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CALCULATION OF THE FERTILISER DOSES APPLIED TO POTATO CROPS BY THE COMPANY SOLFARM SRL, COVASNA COUNTY

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Abstract

The cultivation of potatoes is mainly influenced by the type of fertiliser used, the dose of mineral or organic fertiliser applied based on the soil's supply of nutritional elements and the structure of the soil. The goal of these fertilisation experiments carried out in 2020 was the calculation of optimal and economical doses of NPK fertilisers, based on the soil's supply of nutritional elements, in order to obtain consistent yields of a certain level, using the methodology of an agrochemical study, and to determine the influence of various doses of fertilisers on the yield and on the production efficiency in potato cultivation. To monitor the soil's supply, agrochemical mappings were carried out, used to determine the optimal economical doses required to obtain a yield of 50 t/ha for three potato cultivars: Riviera, Bellarosa ans Arizona. Comparisons were made based on the data obtained, between the doses used by the company Solfarm SRL and the optimal N, P, K fertiliser doses necessary for a yield of 50 t/ha.

Key words*: chemical fertiliser, potato fertilisation, nutritional elements, agrochemical mapping.*

INTRODUCTION

The main purpose of using precision technology in the context of sustainable agriculture is to maintain or increase soil fertility, in addition to ensuring crop efficiency.

The potato is one of the plants that is most recognizant of the soil's natural fertility and of a rational fertilisation, when the other vegetation factors are at an optimal level. The potato has a high specific intake of nutritional elements. Thus, for each 1000 kg tubers and the corresponding surface biomass, it intakes on average 5 kg N, 3 kg P_2O_5, 8 kg K_2O, 3 kg CaO and 1 kg MgO (Ion, 2010).

The doses of chemical fertilisers differ with the purpose of the crop. Following a crop of perennial leguminous plants, the dose of nitrogen is reduced by 20-30 kg/ha, and the dose of phosphate is increased by 20 kg/ha. Following a crop annual leguminous plants, the dose of nitrogen is reduced by 10-20 kg/ha, and the dose of phosphate is increased by 15 kg/ha. Following a crop of technical plants, the dose of nitrogen and phosphate is increased by 10-20 kg/ha (Ion, 2010).

Among the chemical fertilisers containing nitrogen, the ones that are most often recommended are nitrolime and urea in acidic soils, and in neutral soils ammonium nitrate and urea (Miron, 2015).

Nitrogen (N) has a distinguishable effect on the growth of the crop, and is used by the plants throughout the vegetative period.

Nitrogen contributes to the increase of the yield, to the growth of the foliar system, to the increase in the tuber number and size. The potato reaches the highest uptake of nitrogen (150-200 kg N/ha) before bulking, but a smaller quantity continues to be uptaken afterwards. It is an important element for protein synthesis, it stimulates the growth of meristematic tissues, and it encourages stem ramification.

Nitrogen deficiency leads to the growth of light green plants, with small, rigid foliage, with erect leaves, and to a quick (early) maturity.

Nitrogen excess leads to a quick growth of the foliar system during tuber formation. Vines grow very long and fall quickly (Roman et al., 2012).

Phosphate (P_2O_2) is uptaken throughout the entire growth period, especially during foliage growth.

For seed potatoes, the soil must have a good supply of mobile phosphate, while avoiding excess.

Phosphate stimulates root growth and quickens foliage maturity; it stimulates an increase in the number of tubers, but not in their size.
As regards planting material, it provides a vigorous growth of the sprouts and young plants. The optimal phosphate doses encourage quick tuber growth, increased plant resistance against viral infections, increased tuber resistance against shock and storage resistance.
Phosphate deficiency leads to reduced growth, dark green foliage, upward curling of the leaves, lack of lustre and marginal scorching.
Phosphate excess leads to a decrease in the dry matter percentage and can even have a toxic effect, seen in late tuber formation and decreased yields (Burton, 1966).
Potassium (K_2O) stimulates the early growth of the potato, increases stalk vigour and leaf area, without decreasing leaf longevity. Good potassium intake increases plant resistance against pathological and physiological diseases, as well as against draught, amplifies protein synthesis and respiration, helps the plant to grow during dry periods.
The presence of high quantities of potassium in seed tubers encourages early springing. Potassium decreases the blackening of the tuber after cutting and increases the tuber's resistance against breakage, having a positive influence on the normal growth of the tubers.
Potassium deficiency is indicated by a small plant habitus, dark green-bluish colour and the bronzing of the leaves, which turn yellowish as they age, and dry tips. (Burton, 1966).
Potassium excess can negatively affect the yield, especially if the fertiliser contains chloride, to which the potato is particularly sensitive.
The agrochemical mapping paper proposes a synthesis study regarding the pedo-agrochemical conditions, together with recommendations regarding the rational use of agricultural real estate. Agrochemical features allow an in-depth understanding of the land's yield potential. The following can be achieved based on the agrochemical study:

