EFFECT OF DIFFERENT FORMS AND RATES OF NITROGEN FERTILIZATION ON THE SOIL POLLUTION BY NITRATE AND ITS ACCUMULATION IN POTATO AND ECONOMICS OF EXPORT

BY

Khatab Abd EL-Baky EL-Sayed Khatab

B.Sc. Agric. Zagazig University, 1986

A Thesis Submitted in Partial Fulfillment

of

The Requirement for the Master Degree

in

Environmental Science

Department of Agricultural Science
Institute of Environmental Studies & Research
Ain Shams University

2001

APPROVAL SHEET

EFFECT OF DIFFERENT FORMS AND RATES OF NITROGEN FERTILIZATION ON THE SOIL POLLUTION BY NITRATE AND ITS ACCUMULATION IN POTATO AND ECONOMICS OF EXPORT

BY

Khatab Abd EL-Baky EL-Sayed Khatab

B.Sc. (Zagazig University)- 1986

This Thesis for Master Degree in Environmental Science has been approved by:

Name	Signature
Prof. Dr. Samir Abdel – Wahab Aboulroos *Prof. of Soil Science, Soil Dept., Fac. of Agric., Cairo University .*	.....
Prof. Dr. Ayman Farid Abou Hadid *Prof. of Vegetables, Horticulture Dept. Ain Shams University.*	.....
Dr. Ezzat Mohamed soliman *Ass. Prof. of Soil Science, Agricultural Science Dept. Institute of Environmental Studies and Research, Ain Shams University*	.....

Date : / /

EFFECT OF DIFFERENT FORMS AND RATES OF NITROGEN FERTILIZATION ON THE SOIL POLLUTION BY NITRATE AND ITS ACCUMULATION IN POTATO AND ECONOMICS OF EXPORT

BY

Khatab Abd EL-Baky EL-Sayed Khatab

B.Sc. Agric. Zagazig University, 1986

Thesis Submitted in Partial Fulfillment
of
The Requirement for the Master Degree
in
Environmental Science

Department of Agricultural Science

Under The Supervision of:

Dr. Ezzat Mohamed Soliman

Ass. Prof. of soils, Agricultural. Sc. Dept. Institute of Environmental Studies and Research, Ain Shams University

Dr. Alaa Ahmed Abada Sarhan

Lecture of Economic, Economic and Low Dept. Institute of Environmental Studies and Research, Ain Shams University

Dr. Usama Ahmed Ali EL-Behairy

Lecture. Vegetables, Horticulture Dept. Ain Shams University

Dr. EL-Essawy Ali Yassein EL-Kabbany

Researcher, Plant Nutrition Dept. Soil, Water and Environment Institute

ACKNOWLEDGMENTS

I wish to express my gratitude to Dr. Ezzat Mohamed Soliman; assistant Professor of soils, agriculture science Department, Institute of Environmental Studies and Research, Ain Shams University, for his supervision, guidance and valuable suggestion during the course of this investigation and preparation of this manuscript.

Thanks are also Dr. Alaa Ahmed Abada Sarhan; Lecture of Economic, Economic and Low Department, Institute of Environmental Studies and Research, Ain Shams University for his supervision and valuable assistance during preparing reviewing the manuscript of Economic part.

The author feels great indebtedness to Dr. Usama Ahmed Ali Yassein EL-Behairy; lecturer of vegetables, Horticulture Department, Faculty of Agriculture, Ain Shams University for his great help and valuable criticism.

Special thanks, and deep appreciation are also due to Dr. EL-Essawy Ali Yassein EL-Kabbany; prof. of Biochemistry, plant nutrition, Dept., Agricultural Research Center; for suggesting the problem, supervision, guidance through the course of this study, for his great help during the experimental and preparing reviewing the manuscript.

CONTENTS

List of Tables

INTRODUCTION

Formatted

Potato is one of the most important vegetable crops in Egypt. The average area cultivated for potato production in 1999 was 210 thousand feddan and yielded 2005 thousand tons. One and half million tons of potato production used in food consumption, 250 thousand tons tuber seeds in planting winter season and 255 thousand tons in exporting (CAPMAS. 1999). Potato plants required much more nutrients particularly nitrogen than most of the other vegetable crops. Nitrogen is an essential constituent of amino acid, amides, nucleotides and nucleoprotein and it is essential for cell division. It is also constituent of chlorophyll. Nitrogen considers one of the most important fertilizer element which applied from different sources and in different forms i.e. urea, ammonium sulphate, ammonium nitrate and calcium nitrate.

