STUDY ON FERTILIZATION TECHNIQUES FOR LOWERING NITRATE CONTENT IN LETTUCE CROP

By

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B.Sc. Agric. Sci. (Soil Science), Fac. Agric., Cairo Univ., 2000
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SUPERVISION SHEET

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Title of Thesis: Study on Fertilization techniques for Lowering Nitrate Content in Lettuce Crop.
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Department: Soil Science**Approval:** 27 / 12/ 2016

ABESTRACT

Nitrogen is one of the essential elements for plant growth. The most common nitrogen source in hydroponics is nitrate (NO^-_3).When nitrate uptake rate exceeded its assimilation because of excessive nitrate application, nitrate accumulation in plant tissue occurs. Vegetables, particularly leafy vegetables, accumulated nitrate readily. Some previous researches suggested that the vegetables with high nitrate in the diet will cause some health problems. The objective of this work was to study the means by which nitrate concentration can be depressed in lettuce plants, to achieve this purpose, two experiments were conducted

The first experiment was conducted to study the effects of nitrate-N/ amino acid sources ratios on the growth, NO^-_3 accumulation and some macronutrient concentrations of lettuce (Lactuca Sativa L.) var. Sahara to select the best ratios of amino acids to NO^-_3-N for hydroponics culture of lettuce. Eighteen treatments were applied to lettuce plants. The eighteen treatments were a combination of six amino acids (AA), argnine (Arg), alanine (Ala), aspartic acid (Asp), glutamic acid (Glu), glutamine (Gln) and glycine (Gly), and three NO_3-N/AA-N molar ratios: (1) 100: 0, (2) 80:20 (3) 60:40 .All treatments had the same total N concentration at a rate of 12.5 $mmolL^{-1}$ in nutrient solution. The results of this experiment indicated that increasing the portion of AA-N to replace NO_3-N in nutrient solution decreased plant biomasses and glutamic acid had stronger decrease than the other AAs. Nitrate concentration decreased with decreasing NO_3-N/AA-N ratios and glutamic treatment had stronger effect than other AAs.Replacing of amino acids in nutrient solution increased essential, semi essential and non essential amino acids content of lettuce shoot compared to 100% NO_3^--N treatment.

The second experiment was conducted to evaluate the effect of nitrogen sources and rates on growth, nitrate accumulation and macronutrient concentrations of iceberg *(Lactuca sativa*) var sahara. Using ammonium nitrate , ammonium sulfate and calcium nitrate and nitrogen rates (0,30,60 and 90 kg $Nfed^{-1}$) and / or without nitrification inhibitor (ammonium thiosulfate ATS). The highest shoot fresh weight and shoot dry weight values were obtained from ammonium sulfate + ATS in N rates 90 Kg N fed^{-1}.The highest accumulation of nitrate was obtained from calcium nitrate in N rates 90 Kg N fed^{-1}.The highest concentration of N% and P% were obtained from (ammonium nitrate + ATS) and (ammonium sulfate + ATS), respectively with N rate 90 Kg N fed^{-1}while the highest K % concentration was recorded from both ammonium sulfate and (ammonium sulfate + ATS) in N rates 90 Kg N fed^{-1}.

Key words: Lettuce, nitrate, amino acid, nitrogen and nitrification inhibitor.

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INTRODUCTION

Lettuce (*Lactuca sativa* L.) is a plant of considerable agricultural and economic interest but as a leafy vegetable it accumulates large quantities of nitrate especially when grown in high NO_3^--N availability and low radiation. The accumulation of nitrate in plants depends on their genetic characteristics as well as on many environmental factors such as nitrogen supply or methods of application, light intensity, photoperiod, temperature or water supply (Marsˇic´ and Osvald,2002)

Nitrogen is the most essential mineral nutrient that promotes sufficient plant growth and consequently yield. It is absorbed by roots either as ammonium (NH_4^+) or nitrate (NO_3^-) ion and incorporated in amino acids and eventually proteins (Blom-Zandstra, 1989). The most common N source in hydroponics is nitrate (NO_3^-). Frequently farmers use excessive rates of nitrogen in vegetables to avoid N-deficiency (Porto *et al.*, 2008), ignoring environmental pollution, increase in production cost as well produce quality deterioration problems (Wang *et al.*, 2008 and Montemurro, 2010).

Nitrate in vegetables is considered to be the main source of dietary nitrate intake (Santamaria *et al.*,1998). It has been shown that 72%–94% of the NO_3^- in the human body was derived from vegetables (Shen *et al.*, 1982 and Dich *et al.*, 1996).Some previous researches suggested that the vegetables with high nitrate in the diet could put a human into the risk of gastrointestinal cancer and methemoglobinaemia

(Bartsch *et al.*,1988 and Slob *et al.*, 1995). Therefore, there is great concern about the nitrate content in the daily diet, especially in leafy vegetables.

The objective of this work was to study the means by which nitrate concentration can be depressed in lettuce plants .To achieve this purpose, two experiments were carried out. The aim of the first experiment was to investigate the effects of nitrate –N/amino acid-N ratios on the growth, NO_3^- accumulation, and some macronutrients concentrations of lettuce and to select the best ratios of amino acid-N to NO_3^-N for hydroponic culture of lettuce. The second experiment was conducted to evaluate the effect of nitrogen sources and rates on growth, nitrate accumulation and macronutrient concentrations of iceberg *(Lactuca sativa*) varsahara;using ammonium nitrate, ammonium sulfate and calcium nitrate and nitrogen rates (0,30,60 and 90 kg $Nfed^{-1}$) with / or without adding nitrification inhibitor ammonium thiosulfate ATS.

REVIEW OF LITERATURE

Lettuce (*Lactuca sativa*) is an annual plant of the daisy family Asteraceae. It is most often grown as a leaf vegetable, but sometimes for its stem and seeds. Lettuce was first cultivated by the ancient Egyptians who turned it from a weed.Whose seeds were used to produce oil, into a food plant grown for its succulent leaves. Lettuce is most often used for salads, although it is also seen in other kinds of food, such as soups, sandwiches and wraps; it can also be grilled .Lettuce is the only member of the *Lactuca* genus to be grown commercially (Koike*et al.*, 2006).

Lettuce (*Lactuca sativa* L.) is a plant of considerable agricultural and economic interest but as a leafy vegetable it accumulates large quantities of nitrate especially when grown in high NO_3^--N availability and low radiation. The accumulation of nitrate in plants depends on their genetic characteristics as well as on many environmental factors such as nitrogen supply or methods of application, light intensity, photoperiod, temperature and water supply (Marsˇic´ and Osvald,2002)

1. Nitrate accumulation in vegetables and its impact on human health.

Nitrogen is the most essential mineral nutrient that promotes sufficient plant growth and consequently yield. It is absorbed by roots either as ammonium (NH_4^+) or nitrate (NO_3^-) ion and incorporated in amino acids and eventually proteins (Blom-Zandstra, 1989). The most