NITROGEN CONTENT IN TOMATO FRUIT AFTER NPK FERTILISATION

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Tomato is one of the popular and most consumed vegetable in the world. It is consumed as salad with other leafy vegetables, and as stewed, fried, and baked singly or in combination with other vegetables. It is also rich in nutrients and calories.

Consumption of tomato and its products can significantly reduce the risk of developing of colon, rectal, and stomach cancer. Because the mineral composition of tomato depend on the amount and type of nutrients taken from growth medium, such as soil, it is necessary that adequate amount of nutrients should be available for the production and nutrient content of tomatoes.

Rate and type of nutrients applied in the form of fertilizers should be adjusted after analyzing the nutrient contents of soil and plant samples. Tomatoes are regularly fertilized with N, P, K from liming to adjust soil pH. Optimum soil pH for tomatoes cultivation is between 6.0-6.5. In this paper was to observed the nitrogen content in tomato fruit after NPK fertilization. The experience was done in a cambic cernosium soil, with low acidity reaction and the high natural fertility potential favorable vegetables cultivation.

The study was performed on control soil samples (without fertilizers) and soil samples after differentiated NPK fertilization in variable dozes: $N_{30}P_{30}K_{30}$, $N_{45}P_{45}K_{45}$, $N_{60}P_{60}K_{60}$, $N_{120}P_{60}K_{60}$. A field experiment was using tomatoes samples in different precocity steady: early (Export II) and middle tardy (Campbell1327). Nitrogen content in fruit varied from 0.27-0.54 ppm; the highest concentration was found in $N_{45}P_{45}K_{45}$ doses fertilization and the lowest was in control. The tomato sorts not were influences the nitrogen assimilation in tomato fruit.

***Keywords**: tomatoes, fertilszation, nitrogen, potassium, phosphorus.*

Tomatoes are now available year-round, the truly wonderful qualities of tomatoes are the best when they are in season from July through September [18].

Nitrogen (N), phosphorus (P) and potassium (K) are considered fertiliyer macronutrients because plants require them in a relatively large quantity for maximum growth and may need to be added to the soil annually [11]. Nitrogen (N), phosphorus (P) and potassium (K) are in quantitative terms the most important

minerals for the tomato fruit as they account for more than 90% of the mineral content [6].

Nitrogen: Nitrogen is one element is known as essential nutrients for plant growth [1]. While N deficiency in tomato can result from N removal by plant from the soil after the harvest of aboveground plant biomass, absence of soil amendments, such as manures and fertilizers. As N applied from manures and fertilizers to the soil is readily converted into NO_3 for plant uptake, high rate of N fertilization can result in large amount of residual NO_3 build up in the soil after crop harvest. Because NO_3 is soluble in water, high concentration of residual NO_3 can increase the potential for N leaching from the soil and contaminate groundwater. The type of N fertilizer applied can also influence tomato production because NH_4-N can be toxic to tomato growth compared with NO_3-N [12]. To obtain a best management practice that can sustain tomato yield, reduce the amount of N fertilization and N leaching, and improve soil quality and productivity [13].

High N level in the soil, on the other hand, can promote excessive vegetative growth which can delay the setting and maturity of tomato fruits, thereby reducing tomato production [5].

Nitrogen is mobile in plants, which results in yellow lower leaves if there is a deficiency. Too much nitrogen in a plant results in succulent growth, very dark green color, weak spindly growth, and not much fruit. It also may cause brittle growth, especially under high temperatures.[3] Tomatoes with vigorous foliage are usually low in nitrate content. However, where the plant is defoliated by disease, weather or other factors, the nitrate from the soil may move directly to the fruit and accumulate [1]. Nitrogen deficiency symptoms include reduced growth, yellowing of leaves (chlorosis), and reduced lateral breaks. Reds and purples also may intensify with some plants. Deficiency symptoms appear first in old growth. Corrective action for nitrogen deficiency includes fertilizing with a nitrate-based fertilizer. Soil test levels of nitrate should remain near 30 ppm during the active growing season [3].

Potassium: Potassium is absorbed as the ion K^+. Potassium is responsible for regulating the opening and closing of stomata by guard cells in the leaf. Potassium also is essential for translocations sugars and forming starch. Potassium encourages root growth and increases crop resistance to disease. Excess rain or irrigation can cause potassium to leach through the soil. Potassium is mobile once in the plant, meaning that deficiency symptoms will express in the old growth [3]. Potassium helps in vigorous growth of tomato and stimulates in early flowering and setting of fruits, thereby increasing the number and production of tomatoes per plant. Potassium nutrition can affect the quality of tomato fruit [16]. Excess potassium can causes N deficiency in plants and may affect the uptake of other positive ions. Potassium deficiency results in reduced growth, short internodes, burned or scorched leaf margins, necrotic (dead) spots in the leaf, reduced lateral breaks, and a tendency to wilt readily [3].

