

Effect of Chemical and Organic Fertilizer Applications on Lettuce (*Lactuca sativa* L. var. *crispa*) Nitrate Accumulation

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The nitrate content was analyzed in lettuce fertilized by urea as the chemical fertilizer, farm fertilizer and with different amounts of their mixture. At the end of the research, it was observed that different fertilizer applications had an important impact on the nitrate content of the lettuce. It was determined that the nitrate ratio was increased on the leaves of lettuce which were fertilized by urea and different mixture while nitrate content did not change in the leaves as a significant amount in the application of farm fertilizer.

Key Words: Lettuce (*Lactuca sativa* L. var. *crispa*), Chemical and Organic fertilizers.

INTRODUCTION

Lettuce (*Lactuca sativa* L. var. *crispa*) is among the vegetables, which can be grown open and under cover conditions during all the year and consumed as salad and fresh green vegetable. Its cultivar is conducted mostly in fall, winter and spring months. Lettuce has a quite short production period (as 2 to 3 months) and is generally grown before the main vegetable production or after as the second and the third product. In order to favour high sale prices its production is executed in greenhouses and low tunnels in winter time¹. For the leave eaten vegetables, to provide the dark green coloured leave which is demanded by the consumers and to conclude in high yield and efficiency chemical fertilization is applied. Thus, various mixtures, which negatively affect the human health, could be beyond the affordable limit values for human health. N/K fertilizing ratio in vegetables affects significantly the quality measures and false fertilizing results in nitrate and some heavy metals accumulation in leaves². According to the FAO resources it is suggested that the daily taken nitrate amount would not exceed 5 mg for each kg of human weight³.

N affects nitrate and nitrite amount contained by vegetables. Nitrate is mostly saved in shoots and leaves. Especially in leave eaten vegetables, the nitrate, which is high than a specific level, results in nitrite reduction during chewing or in digestive system where methemoglobinemia and nitrosamine and nitrosamids formation occur increasing cancer risk in human beings^{2,4,7}. Therefore, nitrate is undesired especially in leave eaten vegetables.

In this study, the amounts of farm fertilizer, urea and different ratio mixtures of fertilizer those needed by lettuce are taken as a measure in fertilizing and their effects on nitrate accumulation in lettuce are presented.

EXPERIMENTAL

The study was conducted in the fall of 2006 in the practice area of Namik Kemal University Corlu Vocational High School Greenhouse Department. Sowing and planting were realized on 5 October 2006 and 9 November 2006, respectively. Planting was realized by using 50 cm × 30 cm distances in and on the rows respectively. Merita lettuce variety was used in the study. The experiment was set according to the experimental design of three times recurrence random blocks. Plant analysis was conducted on ten sample plants, which were randomly selected of each parcel during the harvest. After grinding the dried sample plants, nitrogen was determined according to the modified Kjeldahl method⁸. Chemical fertilizer was given to the parcels during soil processing before planting. Chemical fertilizers in the form of N urea during plant vegetation were given in three different times as before planting, 20 days after planting and 40 days after planting. Other fertilizers were applied P₂O₅ in triple-super phosphate form and K₂O in potassium sulfate form before planting as base fertilizer^{9,10}.

Control: No fertilizer applied; Organic fertilizer: Farm fertilizer 5 t da⁻¹; Chemical fertilizer: N 20 kg da⁻¹, P₂O₅ 5 kg da⁻¹, K₂O 10 kg da⁻¹; 1st Mixture: 2 3⁻¹ organic fertilizer, 1 3⁻¹ chemical fertilizer; 2nd Mixture: 2 3⁻¹ chemical fertilizer, 1 3⁻¹ organic fertilizer; Double dose chemical fertilizer: Chemical fertilizer dose was used twice.

In the determination of fertilizer application doses, the need of lettuce and elemental material content of the research area soil were taken into consideration.

RESULTS AND DISCUSSION

The nitrate content, which was determined in lettuce samples of different applications at harvest, had been measured for both inner and outer leaves separately and it was found 1 % important. The average ratio of nitrate in outer leaves was measured as approximately twice of the average ratio of nitrate in inner leaves. The effect on nitrate accumulation of different fertilizer applications was found at the level of 5 % importance. The level of nitrate accumulation at the end of organic fertilizer application and at the control where no fertilizer had been applied was determined as very close to each other and was found lower than the chemical fertilizer applications. The nitrate accumulation after organic and chemical fertilizer mixtures had parallel increase as to the ratio of chemical fertilizer in the mixture. The excess dose of chemical fertilizer which had been used twice was given the highest ratio of nitrate accumulation as 758.22 mg kg⁻¹. The nitrate content of inner and outer leaves was determined different at an important level. The nitrate content of outer leaves was higher than inner leaves. This situation is not related to the location but the age of the leave^{9,11}.

TABLE-1
NITRATE AMOUNT OF FERTILIZER APPLICATIONS IN
INNER AND OUTER LEAVES OF LETTUCE (mg kg⁻¹)

Applications	Inner leave	Outer leave	Average**
Control	160.00	210.50	185.25b
Organic	152.12	280.61	216.37b
1 st Mixture	195.02	447.20	321.11ab
2 nd Mixture	220.13	600.15	410.14ab
Chemical Fertilizer	235.05	800.40	517.72ab
Twice dose chemical fertilizer	415.60	1100.84	758.22a
Average*	229.66b	573.29a	401.47

*LSD % 0.01 (inner and outer leave).

**LSD % 0.05 (fertilizer applications).

The effect of different fertilizer applications on total yield was found statistically important in the inaccuracy limit of 10 %. The lowest yield was realized as 2530 kg da⁻¹ in the control application *i.e.*, the application where no fertilizer had been applied and the other applications came after as 3379 kg da⁻¹ in organic fertilizer application; 3467 kg da⁻¹ in chemical fertilizer application; 3530 kg da⁻¹ in 1st mixture; 3610 kg da⁻¹ in 2nd mixture and 3790 kg da⁻¹ in twice dose chemical fertilizer application. Organic fertilizer was given a total yield which was very close to chemical fertilizer and 1st and 2nd mixtures' total yield was higher than chemical fertilizer. The excess dose of chemical fertilizer application which had been used twice could not increase the total yield at an important level. The difference between control and other fertilized parcels was important and the differences of various fertilizer mixtures and doses were not in the importance limit.

TABLE-2
EFFECT OF FERTILIZER APPLICATIONS ON TOTAL YIELD (kg da⁻¹)

Applications	Total yield
Control	2530 b
Organic	3379 a
1 st Mixture	3530 a
2 nd Mixture	3610 a
Chemical Fertilizer	3467 a
Twice dose chemical fertilizer	3790 a
LSD % 10	525.2

The nitrate in organic form causes lower nitrate accumulation than the nitrate given to the plant in chemical form.

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