RESEARCH ON ADDITIONAL FERTILIZATION IN EARLY POTATO CROP ON SAND SOIL

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Abstract

The early potato is one of the most profitable crops. It must be cultivated only in those areas where the environmental factors are favorable for achieving large productions, and the southern area of Oltenia meets the necessary conditions required by the plant's biology.

The researches followed the efficiency of the foliar fertilization as well as the behavior of the early potato plants regarding the realized production, depending on the administered dose. The use of foliar fertilizers on early potato has led to increased yields in all variants. By applying the ATON ZN product, the production of tubers achieved in 2021, of 36266 Kg/ha, was superior to the untreated control by 11100 Kg/ha, which means an increase of 44.1%. By applying the SEACTIV SILVER product, the production of tubers achieved in 2021, of 32166 Kg/ha, was superior to the untreated control by 7000 Kg/ha, which means an increase of 27.8%. The increase in production was achieved due to the increase in the average weight of the tubers from the variant treated with SEACTIV SILVER, which was statistically assured as distinctly significant positive.

***Key words**: early potato, fertilization, crop, foliar fertilization*

INTRODUCTION

The early potato must be cultivated only in those areas where the environmental factors are favorable for achieving large productions, and the southern area of Oltenia meets the necessary conditions required by the plant's biology. The production potential or production capacity of a variety represents the maximum level of economically useful biomass that a genotype can achieve under optimal growth and development conditions (nutrition, water, climate) and in a environment free of diseases and pests (M. Savatti, N. Nedelea et al. 2004). The potato is grown on different soils, with different degrees of water retention, starting from sandy soils and including clay soils. For potato cultivation, the ideal soil is the best structured, with proper water drainage, which allows proper root aeration, respectively the development of tubers without root diseases. The early potato leads to lower yields than the late potato but, in a very short time (40-50 days), it absorbs larger amounts of NPK from the soil, requiring the provision of a higher content of nutrients from the very beginning vegetation. Correct early potato fertilization on sandy soils is essential for optimal plant growth and development and to prevent soil and groundwater pollution. For every 1,000 kg of tubers and related epigean biomass, the potato consumes on average 5 kg of nitrogen – N, 3 kg of phosphorus pentaoxide – P2O5, 8 kg of potassium oxide – K2O, 3 kg of calcium oxide – CaO and 1 kg of magnesium oxide – MgO (Berca M, 2011). In addition to optimizing the administration of fertilizers and finding effective means of combating diseases and pests, one of the ways to obtain superior productions from a quantitative and qualitative point of view is the application of an appropriate technology (V. Berar and Gh. Posta, 2000). The application of nitrogen fertilizers should be determined according to the potential yield of the crop and the expected date of harvest. An optimal nitrogen supply ensures continuous growth and a production level close to the potential yield, while minimizing nitrogen losses in the environment (L. Mustonen, 2004). High nitrogen application rates will delay the amount of dry matter transferred to the tubers and decrease their dry matter content (Vos and Biemond 1992, Vos 1997). Potato has a relatively shallow root system and requires significant nutrient inputs to maintain tuber productivity and quality (Alva et al., 2011). Nitrogen is the most active nutrient element that plays an important role in plant life, being a component of structural protoplasmic proteins, nucleic acids, chlorophyll pigments, some vitamins and enzymes. Nitrogen is used by plants throughout the vegetation period in large quantities and its insufficiency in plant nutrition leads to yellowing of leaves, slowing or stopping of growth. Complex fertilizers provide a combination of nutrients in appropriate amounts and proportions for plant development. New fertilizer production technologies make it possible to obtain a fertilizer with a nutrient ratio suitable for the specific needs of plants (Piwowar, 2011). Foliar fertilization helps to provide additional nutrition to the plant in addition to soil fertilization and ensures the rapid correction of nutrient deficiencies. The foliar application of nutrients in various stages of growth ensures the plant a healthy and harmonious development and a considerable increase in production and quality. Foliar fertilization has recently been widely used to correct plant nutritional deficiencies, having potential advantages over soil application and can increase the effectiveness of solid fertilizer use [Silberbush 2002]. Foliar fertilization has been shown to be an excellent way to provide plant secondary nutrient (magnesium, calcium and sulphur) and micronutrient (manganese, zinc, copper, iron, molybdenum and boron) needs while supplementing NPK requirements for critical periods of growth. Foliar fertilization affects yield, both quantitatively and qualitatively [Kozera et al. 2006).

