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Original Article

The Effects of NPK Fertilization on Growth Dynamics of Potato Plants Under Non-Irrigated Conditions

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Abstract

The effects of NPK fertilization on growth dynamics of potato plants under non-irrigated conditions were studied during 2013-2014, in Brasov experimental conditions. In this experiment were used two potato varieties, Christian and Roclas. Two different nitrogen fertilizers levels, N100 kg/ha and N200 kg/ha were used. The variants were done with two complex fertilizers given before planting: C15-15-15, for NPK report of 1:1:1 and C5:10:22, supplemented with ammonium nitrate through which was realized NPK 1:0.9:2 report. Dynamics of biomass components, yield accumulation and tubers starch content was monitored by performing six harvests on dynamics. Maximum aerial mass was recorded in the first two observations in both varieties, after 25 and 37 vegetation days in 2013 and 22 and 34 vegetation days in 2014. In 2013 maximum production was obtained in fertilized variant with N200:P180:K400, to Christian variety 975 g/plant (at 52 days after emergence DAE) and to Roclas varieties 1021 g/plant (at 80 DAE). In the two years studied, the maximum levels of starch content were registered in variants N100, P100: K100, starting with 61-62 DAE, after that, on this variant the increases of starch content have become insignificant. As a result of various hydrothermal conditions in those two years, the maximum starch content of 16.3-16.7% recorded in 2013 to Christian, were reduced in 2014 to 14.5-15.1%. The effects of climate on tuber starch content could not be manifested to Roclas variety, maximum content exceeded 17% on both years. Doubling doses of NPK from both reports resulted in declines of tuber starch content which was manifested stronger in the year 2014 with higher humidity.

Keywords: potato, fertilization, starch accumulation

1. Introduction

Climatic condition influence potato plant growth and developement. Meteorological factors directly influence potential crop productivity, regulating its transpiration, photosynthesis and respiration processes in such a way as to control the growth and development of the plants throughout their physiological mechanisms at a given site [6]. With high temperatures and moist soil conditions the effect of nitrogen on the growth habit is more pronounced than with lower temperatures and drier conditions [2.

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For potatoes, either deficient or excessive plant nutrient can reduce tuber bulking and quality. Nutrient deficiencies may limit the leaf canopy growth and its duration, resulting in reduced carbohydrate production and tuber growth [5]. After emergence, the haulm and roots develop simultaneously; haulm growth and root growth are corelated [2]. Crops supplied with hight levels of nitrogen reach maximum tuber production at a later date than those where the level is lower. Nitrogen is the dominant nutrien taken up by potao and plant N requirements are greater than any other nutrient; when N supply is too low, total growth will decrease [1].

Nitrogen fertilization rates stimulates haulm growth [2] and have the greates influence on potat yield; nitrogen causes exuberant growth of the green parts of the plant, thus also increasing the yield [4]. Canopy growth and development influence main tuber yield components [3]. Increasing the dose of nitrogen decrease the starch accumulation of potato tubers. Potatoes require large amounts of soil K. Potassium deficiencies reduce the yield, size and quality of potato crop and a lack of adequate soil K is associated with low specific gravity in potatoes [5].

The effects of NPK fertilization on growth dynamics of potato plants under non-irrigated conditions were studied during 2013-2014, in Brasov experimental conditions.

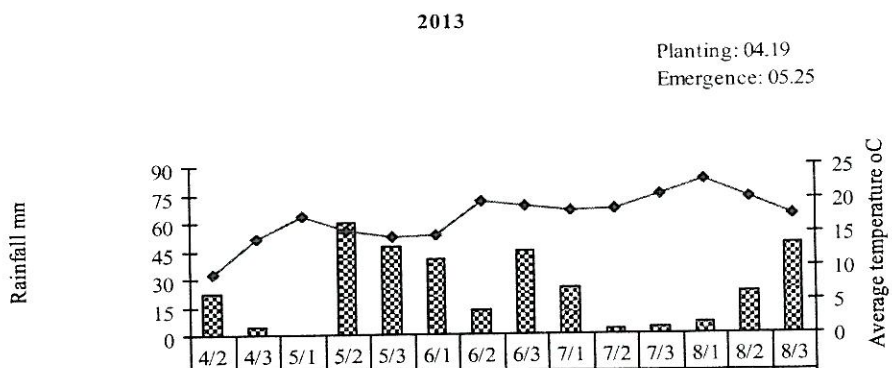
2. Material and Method

The experience of multi-factorial type, with plots subdivided, was done in Brasov on a black earth soil in a non-irrigated crop. Was studied the effects of basic fertilization with different NPK doses and reports on the dynamic growth of potato plants on non-irrigated conditions for two potato varieties, Christian and Roclas. Two different nitrogen fertilizers levels, N100 kg/ha and N200 kg/ha were used. The variants were done with two complex fertilizers given before planting: C15-15-15, for NPK report of 1:1:1 and C5:10:22, supplemented with ammonium nitrate through which was realized NPK 1:0.9:2 report.