Phosphorus: Phosphorus is absorbed as the $H_2PO_4^-$ or $HPO_4^=$ ion. This complex does not leach readily from the soil and is mobile once in the plant.

Phosphorus is rapidly "fixed" with iron, magnesium, and aluminum on soil particles, when applied under acidic soil conditions [3].

Phosphorus helps to initiate root growth of tomato and therefore aids in early establishment of the plant immediately after transplanting or seeding. Starter solution containing high concentration of P is normally applied to tomato plants within few days after transplanting for early root development and establishment in the soil [12].

Plants actually use relatively small amounts of P when compared to N and K. Excess phosphorus can induce nitrogen and micronutrient deficiencies of Zn, Fe, or cobalt. Phosphorus is especially important for young plants and seedling growth. Phosphorus deficiency in plants generally is expressed in reduced growth, intense coloring, browning or purpling of foliage in some plants, thin stems, reduced lateral breaks, loss of lower leaves, and reduced flowering [3].

It also improves the color of skin and pulp, taste, hardiness, and vitamin C content [12].

Nitrogen (nitrates and nitrites) is known to cause several health effects. High nitrogen uptake can cause problems in thyroid gland and it can lead to vitamin A shortages. In stomach and intestines nitrates can form nitroamines; dangerously cancerigenic compounds [17].

MATERIAL AND METHOD

Field experiments

Sampling dept is the important factor for soil analyses. Deep sampling could pose a limitation for practical use in assessing N fertilization. Nitrate soil test are based on a 30 cm sampling dept [9].

Soil samples were taken (0-25 cm depth) before and after fertilization.

Was use dry/granulated fertilizers NPK – this is the most common type of fertilizer applied to the garden. Granules are coated to prevent moisture absorbtion [11].

Tomatoes samples were collected on June-July (*varieties Export II*) and August (*Campbell 1327*).

Analytical methods

Soil properties were analyzed using the fallowing methods: pH was determined in aqua solution.

Total N (%) was determined by the Kjeldahl method, digested in H_2SO_4 distilled and titrated with 0.1M NaOH. Phosphorus was determined by spectrophotometry using Spectrophotometer UV-VIS SPECORD 205 by Analytik Jena and Potassium by flame photometry method [10].

Nitrogen ($N\text{-}NO_3$) of tomatoes fruit was determined colorimetric in extract with acetic acid 2% by fenoldisulfonic acid method [10].

RESULTS AND DISCUSSIONS

Most soils do not naturally possess all the nutrients that are needed to produce top quality yields, crop after crop.

The nitrogen content in Romanian country soils have between 0.09-0.35% N [7]. The best fertilizer grade to be use depends on many factors, such as what nutrients are needed, what the soil structure and chemistry are, and the method of applying the fertilizer. A fertilizer is said to be complete when is contain nitrogen, phosphorus and potassium.

The fertilizers are better used in optimum water supply condition [8].

Nitrate-nitrogen is soluble in water and moves soil moisture. Significant quantities of nitrogen rarely out of the root zone in medium and fine textured soils when reasonable management practices are followed. Annul additions of N to the soil through rain and snow about equal the amount leached [1]

The nitrogen also affects the ripening of the fruit; more fruits will be unevenly ripe at low nitrogen concentration than at high. Nitrate global level concentration in tomatoes in concordance with WHO Codex code VO 448 is 15 mg/kg.

Tomatoes need moderate to high levels of phosphorus and potassium. Supplementary P and K may be added as indicated by sol test results [2].

In this experience the fertilization was applied in spring, with four weeks before tomatoes plantation in variable doses: $N_{30}P_{30}K_{30}$, $N_{45}P_{45}K_{45}$, $N_{60}P_{60}K_{60}$, $N_{120}P_{60}K_{60}$ and without fertilizers.

In table 1 was presented soil agrochemical parameters before experiment.

Table 1

Soil agrochemical parameters before experiment

pH	N(%)	P(ppm)	K (ppm)
6.34	0.29	163	160

The soil analysis show that soil its favorable for tomatoes cultivation, with high natural fertility potential favorable vegetables cultivation.

Tomatoes fruit were collected at thoroughly fruit maturity.

In table 2 was presented nitrate concentration in tomato fruit.