The strategy of Egyptian economic development gives a special importance to the expansion, diversification and improving the economic situation of Egyptian potatoes. The policy of the country aims to improve potato production, quality, domestic consumption, internal marketing and foreign trade in order to increase the amount of potato exporting. Potato production can be increased by planting high yielding varieties showing great response to fertilization.

Excess nitrogen fertilizer can be lost from the potato root zone mainly as NO_3^- to groundwater. Few years ago on record of high levels of nitrate was noticed in a particular lot dehydration potato. This prompted several investigations to test the nitrate content of potato tuber. High nitrate in our food and water supply

constituted a potential health hazard because of the role of this compound as a precursor in the formation of nitrate. Nitrite has been shown to cause serious health problems. The aim of the current investigation is to evaluate the effect of different forms and rates of nitrogen fertilization on soil pollution by nitrate and its accumulation in potato and economics of exportation.

II. REVIEW OF LITERATURE

Nitrogen fertilizer for different soils in Egypt is essential to affecting growth, yield, storageability, nitrate content and chemical composition of potato and the drainage water pollution by nitrate.

The review of literature will be divided into three major parts.

Part 1 : Plant:

1.1. Vegetative growth characters.

1.2. Total tuber yield and its components.

1.3. Physical and chemical characters.

A-Specific gravity
B-Dry matter percentage.
C-Nutrients N, P and K content.
D-Nitrate content.
E-Carbohydrate fractions content.

1.4. Storageability

Part 2: Drainage water:

Part 3: Soil

3.1. Residual nitrogen forms in the soil.

Part 4: Economics of potato exportation.

2.1. Effect of forms and rates of nitrogen on vegetative growth characters:

Polizotto *et al.* (1975) studied the effect of different nitrogen sources, i. e., NH_4- N, NO_3 - N and $NH_4 + NO_3$ and found that growth of potato plant was greatest with

nitrogen supplied as NO_3 - N least with NH_4- N and intermediate with $NH_4 + NO_3$. EL-Gamal (1985) in a field trials investigated the influence of different nitrogen sources applied at 200 Kg N/fed. He found that average number of stems per plant did not affected significantly by the nitrogen sources. Shaheen *et al.* (1989) observed that both plant height and number of branches per plant were not respond to the differences in nitrogen source when applied as urea and ammonium nitrate.

Barakat *et al.* (1991), working on clay soil reported that application of nitrogen as ammonium sulphate increased weight of fresh shoots and leaf area per plant more than ammonium nitrate and urea. Karadogan (1995) found that plant height and number of tubers per hill were higher with ammonium sulphate than ammonium nitrate. Westermann and Sojka (1996) noticed that plant fresh and dry weight tended to be larger when nitrogen fertilizer was applied from urea than ammonium nitrate.

Concerning the effect of nitrogen rates on vegetative characters, EL- Gamal (1985) in clay day found that, the number of main stems was not affected by different nitrogen levels. Sekhon and Singh (1985) fertilized potato plants with nitrogen levels i.e. 60,120,180 and 240 Kg N/fed as ammonium sulphate and demonstrated that increasing the amount of nitrogen applied increased plant height and dry weight of shoots. Shehata and Abo-Sedera (1994) in a field experiment, applied nitrogen fertilizer as ammonium nitrate at levels of 40,60,80 and 100 Kg N/fed and found that plant height, fresh weight per plant, number and weight of

tuber per plant increased with increasing nitrogen level up to 80 Kg N/fed.

In addition, Shehata and Bakeer (1995) in sandy soil, found that, increasing the application of nitrogen level up to 160 Kg N/Fed. give the higher values of studied growth parameters, i.e., plant height, fresh and dry weight per plant, number of main stems and number of tubers per plant. Mukhin and Gushchina (1996) studied the effect of nitrogen fertilizer levels i.e.0, 60,120 and 240Kg N/ha and noticed that the average number and weight of tubers per plant increased with increasing nitrogen fertilizer rate.