MATERIALS AND METHODS

The research was carried out in 2021 on the Arizona early potato variety, which was intervened by additional administration during the vegetation period of seven fertilizers, on agrofund N100P80K80 kg s.a./ha. The monofactorial experiment was placed in randomized blocks, with 8 variants in 3 repetitions, and aimed to optimize production according to the additional dose applied. In 2021, the following variants were studied for early potatoes grown on sandy soils:

- V1 - Untreated control
- V2 - *EUROFERTIL TOP 51*, doses 200 kg/ha solid fertilizer, one application when the stems were 10 cm. height.

- V 3 - *PHYSIO MESCAL G18*, doses 300 kg/ha, an application when the stems were 10 cm. height.
- V 4 - *CORONA N*, doses 3 l/ha, an application when the stems were 10 cm. height
- V 5 - *GENAKTIS 3*, doses 4 l/ha, an application when the stems were 10 cm. height.
- V 6 - *SEACTIV SILVER*, doses 4 l/ha., two applications, the first application when the stems were 10 cm. height, and the second application, at flowering.
- V 7 - *ATON ZN*, doses 3 l/ha., three applications, the first application when the stems were 10 cm. height, on May 5 and the following applications, 21 days apart.
- V 8 - *DEFLAN PLUS IT*, doses 2 l/ha., three applications, the first application when the stems were 10 cm. height and the following applications, 21 days apart.

Foliar fertilization was carried out two weeks after the emergence of the potatoes, when the shoots were 10 cm. height. This was done manually, with a vermorel type device. The tubers were planted on March 26, by mechanized opening of the ditches, manual planting of sprouted tubers and then mechanized covering of the ditches. The distance between rows was 70 cm, and between tubers per row 25 cm, achieving a planting density of about 57,000 plants/ha.

Observations and experimental determinations were made regarding:
- early potato production;
- soil fertility state: initial (before planting tubers) and final state (after harvesting).

The soil samples were collected at a depth of 0-40 cm, and the following determinations were made in the laboratory:

-total nitrogen – Kjeldahl method;

- extractable phosphorus (P-AL) - the Egner - Riem Domingo method, by which phosphates are extracted from the soil sample with an acetate - ammonium lactate solution at pH - 5.75, and the extracted phosphate anion is determined colorimetrically as - blue of molybdenum;

- exchangeable potassium (K-AL) – the Egner – Riem Domingo method by which the hydrogen and ammonium ions of the extraction solution replace the potassium ions in exchangeable form from the soil sample which are thus passed into the solution. The dosage of potassium in the solution thus obtained is done by flame emission photometry.

-organic carbon – method of wet oxidation and titrimetric dosing (according to Walkley – Blak in Gogoaşa modification);

- soil pH, potentiometric method

RESULTS AND DISCUSSIONS

Potato production is influenced by a complex of biological, ecological and technological factors.

Climatic conditions exert their influence on the growth and development of potato plants through the effect of temperature, precipitation, light, relative humidity of air and soil (Table 1).

Table 1. Climatic conditions from March-June 2021, recorded at the weather station of RDSPCS Dăbuleni

Month	March	April	May	June
Average temperature (°C)	5,1	9,72	17,6	21,7
Absolute maximum temperature (°C)	19,2	26,7	31,8	39,6
Absolute minimum temperature (°C)	-7,1	-3,9	1,2	10,2
Precipitation (mm)	116,2	30,6	55	53
Moisture%	71,4	62,79	60,7	69,9
Multiannual mean temperature (°C)	5,87	11,89	16,94	21,53
Multiannual average of precipitation (mm)	41,22	46,57	62,76	70,16

The optimum temperatures for the formation and growth of tubers are 16-18 °C, hence the need to plant potatoes early, especially in lowland areas. The average monthly temperature was between 5.1 °C in March and 21.7 °C in June, with an average over the four months of 13.5 °C, lower by 0,55 °C compared to the multiannual average. The precipitation recorded in these months amounted to 208.8 mm., lower by 11,91 mm. compared to the multiannual average of precipitation. Against the backdrop of high temperatures, correlated with the lack of precipitation, the phenomenon of drought has set in, making it necessary to irrigate the potato crop. Early potatoes have a faster rate of absorption, requiring the application of soluble fertilizers, while semi-late and late varieties make use of less soluble fertilizers, even manure. The amount of nitrogen applied in the fertilization options was used by the plants for their growth and the production of tubers. As for the content of extractable phosphorus and exchangeable potassium, the values were lower in the variants in which a greater amount of nitrogen was administered, variants in which the production of tubers was also higher. Also, the content of organic carbon decreased percentage in all variants, and the soil reaction remained at moderately acidic values. The obtained results showed how the main nutrients from fertilizers were used by the potato plants (Table 2).