Table 2

Nitrate content in tomato fruit

Tomatoes varieties	Fertilization dozes	$N\text{-}NO_3$ ppm
Export II	Control	0.27
	$N_{30}P_{30}K_{30}$	0.38
	$N_{45}P_{45}K_{45}$	0.45
	$N_{60}P_{60}K_{60}$	0.34
	$N_{120}P_{60}K_{60}$	0.41
Campbell 1327	Control	0.29
	$N_{30}P_{30}K_{30}$	0.31
	$N_{45}P_{45}K_{45}$	0.45
	$N_{60}P_{60}K_{60}$	0.34
	$N_{120}P_{60}K_{60}$	0.35

Tomatoes fruit is vegetables with very low $N\text{-}NO_3$ content (< 200 mg/kg^{-1} fresh matter) [14].

Average N% composition of tomatoes fruit is 0.2%N [4].

The highest concentration was found in $N_{45}P_{45}K_{45}$ doses fertilization (0.45 ppm for all varieties) and the lowest was in control (0.27 ppm for Export II and 0.29 ppm in Campbell varieties). All results its many below maximum limits accept of Romanian market.

Maximum limits accept for nitrate in tomatoes fruit of was 150 mg/kg fresh matter [16].

These limits are different in all country. Fresh market tomatoes require about 75-100 pounds of nitrogen (N) per acre = 83-112 kg N/ha (Pound/ha x 1.12 = kg/ha) [2].

CONCLUSION

The obtained results indicates that:

The soil analysis show that soil its favorable for tomatoes cultivation, with high natural fertility potential favorable vegetables cultivation.

Tomatoes sorts did not influence the nitrogen content in fruit.

Tomatoes fruit is vegetables with very low $N\text{-}NO_3$ content. Average N% composition of tomatoes fruit is 0.2%N. The highest concentration was found in $N_{45}P_{45}K_{45}$ doses fertilization (0.45 ppm for all varieties) and the lowest was in control (0.27 ppm for Export II and 0.29 ppm in Campbell varieties).

All results its many below maximum limits accept of Romanian market (maximum limits accept for nitrate in tomatoes fruit of was 150 mg/kg fresh matter).

This area is favorable to ecological vegetables production. Do not over apply nitrogen fertilization.

REFERENCES

1. Brown, J.R., Marshall, C. and Smith S. G., 2007 - *Nitrate in soils and plants*, MU Extension.
2. Diver, S. et al.- *Organic Tomato Production*; http://attra.ncat.org/attra-pub/PDF/tomato.pdf
3. Flynn, R.,2002- *Plant Nutrition and Fertilizers*, New Mexico Extension Master Garden Manual-Second Edition, 12
4. Grierson, D., Kader, A.A., 1986 - *Fruit ripening and quality* , The Tomato Crop, p.241-280.
5. Kaniszewki, S. and Elkner, K., 1990- *Effect of nitrogen fertilization and irrigation on yield and fruit quality of two stated tomato cultivars*. Hort. Abstract, p. 406.
6. Kinet, J.M., Peer, M.M.,1997 – *Tomato* in: Wien, H.C.(eds.), The Phisiology of vegetable Crops , CAB international, Cambridge, p.208-258.
7. Lixandru, Gh., 1990 - *Agrochimie*, Ed.didactica si Pedagogica, Bucuresti.
8. Manescu, B., Stefan, M., 2003, **-** *Sisteme horticole comparate***,** Editura Ceres, Bucuresti
9. Magdoff, F.R. et al., 1984 – *A soil test foe nitrogen availability to corn,* Soil Sci.Soc.Am.J.48:1301-1304
10. Metodologia de analiza agrochimica a solurilor in vederea stabilirii necesarului de amendamente si de ingrasaminte,1983,- vol. I, partea 1.
11.Relf, D., McDaniel, A., Donahue, S., 2002 - *Fertilizing the Vegetable Garden*, Virginia Tech., Publication Number 426-323.

12. Sainju M.U.et all., 2003 – *Mineral nutrition of tomato*, Food. Agriculture & Environment , vol.1 (2), 176-183.
13. Sainju, M.U., Singh, B.P., Rahman, S., and Reddy, V.R. 1999 - *Soil nitrate nitrogen under tomato following tillage, cover cropping, and nitrogen fertilization*. J. Environ. Qual. 28, 1837-1844.
14. Santamaria, P., 2006 – *Nitrate in vegetables: toxicity, content, intake and CE regulation*, J.Sci.Food Agric.86: 10-17.
15. Varis, S., and George, R.A.T., 1985 - *The influence of mineral nutrition on fruit yield*, *seed yield, and quality in tomato*. J. Hort. Sci. 60, 373-376.
16. *** Ordinance no.975/1998- *Maximun limits accept for nitrate in some vegetables*, Romanian Ministry of Public Health.
17. www.lenntech/Nitrogen (N) – Chemical properties, Health and Environmental effects.
18. www. whfoods.org.tomatoes.