorate. Their general characteristics are given in Table 1. The soil was sieved through a 2 m m sieve, well mixed and packed either in pots or in lysimeters. The depth of the soil in any case was 36 cm., but its weight was different according to apparent density. Soils were planted to cotton (**Gossypium barbadense** var. monoufy).

Pot experiment consisted of 5 pots (45 cm diameter and 45 cm height) per each soil. Seeds of cotton were sown in 3 pits per pot and after emergence 2 plants were left in each pit. Calcium nitrate, superphosphate and potassium sulphate fertilizers were added after thinning at the rate of 146, 49 and 27 mg/kg soil respectively.

Lysimeter experiment consisted of 3 lysimeters (147 X 71 X 50 cm) for each soil. Seeds of cotton were sown in 10 pits and after emergence, 2 plants

TABLE 1. General Characteristics of the Soils Used (oven dry basis)

Soil characteristic	Soil I	Soil II
Total nitrogen, %	0.11	0.03
Total soluble salts, %	0.10	0.26
Clay, %	42.10	13.60
Silt, %	30.40	10.50
Sand, %	27.40	75.70
Total carbonates, %	0.25	0.14
Water holding capacity, %	67.29	44.91
Cation exchange capacity, meq/100g	42.00	21.40
PH	7.4	7.3
Soil texture	Clay loam	Sandy loam

were left in each pit. The same fertilizers, as in the pot experiment were added after thinning at the rate of 130, 86 and 43 mg/kg soil respectively. Occasionally, the leachate from each lysimeter, due to excess irrigation was collected.

In both pot and lysimeter experiments, cotton was sown at the end of March and harvested at the end of September 1966. During the growth period, the plants were irrigated with tap water and sprayed with insecticides. Thinned plants and fallen leaves were collected. At harvest, the cotton plants were divided into roots, stalks, lint and seeds. These plant materials were dried at 66—68°C for 24 hours, weighed, ground and analyzed.

Total nitrogen content was determined in the following materials : soil before and after the experiment, seeds, fertilizers, insecticide solutions, irrigation water, leachate and the different parts of the harvested crop. In addition, ammonium, nitrate and nitrite forms were determined in the soil. Nitrogen determinations was carried according to Black et al (1965).

RESULTS AND DISCUSSION

Nitrogen input : Table 2 shows the amounts of nitrogen added per pot or lysimeter in the form of fertilizers, seeds, insecticides and irrigation water. In the pot experiment the amount of applied calcium nitrate varied according to the oven dry weight of each soil pot pot.

Changes in Soil Nitrogen : Ammonium — N, nitrite — N and nitrate — N contents of the two soils before cultivation and after the harvest were found less than 2 ppm. Total nitrogen only therefore is considered. As shown in Table 3, total nitrogen content of each soil decreased at the end of the growing season. However, the losses were higher from the pots than from the lysimeters. On percentage basis, losses were also higher from the sandy loam than from the clay loam soil. Such variability in soil nitrogen losses would indicate the extent of nitrogen mineralization in each treatment.

Nitrogen Recovered in Plant Materials : The nitrogen found in the collected thinned plants and

TABLE 2. Nitrogen added to the Soils Used.

Nitrogen source	N, gm/pot		N,gm/
	clay loam	sandy loam	lysimeter *
Ca (NO_3)$_2$ fertilizer	1.38	1.72	10.26
K and P fertilizers	0.01	0.01	0.16
Seeds	0.31	0.34	2.49
Insecticides	0.01	0.01	0.04
Irrigation water	0.28	0.22	0.88
Total	1.99	2.30	13.83

*) For clay loam and sandy loam soil.

TABLE 3. Changes in Total soil Nitrogen* (gm/pot or Lysimeter).

Expt.	Soil	Initial	Final	Percent loss
Pot	Clay loam	56.23	49.83	11.4
	Sandy loam	25.74	21.65	15.9
Lysimeter	Clay loam	614.88	583.83	5.0
	Sandy loam	192.87	173.39	10.1

*) Average of 3 replicates for lysimeter expt. and 5 for pot expt.

fallen leaves and that recovered in the different parts of the harvested crop are shown in Table 4. More nitrogen was removed by the plant materials from the clay loam than from the sandy loam soil but recovery was greater from the pot than from the lysimeter experiment.

Nitrogen Recovered in Leachate : In the lysimeter experiment, excess water of irrigation was collected as drainage water. Total volumes of leachate, collected during the growth period, were 23.0 and 32.5 liters/lysimeter for the clay loam and the sandy loam soils respectively. As shown in Table 4, negligible amount of nitrogen was lost through this pass.

Nitrogen Balance : On the basis of Tables 2,3 and 4 a nitrogen balance sheet for the pot and lysimeter experiments is presented in Table 5. Part of the nitrogen added to and released from the soil was recovered by the plants but a greater part disappeared from the soil—plant system. The unrecovered nitrogen is believed to be due mainly to biological denitrification (Allison 1955, 1965). The reaction

ملـــخص عربى
ARABIC ABSTRACT

ميزان الآزوت فى اراضى منزرعة قطن

قدر ميزان الآزوت فى نوعين من الأراضى : طينية طميية ، رملية طميية منزرعة قطن فى تجربتين : الأولى اجريت فى براميل والثانية فى ليسيمترات ٠

وقد قدر النيتروجين فى : البذرة ، الأسمدة ، مياه الرى ، مبيدات الحشرات ، نباتات القطن ، مياه الصرف ، الأرض قبل الزراعة وبعد الحصاد ٠٠ واستخدمت هذه التقديرات فى حساب ميزان الآزوت فى كل تجربة ٠

ويستدل من النتائج على الآتى :

١ ـ لا يتوازن الآزوت المضاف مع الآزوت الذى يوجد فى النبـــاتات بغض النظـر عن نوع الأرض أو نوع التجربة ومن الواضح وجود فقد معنوى فى النيتروجين من نظام الأرض المنزرع بها نباتات قطن فى كلا من التجربتين ٠

٢ ـ عند حساب النيتروجين كنسبة مئوية من مجموع محتـوى الأرض من النيتروجين قبـل التجـربة + النيتروجين المضاف كان الفقد فى تجربة البراميل ١٠٪ ، ١٦٪ فى حالة الأراضى الطينية الطميية ، الرملية الطميية على التوالى بينما كان هذا الفقد فى تجربة الليسيمترات ٥٪ ، ١٠٪ ٠

٣ ـ فى تجربة البراميل كانت كمية النيتروجين الممتص بواسطة نباتات القطن أكثر منهـا فى حالة تجـــربة الليسيمترات ٠

٤ ـ فى تجربة الليسيمترات كانت كمية النيتروجين الموجودة فى ميـــاه الصرف أقل من ١ر٠٪ من مجمـوع النيتروجين المضاف + محتوى الأرض من النيتروجين فى بداية التجربة ٠