The two years of study, 2013-2014, aimed the growth dynamics of potato plants, yield and starch accumulation in tubers. Six harvests were made for each variant, starting with the 25th day post potato emergence in 2013 and the 22nd day post potato emergence in 2014. For each harvested plant were made the following observations: aerial weight, weight of the underground part, tuber weight and tuber starch content. The research was conducted in two years with very different growth conditions in terms of climate. During the observations, were followed decadal average temperatures and precipitation amount.

In 2013 planting was done in the second decade of April (fig. 1).

Once planted in April and early May, rainfall was reduced. Since May, rainfall in each decade were common until the beginning of July. Thermo-hydrate conditions of this period favored the emergence and growth of lush foliage. Decades two and three in July and early August were particularly dry. Due to the lack of rainfall and high temperatures foliage could no longer support itself, photosynthetic activity going into decline since the first decade of August and plants dried on an accelerated basis



	4/2	4/3	5/1	5/2	5/3	6/1	6/2	6/3	7/1	7/2	7/3	8/1	8/2	8/3
PPmm	22,2	4,2	0,0	60,0	47,4	40,6	13,2	45,0	24,6	2,8	3,6	6,0	22,2	48,0
TgradeC	9,1	14,2	17,7	15,4	14,4	14,8	19,7	19,1	18,4	18,7	20,8	22,9	20,2	17,6

Month / decade

Figure 1. Average temperatures and decadal rainfall amount during observations made in 2013.

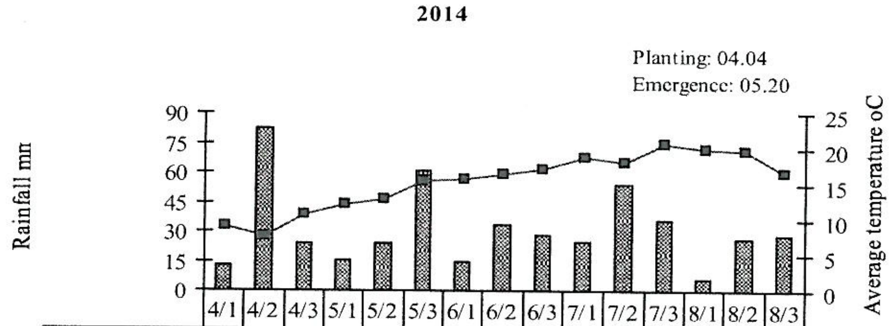
Climatic conditions in 2014 allowed planting in the first decade of April (fig. 2). Thermo-hydrate conditions in 2014 were very favorable for the development of potato plants by the end of July. Also, the high frequency of days with precipitation and high temperatures favored to more sensitive varieties (Christian) the infection with late blight. High temperatures and low rainfall in August led to plant maturation and vegetation stopping of mid-late and mid early varieties.

Dynamics of fresh biomass components and starch content of the tubers was studied separately for each fertilization variant on Christian and Roclas varieties, by ANOVA, followed by multiple compared with Duncan test for values measured at different harvest times during the two years.

For comparative study of plant evolution and the starch content for each variant of fertilization, variety and year, was calculated for each variant one regression between vegetation number of days from the emergence, the measurement date and the variable measured.

For all the studied elements, quadratic equation model was chosen by the type Y = b0 + (b1 * t) + (b2 * t**2).

With this model, regressions were statistically calculated for all elements studied, except underground part weight. The paper presents an example for dynamic concentration curves of tuber starch.



	4/1	4/2	4/3	5/1	5/2	5/3	6/1	6/2	6/3	7/1	7/2	7/3	8/1	8/2	8/3
PPmm	12,8	81,9	23,8	15,2	23,8	61,2	14,2	33,2	28,6	25,2	54,0	36,2	5,8	26,2	28,6
TgradeC	9,1	7,6	10,7	12,1	12,9	15,4	15,6	16,4	17,2	18,9	18,1	20,7	19,9	19,7	16,7

Figure 2. Average temperatures and the amounth of decadal rainfall during the observation period in 2014

3. Results and Discussions

Maximum aerial mass was recorded in the first two observations in both varieties, after 25 and 37 vegetation days in 2013 and 22 and 34 vegetation days in 2014. In 2013 (table 1), the highest values (Christian 867 g/plant and Roclas 1045 g/plant) were measured in fertilized variant with N200:P180:K400. In 2014 (table 1), the highest values (Christian 1125 g/plant and Roclas 1134 g/plant) were made by fertilization with N200:P200:K200. In both years the aerial fresh weight was significantly reduced in both varieties. Lowest reductions were recorded to Roclas variety, in both years, on variants with high doses of nitrogen (N200:P200:K200 and N200:P180:K400). In these two variants vegetation continues to 80 and 78 days after emergence.

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