- the rational use of fertilisers;
- the application of preventive measures against soil degradation;
- the increase in natural fertility;
- determining the soils' yield potential.

Soil reaction, expressed as pH, is an indication of the environment where the potato plant grows. Soil reaction can be acid, neutral, or alkaline, with various intermediary levels.
Humus is the main source of nutritional elements in the soil, which, depending on its quantity and quality, determines, to a high extent, soil fertility (Plămădeală, 2008).
The potato plant tolerates a more acidic physiological reaction of the soil, the most adequate pH being 5.5-6.5, but it can be grown without significant damage on soil with pH between 4.5-7.5 (Saulescu, 1971).
With a higher pH there is danger of a stronger presence of the common scab. This is why potato crops are not grown on soil that was treated during the previous year (Axinte et al., 2006).
The nitrogen index (NI) is used to determine the quantity of nitrogen available in the soil. Soil where the NI is lower than 2 is considered to have a low supply of nitrogen, soil where the NI is between 2.1 and 4.0 has a medium supply, and above 4.1 good and very good supply.

MATERIALS AND METHODS

For the production and propagation of potato planting material from higher biological categories, the increase of the propagation index and the optimum efficiency of the yield, are important objectives (Berindei, 2000).
Currently, the company SOLFARM SRL grows seed potatoes on area of 35 ha each year.
Starting with the observation that the company, in particular for potatoes, applies larger quantities of chemical fertilisers than needed by the crop for the yield obtained, the purpose of these fertilisation plans for 2020 was to determine the optimal and economical NPK dose, based on the soil's supply of fertilising elements, to obtain consistent yields of a certain level, using the methodology of agrochemical studies in the future.
For trial cultivars, the higher biological category was used when planting, tubers from the 30-55 mm diameter fraction, i.e.:

- Riviera, very early potato cultivar

Riviera

- Bellarosa, extra-early, red, potato cultivar

Bellarosa

- Arizona, medium-early potato cultivar

Arizona

Organic fertiliser was applied in autumn, 30 t/ha per trial lot. Chemical fertiliser was applied on all 3 lots of the company SOLFARM as follows Table 1.

The following are represented in Table 2: soil reaction, the soil's supply of mobile phosphate, the values of the nitrogen index reflecting the soil's supply of available nitrogen, the soil's supply of mobile potassium, the organic matter content (humus).

Table 2. The results of the soil samples

Area (ha)	Prem. Culture (2018-2019)	Recent crop (2019-2020)	pH	NI %	Humus %	Mobile phosphate (ppm)	Mobile potassium (ppm)
2	Rape	Potato	5.92	2.18	2.59	84.63	300
2	Rape	Potato	5.43	2.84	3.68	55.63	260
2	Rape	Potato	5.25	2.41	3.22	55.22	240

The soil samples taken from the 3 lots, the pH varied between 5.25-5.92 indicating a moderate acidity.

As regards the supply of nutritional elements, the soil has a good supply of phosphate (55.22-84.63 ppm) and a very good supply of potassium (240-300 ppm). The values of the nitrogen index were between 2.18-2.84 (medium).

The organic matter content (humus) in the soil falls within the limits of a medium to good supply level (2.59-3.22%).

The recommended quantities of chemical fertiliser were between 372 and 432 kg a.s./ha (Table 3).

