Reducing sugars, vitamin C and phenol compounds in potato tubers cultivated with new synthetic growth regulators application

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Introduction

In 1992 in the west European countries there were 849 preparations registered and used as plant growth regulators of natural and synthetic origin [4]. Some of them demonstrate a wide range of operation on many plant species, while the others act selectively against one species only. It refers mainly to the synthetic regulators.

A considerable part of these preparations (44,4%) was recommended to be used in the floriculture. As to potato cultivation only 5,1% of the preparations could be used there. It suggests that new growth regulators for potatoes should be intensively worked on nowadays.

On account of this the present authors carried out a 3 years` cycle of researches with new synthetic growth regulators i.e. Poteitin made in Ukraine and Mival in Russia. These preparations were applied in cultivation of 34 potato varieties popular in Poland and 3 Dutch ones.

Poteitin is a complex of N oxide of 2,6 dimethylpyridine with succinic acid registered in Ukraine in 1993. It is a selective regulator recommended for potato cultivation only [1,2,3].

Mival is a silico-organic biostimulator of a wide operating spectrum for various plant species. Its active substance is made by 1-chloromethylsilatrane. It is classified as untoxical and clean ecologically. LD = 2 - 2,5 g per 1kg of white mouse body weight.

This preparation decomposes to SO_2 , CO_2 , H_2O, $CO(NH_2)_2$ and $C_2H_5NH_2$ [5] in the soil and plant.

Materials and methods

The studies were based on the results of a field experiment conducted in 3 years` cycles on the soil developed from high loamy sand. The soil showed a medium to high phosphorus content, a high potassium content, whereas its reaction was from light acid to neutral.

The potatoes were fertilized with manure in dose of 250 dt ha^{-1} and mineral fertilizers in amounts of: 100 kgN, 100 kg P_2O_5, 150 kg K_2O ha^{-1}.

The seeding material of the tested varieties was at the degree of superelite.

The growth regulators were used for seed-potato spray in form of Poteitin water solutions

10 mg dm^{-3} concentration and Mival 500 mg dm^{-3}. The preparation consumption was 300 mg of Poteitin and 15 g of Mival in 30 dm^3 water per 1t of seed-potatoes. The control tubers were sprayed the distilled water.

The experiment comprised 34 following Polish cultivars: Aster, Atol, Beryl, Bliza, Bogna, Brda, Bronka, Bryza, Bzura, Certa, Ceza, Cisa, Dryf, Duet, Elida, Elipsa, Fala, Fauna, Fregata, Frezja,

Heban, Irys, Jasmin, Lotos, Mila, Orlik, Perkoz, Pilica, Pola, Ronda, Ruta, Sokól, Stobrawa, Tarpan and 3 Dutch ones: Diamant, Eskort and Premieur.

All earlinerss groups were used in the experiment.

The analyses on the fresh material of 50 tubers from each potato cultivar were made immediately after the harvest. Reducing sugars were determined by the colorimetric method with the dinitrosalicylic acid (DNS). Vitamin C was established by means of Tillman`s method and phenol compounds after Mopson and Swain`s method. Each analysis was repeated three times for each variation. The content of a particular tuber component was in g/100g fresh matter (reducing sugars) and in mg/100 g f.m. (vitamin C and phenol compounds)

The results obtained were statistically worked out by means of the analyses of variance while their verification was made according to Tukey`s test.

Results and discussion

Reducing sugars content

The potato tubers cultivated with Mival and Poteitin showed a reducing sugars concentration ranging from 0,24 mg in 100 g of fresh mass in Ceza cv. to 0,45 mg in Bryza one. Analysing the regulator influence on this element concentration it was found out that Poteitin has statistically decreased significantly this concentration (by 10%-17%) in the tubers of only 4 later cultivars (Fauna, Fala, Eskort, Ceza),where as it increased in the tubers of 4 other varieties of short vegetative period (Aster, Perkoz, Frezja, Beryl). Yet, for the other cultivars the changes resulting from Poteitin use were statistically insignificant (Fig. 1.).

