

FERTILIZATION OPTIMIZATION IN THE CASE OF THE LUIZA POTATO VARIETY THROUGH THE REFINEMENT OF THE ROMANIAN CHEMICAL FERTILIZERS IN THE TG. SECUIESC DEPRESSION (ROMANIA)

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Abstract. Profitable potato cultures cannot be developed without chemical and/or organic fertilization. The fertilization must assure the best possible valorization of the intensive varieties' production potential under the ecological conditions existing in the cultivation region.

The experiments took place at the Potato Research and Cultivation Station Tg. Secuiesc in the period 2005-2007.

Our research proposed this approach to the aspects of potato fertilization in the case of the Luiza variety, created at the Potato Research and Cultivation Station Tg. Secuiesc.

To achieve a higher production level, 7 levels of fertilization and 3 types of fertilizers were studied, representing NPK rates of 1:0:0 (ammonium nitrate), 1:1:0 (Complex 20:20:0), respectively 1:1:1 (Complex 15:15:15).

The highest and most stable productions are achieved by adding nitrogen in doses of 150-200 kg active substance / ha, and the presence of phosphorus and potassium up to these levels provides a maximum production at the application of the binary fertilizer, Complex 20:20:0, as well as at the application of the fertilizer Complex 15:15:15.

Keywords: potato, variety, fertilization, nitrogen doses, Romania

INTRODUCTION

The profitable potato crops, thanks to high yields, can not be conceived without chemical/organic fertilization.

The fertilization must ensure the high utilization of yield potential of intensive varieties in the ecological condition of cultivation area. Besides of the achievement of yield level, the nutritive elements influence the resistance to diseases as well as the quality of yield, although the unilateral fertilization with high quantity of nitrogen can produce sensitiveness of plants [4, 5].

The specialy papers, regarding fertilization of potato in diferent climatic and soil spotlight big and sometime contradictory diferences between rates and quantity of nutritive elements to achieve of certain level of yield.

In the first period after plantation, until a foliage surface of approx. 200 cm² is formed, the potato plant extracts the nutritive elements necessary to its growth from the mother tuber in a proportion of 96% and only in a proportion of 4% from the soil, through its radicular system [2, 3].

At the beginning the assimilation of the nutritive elements from the soil is much reduced, but this process intensifies rapidly, reaching its highest level at the beginning of flowering, when the accumulation of dry substances is the most intense [6, 9].

According to the type of fertilizer, the applied dose and the assimilation rhythm of the rates among the main nutritive elements it is achieved the fertilization optimization through the optimization of accumulations [7, 8].

MATERIALS AND METHODS

The experiments were carried out in the period 2005-2007, at the Tg. Secuiesc Potato Research and Development Station.

Table 1. The experimental factors and the graduations used

Factor A – type of fertilization (NPK rate)	Factor B - Nitrogen level (kg active substance /ha)
b1-Ammonium nitrate (1:0:0)	c1 – N0
b2-Complex 20:20:0 (1:1:0)	c2 – N50
b3-Complex 15:15:15 (1:1:1)	c3 – N100
	c4 – N150
	c5 – N200
	c6 – N250
	c7 – N300

The LUIZA variety

It is a variety created at the Potato Research and Development Station Tg. Secuiesc, it belongs to the group of semi-late varieties, with a vegetation period of 100 – 120 days, and it is produced for summer and autumn-winter consumption and industrialization.

