Advanced Fertilizers Technologies

Lecture 6

Increasing Nitrogen Use Efficiency

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Introduction:

Nitrogen fertilizers are exposed to many reactions, causing their loss in the form of gases through the process of volatilization or by the process denitrification under wet conditions in the form of nitrogen gas or nitrogen oxides, or nitrogen can be loss in the form of nitrate ions in sandy soil, causing contamination of groundwater or its fixation by microorganisms.

Many studies have found that up to 80% of the nitrogen added to the soil is lost, which requires adopting some strategies to increase the efficiency of the nitrogen fertilizer added or original in the soil through the following methods : -

1. **Level of Nitrogen Added**
2. **Time of Nitrogen Application**
3. **Methods of Nitrogen fertilizer Application**
4. **Nitrification Inhibitors**
5. **Urease inhibitors**

First: Level of Nitrogen Application

Every plant has its needs of nutrients to reach the maximum and best growth and production. However, environmental and genetic factors have an effect on the amount of nutrients absorbed from the soil, and then affect its concentration (content) in a plant and its transfer to other parts of the plant. Also, the plant part and its age have an effect on its concentration from one soil to another and from one part to another part of a plant. Therefore, it is necessary to conduct agricultural experiments, whether in the field or in the greenhouse or glass house, using several levels of the nutrient in the form of fertilizer, and determining the appropriate level with the highest absorbed amount and the least loss of fertilizer at an appropriate price through conducting statistical analyzes

Table 1: Effect of nitrogen fertilization on yield of fruits(kg) of date palm cultivar Al-Hilawai(Ibrahim *et al.*,2001).

Nitrogen fertilizer rate (kg/date palm/year)		
0	2	3
29.47	31.18	32.15

Second: Time of nitrogen application

The date of adding nitrogen fertilizer is one of the important factors affecting the efficiency of nitrogen fertilizer because of the limitation between the time of adding fertilizer and its absorption by the roots, due to the loss of fertilizer by volatilization, leaching and denitrification .

Therefore, choosing the right time to add fertilizer is necessary to reduce nitrogen loss, increase fertilizer use efficiency and reduce fertilizer loss.

The plant needs nitrogen in the stage of vegetative growth, and the need for it continues in the later stages, but in quantities that gradually decrease with the age of the plant. Therefore, choosing the right time to add the fertilizer increases its efficiency when it corresponds to the peak of the plant's need for the nutrient.

The time of adding the fertilizer depends on several factors, including ,

type of crop, **the properties of the fertilizer, the climate**, **method of nitrogen fertilization**, **properties of the soil**

Adding fertilizer in doses instead of all at once can achieve a great benefit for nitrogen fertilizer. Cooke (1972) indicated that nitrogen loss rates can be reduced by dividing the fertilizer dose (the fertilizer recommendation) into several dose instead of one dose, and then the efficiency of fertilizer use can be increased, and it must take into account the time of addition, the stage of plant growth and the time rain and irrigation, to increase the efficiency of fertilizer use.

The fertilizer dose is usually divided into two or three doses instead of one dose to ensure the best balance between vegetative and fruitful growth. The fertilizer dose is rarely added after flowering, because the use of fertilizer is futile.

Table 1. Mean leaf area, plant height, days to maturity, and number of grains ear^{-1} of maize as affected by nitrogen rates and its application times

Nitrogen rates (kg ha^{-1})	Mean leaf area (cm2)	Plant height (cm)	Days to maturity	Number of grains ear^{-1}
80	245.35 b	167.89 c	98.56 b	335.22 b
120	256.43 a	174.22 b	100.89 a	341.33 ab
160	258.19 a	188.00 a	101.44 a	369.67 a
200	264.21 a	190.33 a	101.56 a	374.22 a
LSD	10.6	5.61	1.09	32.29
Application times (AT)				
AT1	248.91 b	176.58 a	100.08 b	340.25 b
AT2	260.93 a	184.25 a	101.42 a	380.75 a
AT3	258.30 a	179.50 ab	100.33 b	344.33 a
LSD	9.18	4.86	0.94	27.97
Control	215.03 b	164.66 b	96.66 b	257.33 b
Rest	256.04 a	180.11 a	100.61 a	355.11 a
N x AT	18.36	Ns	Ns	Ns

Note: (AT1 = full at sowing, AT2 = 1/2 at sowing + 1/2 at 25 days after sowing, AT3 = 1/3 at sowing + 1/3 at 25 days after sowing + 1/3 at 50 days after sowing).

Means of same category followed by different letter are significantly different from one another at p≤0.05%.

Third: Method of N Application

Small part of nitrogen added in the form of ammonium or produced form organic fertilizers or urea is lost in the form of ammonia gas, especially in calcareous soils. Therefore, it is necessary to choose the appropriate method of adding nitrogen fertilizer to reduce nitrogen loss and increase the efficiency of the fertilizer.

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The method of adding nitrogen fertilizer depends on several factors, including

soil properties, especially soil texture, moisture content, **mobility of the element** and its **transformations in the soil**, **the nature of crop growth**, **the length of the growing season**, **root depth of the plant**, **its spread and the surrounding environmental conditions.**

One of the most important ways to add nitrogen fertilizers is to add in the form of band and with irrigation water (fertigation) and spraying. The method of fertigation and spraying has proven its high efficiency compared to the traditional methods in increasing the efficiency of nitrogen fertilizers