Table 2. Soil chemical composition - Year 2021

Variant	Total nitrogen (%)	Extractable phosphorus (ppm)	Exchangeable potassium (ppm)	Organic carbon (%)	pH
V 1	0,04	74	132	0,77	6,63
V 2	0,03	78	82	0,52	6,11
V 3	0,03	89	58	0,72	5,81
V 4	0,04	62	76	0,49	5,84
V 5	0,03	87	96	0,9	5,94
V 6	0,02	62	74	0,54	6,11
V 7	0,05	103	129	0,75	6,12
V 8	0,03	63	72	0,53	6,14
Supply status	Poorly supplied	<0,10	8,1 - 18	<66	<0,58
	Middle	0,11-0,15	18,1 - 36	66,1 - 132	0,59 - 1,16
	Well suplied	0,16 - 0,20	36,1 - 72	132,1 - 200	1,17 - 2,32

By analyzing the influence of the additional application of fertilizers on the obtained productions, the variant fertilized with ATON ZN was highlighted, where the production was statistically assured as very significantly positive, the increase in production obtained compared to the control variant being 11.1 tons/ha. (Table 3).

Table 3. The influence of fertilizers on the obtained production

Varianta	Productia medie (t/ha)	Producția Relativa (t/ha)	Diferenta (t/ha)	Semnificatia
V 1	25,2	100,0	Mt	
V 2	31,6	125,6	6,4	**
V 3	31,8	126,5	6,7	**
V 4	31,1	123,7	6,0	**
V 5	31,9	126,6	6,7	**
V 6	32,2	127,8	7,0	**
V 7	36,3	144,1	11,1	***
V 8	31,6	125,6	6,4	**

LSD 5%= 4,51 to/ha;
LSD 5%= 6,25 to/ha;
LSD 5%= 8,69 to/ha

In the other fertilization variants, production increases were obtained compared to the non-fertilized option, between 6.0 and 7.0 tons/ha, being statistically assured as distinctly significant. After harvesting the tubers per variant, their weight increase was highlighted in the additionally fertilized variants. The average weight of marketable tubers harvested per nest showed values between 291 g/plant and 833 g/plant at V 7, variant fertilized with ATON ZN. Compared to the average production obtained with the *Arizona* variety in all eight variants, the V 7 variant stood out (*ATON ZN*, three applications, the first application when the stems were 10 cm high, on May 5 and the following applications, 21 days apart), the difference compared to the average production of the variety being 4.82 tons/ha., the difference being statistically ensured as being significant, with the other variants being insignificant.

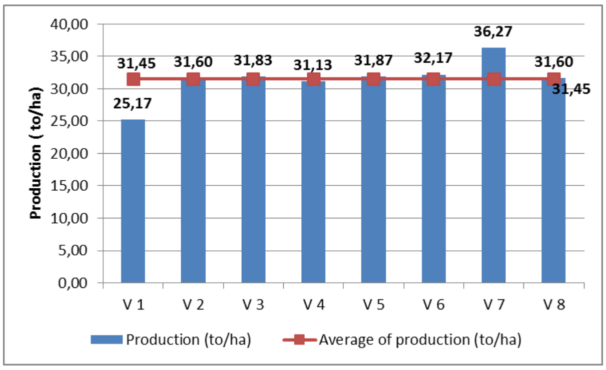

Figure 1. Production average

CONCLUSIONS

From the point of view of production, the variants fertilized with *ATON ZN*, three applications, concentration 0.75% and *SEACTIV SILVER*, two applications, dose 4 l/ha, concentration 0.5%, were highlighted, which recorded a production of 36.3 t/ha, respectively 32.2 t/ha, with a production increase of 11.1 t/ha, respectively 7.0 t/ha.

In the other fertilization options, production increases were obtained compared to the non-fertilized option, between 6.0 and 7.0 tons/ha, being statistically assured as distinctly significant.

The increase in production was achieved due to the increase in the average weight of the tubers from the variant treated with foliar fertilizers. The difference compared to the average production obtained in the *Arizona* variety in the eight fertilization options was 4.82 tons/ha in the *ATON ZN* fertilization option, three applications, dose 3 l/ha, in a concentration of 0.75%.

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