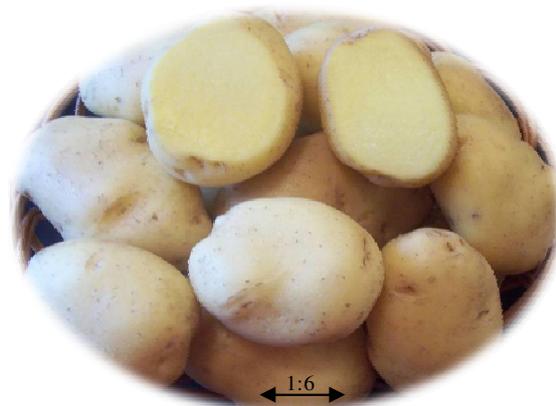


Figure 1. The Luiza variety – potato tubers

The stems are of average height and semi-erect, the plant features dark-green, average-size leaves, inflorescences of small to medium size with white flowers. The tubers are oval, with yellow skin and light-yellow pulp.

The sprouts are of average size, at the beginning of their growth of conical shape, later of cylindrical one, the terminal bud is violet-red, with short lateral ramifications.

It is a variety with leaves and tubers moderately sensitive to the late blight of potato, very resistant to the potato virus Y and to the potato leaf roll virus, as well as resistant to the potato cyst nematodes.

It has excellent culinary features, a relatively firm texture; it is suitable for various culinary products, for autumn-winter consumption and chips, pommes frites.

Fertilizers applied in the experiment

Ammonium nitrate it has got 33.0-34.5% nitrogen content, most frequently of 33.5%. It appears in the form of a crystallized or granulated salt of white, sometimes pink-yellowish color, it is water-soluble and very hygroscopic. It can be applied on every type of soil, but with restrictions on soils with an acidic reaction.

The Complex Fertilizer 20-20-0 it is a mineral compound that contains two nutritive elements: nitrogen and phosphorus. The identification code of these fertilizers is conventionally based on the individual size of the components. This type of fertilizer contains 20% nitrogen and 20% phosphorus.

The Complex Fertilizer 15-15-15 it is a mineral compound that contains three nutritive elements: nitrogen, phosphorus and potassium. This type of fertilizer contains 15% N, 15% P₂O₅ and 15% K₂O.

- The administration of chemical fertilizers was carried out at the preparation of the germination bed;
- The location of the experiment according to the method of subdivided plots in three repetitions;
- The calculation and interpretation of results was carried out according to the method of variance analysis, and for the appreciation of the significance of differences it was used the test of multiple comparisons [1];
- Observations were carried out during the vegetation period with reference to:

- the date of the main agrophytotechnical works carried out;
- the dates of the main phenophases;
- the number of planting holes in the two middle rows;
- the harvest was carried out according to variants and repetitions;
 - number and tuber weight > 2.3622 in;
 - number and tuber weight 1.1811 in - 2.3622 in;
 - number and tuber weight < 1.1811 in;

RESULTS

The behaviour of the Luiza variety at fertilization

The production of tubers obtained from the Luiza variety in the experimental years 2005-2007

In the course of the experiment on potato with types of fertilizers and fertilizer doses carried out at Tg. Secuiesc between 2005-2007, in the case of the Luiza variety it was obtained an average production of 28.2 t/ha. As presented in (Table 2) the productions differed from one experimental year to another.

As a result of the effects of fertilization in the case of the researched variants in the experimental years there were obtained coefficients of variation between 8.4 and 17.0 %.

During the experimental period this variety's behaviour was the best in the year 2007 and the worst in 2005.

The influence of the NPK rates on the production in the case of the Luiza variety

The average productions obtained at the NPK rates of 1:0:0, 1:1:0 and 1:1:1 in the range of doses of N 0 – 300 kg active substance/ha were sensitively equal in the case of the Luiza variety and were situated around 28 t/ha (Table 3).