Table 1. The influence of fertiliser doses on the yield obtained by SC. SOLFARM SRL

Species Type	Fertilisation 1 with YARAMILA 9-15-25		Fertilisation 2 with YARAMILA 8-11-23		Fertilisation 3 NITROCALCAR		Yield (t/ha)
	a.s. kg/ha	year 2019	a.s. kg/ha	year 2019	a.s. kg/ha	year 2019	
Riviera	430	08.03	430	29.03	350	17.04	40
Bellarosa	430	08.03	430	29.03	350	18.04	55
Arizona	430	08.03	430	29.03	350	19.04	42

Table 3. Fertiliser doses calculated based on an agrochemical study

Species Type	Estimated yield (t/ha)	Fertilisation recommendations for 2020 (a.s./ha)			Total NPK (s.a./ha)	Remarks
		N	P_2O_5	K_2O		Compound +Nitrolime (4 years)
Riviera	50	239.98	86.98	65.44	372	16:16:16
Bellarus	50	226.94	115.41	71.61	414	16:16:16
Arizona	50	234.63	116.68	80.15	432	16:16:16

RESULTS AND DISCUSSIONS

Taking under analysis the influence on the yield of these fertiliser doses, it seems that the highest total yield was obtained for the Bellarosa veriety (55 t/ha), followed by the Arizona variety with a yield of 42 t/ha, and the lowest yield was obtained for the Riviera variety (40 t/ha) (Figure 1).

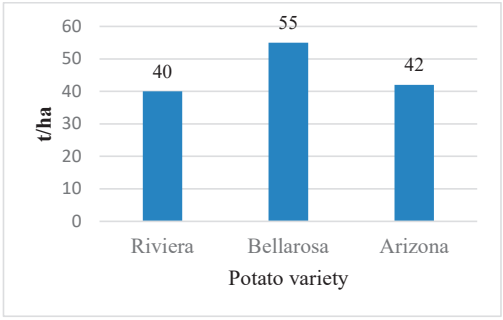

Figure 1. Yield obtained by SC Solfarm SRL in 2019

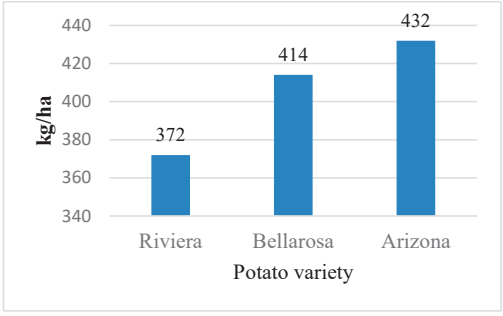

Figure 2. Determining the NPK fertiliser dose for the yield of 50 t/ha

The most efficient yield is obtained based on the recommended system of the NPK dose calculation, based on the data in the agrochemical mapping of the soil for obtaining a potato yield of 50 t/ha (Figure 2).

It can be seen that based on the methodology of the agrochemical study, from the yield perspective, the quantity obtained is almost identical in both cases (Bellarosa variety-yield of 55 t/ha and estimated yield of 50 t/ha), using a fertiliser dose significantly lower, without the risk of reduced yield. There is no business reason either for the fertiliser dose to be too high (Figure 3).

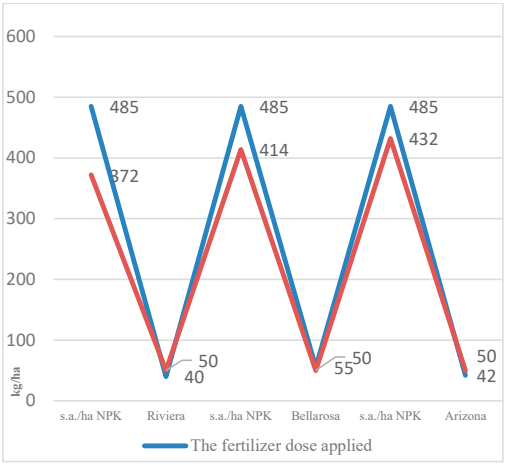

Figure 3. The NPK a.s. quantity used and proposed for 2020

CONCLUSIONS

The potato is a staple crop with a distinct economic and social importance for the agriculture in the Covasna county, first of all as a result of the ecological conditions favourable to this crop and less favourable to others, and secondly as a result of the productivity provided, compared to other crops.

If the soil is supplied with phosphates, it can be seen that good and very good results are obtained for the three lots. This synthesis shows that on most lots there are no special problems regarding phosphate fertilisation.

It must be noted that the soil's supply of mobile potassium on the three lots exceeds the "very good supply" threshold, in which case potassium is applied in very low doses, decreasing the fertiliser cost.

We believe that the results of the agrochemical mapping initiated by SOLFARM SRL aiming to streamline potato fertilisation according to the planned yield will lead to higher and more efficient yields.

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******Cartarea agrochimică a teritoriului*** - SC SOLFARM SRL Sfântu Gheorghe, Jud. Covasna.