2.2. Effect of forms and rates of nitrogen on potato yield and its components:

Lorenz *et al.* (1974) found that tuber yield of potato subjected to ammonium sulphate was higher than that obtained with urea as nitrogen fertilizer source. Baker *et al.* (1980) used urea and ammonium sulphate as nitrogen fertilizer sources and found that, the maximum tuber yield obtained with application of ammonium sulphate. Valdes *et al.* (1982) working on different nitrogen sources i.e. ammonium sulphate, ammonium nitrate and urea and indicated that the potato yield was not affected significantly with differences in nitrogen sources. Plate and Matthews (1984) studied the effect of nitrogen sources as ammonium sulphate and urea on potato plants and showed that potato tuber yield obtained by using urea was slightly better than using ammonium sulphate. In a field experiment EL-Gamal (1985) indicated that total yield production was not affected by nitrogen sources. Although the highest

percentage of marketable portion of potato tubers was obtained by using urea as a nitrogen source. Bundy *et al.* (1986) treated potato plants with ammonium sulphate, ammonium nitrate, calcium nitrate and urea the yield obtained by using ammonium sulphate was significantly higher than those obtained by using ammonium nitrate, urea and calcium nitrate respectively.

In addition, Lee (1986) fertilized potato plants by ammonium nitrate and ammonium (aqua form) and showed that no significant difference in final yield was found. Salsac *et al.* (1987) reported that nitrate nutrition resulted in higher tuber yield compared to ammonium nutrition. Sanderson and White (1987) treated potato plants with urea and ammonium nitrate at level 0,67,135 and 202 Kg N/ha and found that the highest production of tubers yield resulted from using ammonium nitrate while the total yield was reduced by using urea. Sharma, and Grewal (1987) indicated that potato tuber yield was greatest by using ammonium sulphate than using urea. Sharma (1990) working on the effect of nitrogen sources as ammonium sulphate, ammonium nitrate and urea at levels 60 Kg N/ha and demonstrated that total tuber yield was the highest by using ammonium sulphate compared to the other two sources. Barakat *et al.* (1991) in a field experiment studied the effect of ammonium sulphate, ammonium nitrate at levels of 0,40,80 and 120 Kg N/fed and reported that number, and weight of tubers per plant and total tuber yield increased by using ammonium sulphate more than using ammonium nitrate and urea respectively.

Moreover, Sud and Grewal (1994) applied potato plants with 0 and 200Kg N/ha as ammonium sulphate, calcium nitrate and urea, they mentioned that the highest total tuber yield was obtained by using ammonium sulphate. Karadogan (1995) demonstrated that total tuber yield and proportion of large tuber were higher by using ammonium sulphate than ammonium nitrate. Westerman and Sojka (1996) investigated the effect of nitrogen sources as ammonium nitrate and urea applied at 220 Kg N/ha and reported that total tuber yield, large tubers and marketable tubers were higher by using urea than ammonium nitrate. Cao and Tibbitts (1998) indicated that number of tubers per plant and total yield were increased with application of nitrate compared to ammonium.

Regarding the effect of nitrogen rates on the productivity of potato yield, Dubetz and Bole (1975) working on nitrogen fertilization at levels of 0, 224, 448 and 896 Kg N/ha as ammonium sulphate and showed that potato tuber yield increased with increasing nitrogen fertilizer level. Widdowson and Penny (1975) studied the response of potato to excess amounts of nitrogen fertilizer i.e.1260, 1880,2510 and 3140 Kg N/ha as ammonium nitrate and observed that yields of both fresh and dry tubers increased by giving extra fertilizer. Rezk (1980) applied potato plants, grown at summer season, with 50,100 and 150 Kg N/fed in urea form and found that total tuber yield increased by 16.7% and 28.2% with increasing rates of nitrogen from 50 to 100 and from 100 to 150Kg N/fed respectively. Sekhon and Singh (1985) treated potato plant with 60,120,180 and 240 Kg N/ha and observed that the increase in the