Table 2. Variation amplitude of productions in the experimental years in the case of the Luiza variety

Year	Average ± Standard deviation	Minimum	Maximum	Coefficient of variation (%)
2005	22.17 ± 3.74	16.9	31.6	17.0
2006	29.93 ± 2.82	25.9	35.2	9.4
2007	32.55 ± 2.76	28.0	38.5	8.4
Total	28.21 ± 5.41	16.9	38.5	19.1

Table 3. Variation amplitude of productions obtained at different NPK rates in the case of the Luiza variety

NPK rate	Average ± Standard deviation	Minimum	Maximum	Coefficient of variation (%)
1:0:0	27.4 ± 6.31	16.9	35.0	19.3
1:1:0	28.1 ± 4.87	17.2	35.4	17.3
1:1:1	28.9 ± 6.14	17.2	38.5	21.2
Total	28.2 ± 5.41	16.9	38.5	19.2

The influence of nitrogen doses on the production in the case of the Luiza variety

Under the researched circumstances, on average the growth of the fertilization levels up to N 150 kg/ha determined the growth of the production of the Luiza

variety up to 30.9 t/ha, after which, on average it can be observed a decrease of the production.

The productions with the lowest variations, due to the applied fertilizers and last but not least, to the growth conditions of the plants in the case of the Luiza

variety were situated between the doses of 150 and 200 kg/ha N. At these levels the coefficients of variation were of 14.4 and 10.4 % (Table 4).

The variation of the production levels in the researched ranges decreases in parallel with the

increase of the fertilization levels up to N200. At higher fertilization doses increases of the CV can be registered, however they do not reach the level of those with low fertilization doses.

Table 4. Variation amplitude of productions obtained at different nitrogen doses in the case of the Luiza variety

N doses kg. active substance / ha	Average ± Standard deviation	Minimum	Maximum	Coefficient of variation (%)
0	25.06 ± 6.72	16.9	35.8	26.8
50	28.43 ± 6.91	19.4	38.5	24.3
100	29.38 ± 6.02	19,9	34.9	20.5
150	30.91 ± 4.45	23.3	35.4	14.4
200	30.16 ± 3.13	24.2	36.0	10.4
250	27.15 ± 4.61	21.5	35.0	17.0
300	26.42 ± 4.07	21.4	31.4	15.4
Total	28.21 ± 5.41	16.9	38.5	19.2

The differences in production in different years are displayed both at the unfertilized variants and the productions obtained with different NPK doses (Fig. 2).

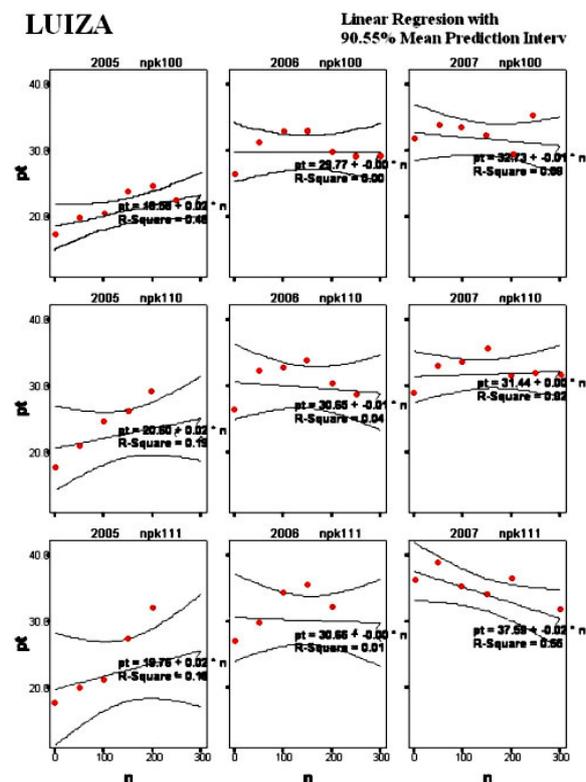


Figure 2. Correlations between the nitrogen levels at different NPK rates in the case of the Luiza variety in the three experimental years

In the year 2005 in the case of the Luiza variety, without NPK fertilization there were obtained productions of under 18 t/ha. The increase of the fertilization levels resulted in the growth of productions with lower gains in the case of fertilization exclusively with nitrogen, the maximum production being of 24,2 t/ha at the level of N200.

In the case of the NP fertilization at this level of nitrogen there were obtained 28.7 t/ha. It the fertilization was carried out with NPK, a statistically equal production level was obtained with 150 kg of nitrogen. Above the level of N200 the productions

presented a tendency to decrease at all the studied NPK rates.

In the year 2005 there were found significant relations between the growth of the nitrogen level and the productions of the Luiza variety at all studied NPK rates.

On Figure 2 the graphical representations of the quadratic equations indicate favourable consequences of the NP and NPK fertilization, especially at fertilization levels of N150 – N200, in comparison to the fertilization exclusively with N. Outside this interval the production growth decreases as the nitrogen level decreases or increases in comparison to the optimum level.

In the year 2005 in the case of the Luiza variety without applying any fertilizers there were obtained productions of cca. 26 t/ha. At all the studied NPK rates there were obtained productions of 30 and above 30 t/ha from the level of N50, productions which slightly grew, without being significantly different from statistical point of view, up to the level of N150 at the NPK rate of 1:0:0 and up to N200 at the NPK rates of 1:1:0 and 1:1:1 (Fig. 3).

In the year 2006 the influence of nitrogen doses on the productions of the Luiza variety were similar in the absence of presence of phosphorus and that of the phosphorus and potassium, the differences in production being smaller even when the nitrogen doses were close to the optimum (Fig. 4)

Due to the climatic conditions of the year 2007, which determined the appearance of new tubers on the whole, there were registered higher productions than in the previous years at all variants of the Luiza variety which correlated easily with the growing nitrogen doses, especially in the lack of fertilization with phosphorus and potassium (Fig. 5).

DISCUSSIONS

The application of technologies specific to the pedoclimatic and social-economic conditions and the achievement of major efficiencies require every technological sequence to be carried out considering the plant's needs for vegetation factors and their influence on the production's development, respecti-

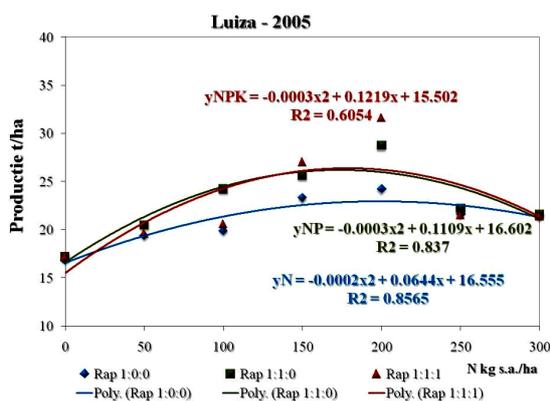


Figure 3. The influence of the nitrogen doses on the production at different NPK rates in the year 2005 in the case of the Luiza variety

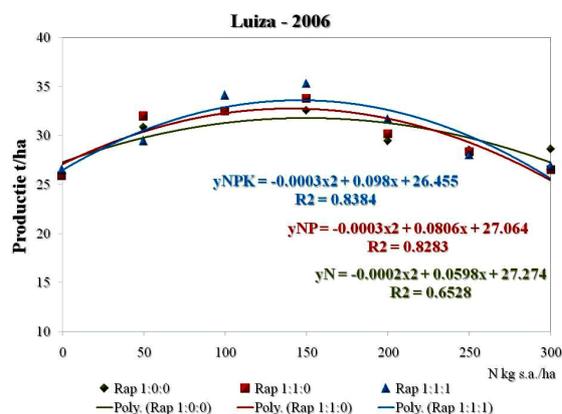


Figure 4. The influence of the nitrogen doses on the production at different NPK rates in the year 2006 in the case of the Luiza variety

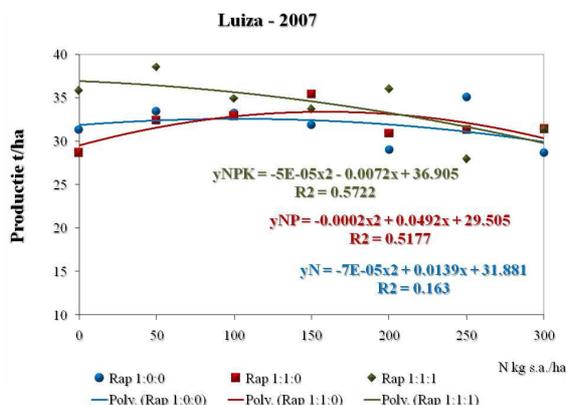


Figure 5. The influence of the nitrogen doses on the production at different NPK rates in the year 2007 in the case of the Luiza variety

vely the immediate economic consequences and the long-term ones, as well. Modern cultivation technologies must ensure a high production and profitability, as well as the protection of the environment and the product

The obtained productions are determined directly by the variety, the pedoclimatic conditions of the experimental years, the way in which the NPK

fertilization was carried out, the size of the planting material, the planting technology sequences and the applied fitosanitary control

The average productions realized at the NPK rates of 1:0:0, 1:1:0 & 1:1:1 in the interval of the N doses 0 – 300 kg active substance/ha were considerably equal in the case of the Luiza variety and they were situated around the value of 28 t/ha. The most stable productions with low variability from one year to another are obtained at doses of 100-150 N kg active substance/ha, where the lowest coefficient of variation is realized. The growth of fertilizer doses above these levels results in larger variations of productions due to the researched factors

In the case of the Luiza variety the highest and the most stable productions are obtained by the application of the nitrogen in doses of 150 – 200 kg active substance/ha, and the presence of the phosphorus and the potassium up to these intervals results in a maximum production both at the application of the binary fertilizer Complex 20:20:0 and that of the fertilizer Complex 15:15:15. Under these circumstances of optimization of the potato production, in the case of the Luiza variety it is obtained the higher rate (91%) of commercial production

The fertilization with NP and NPK based on N 150 – N200 kg active substance/ha is optimum and it results in the most favourable effects, outside this interval the growth of the productions are lower, both at higher and lower doses of nitrogen .

REFERENCES

- [1] Ardelean, M., (2005): Principii ale metodologiei cercetării agronomice și medical veterinare, Ed. Academic Pres, Cluj – Napoca, pp. 94 - 95.
- [2] Beukema, H.P., Zaag, van der, D.E., (1990): Introduction to potato production. Wageningen, Holland.
- [3] Copony, W., Mănoiu, I., (1988): Fertilizarea culturii cartofului, I.C.P.C. Braşov, manuscript.
- [4] Ianosi, S., (2002): Bazele cultivării cartofului pentru consum, Phoenix Printing House.
- [5] Ianosi, S., Ianosi, M.E., Plămădeală, B., Popescu, A., (2002): Cultura cartofului pentru consum, Phoenix Printing House.
- [6] Măzăreanu, I., Ianosi, M., Copony, W., (1990): Eficacitatea îngrășămintelor minerale funcție de desimea plantelor, în diferite condiții pedoclimatice la cartoful de consum. I.C.P.C. Annals, 17:183 – 207.
- [7] Nemes, Z., Baciu, A., Popa, D., Mike, L., Petrus-Vancea, A., (2008): The study of the potato's life – cycle phases important to the increase of the individual variability. Analele Universității din Oradea, Fascicula Biologie, Tom, XV: 60 – 63.
- [8] Nemes, Z., (2008): Perfectionarea tehnologiei de cultivare a cartofului de consum in depresiunea Tg.Secuiesc – judetul Covasna – Phd thesis, U.S.A.M.V. Cluj Napoca, Fac. of Agriculture, Romania [in Romanian].
- [9] Szalay, A., (1998): Bevezetes a burgonyatermesztesbe. Mezogazdasagi Szaktudas Kiado, Budapest.