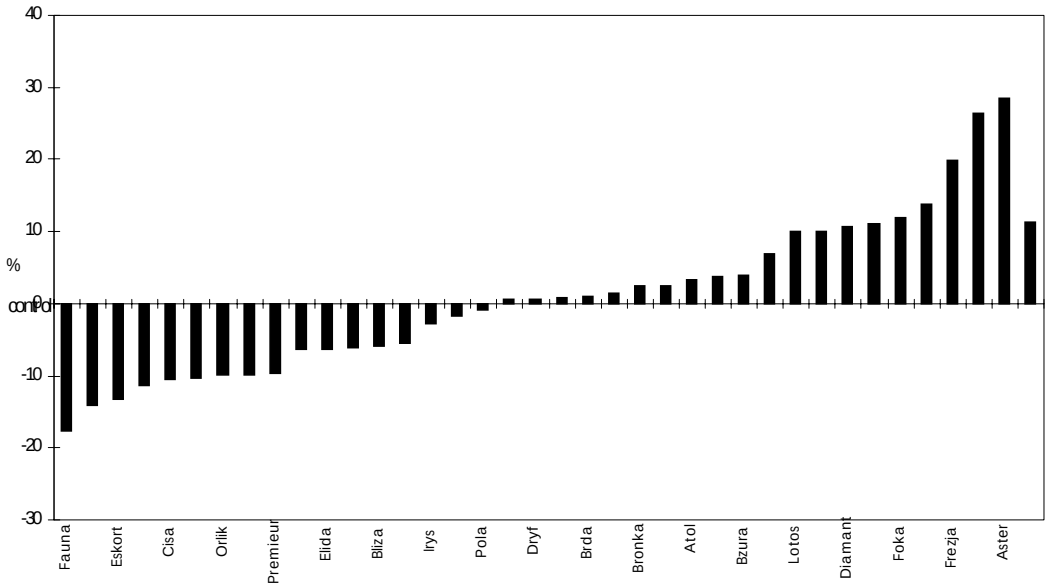

Fig. 1: Influence of Poteitin on the content of reducing sugars in potato tubers of different varieties (% of control).

Mival changed reducing sugars content in tubers to even smaller extent. The changes of the element proved to be statistically significant in the tubers of only 6 cultivars. In one cultivar -Fala there was a drop of concentration recorded and for five others (Atol, Aster, Heban, Pilica and Foka) a concentration growth (Fig. 2.). The reducing sugars content increase may limit the use of tubers of these cultivars for chips produce.

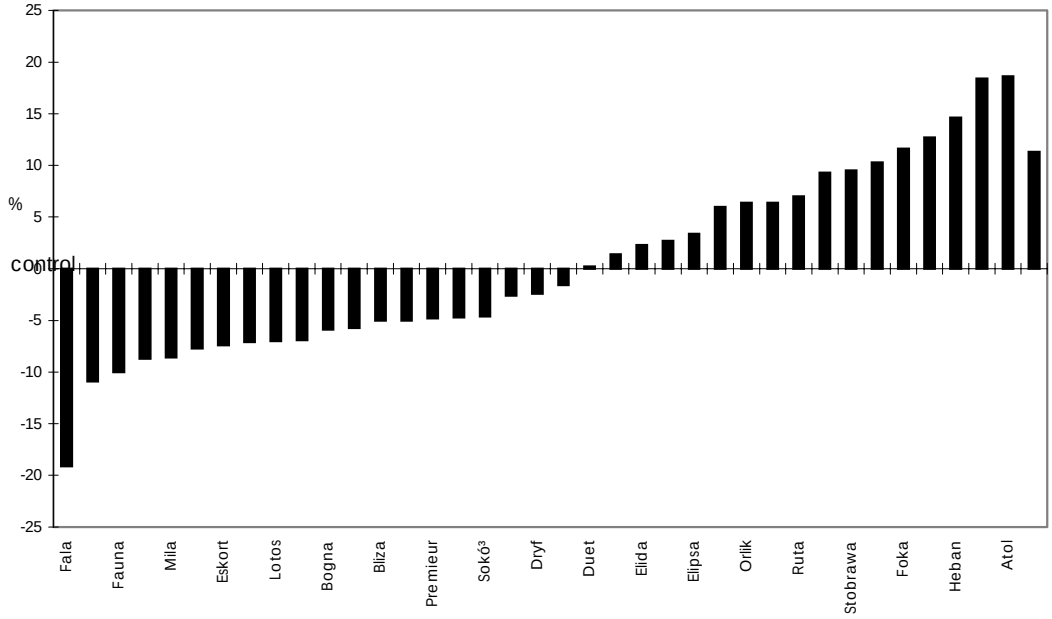

Fig. 2: Influence of Mival on the content of reducing sugars in potato tubers of different varieties (% of control)

Vitamin C content

The experiments of the present authors showed that Vit. C content determined as sum of the ascorbic and dehydroascorbic acid changed from 16,1 mg in the Elipsa tubers to 26,2 mg in 100 g of Diamanta fresh mass tubers. Poteitin used for seed-potato spray caused an increase of Vit. C content in the tubers of most cultivars and in some of them even by 20%-54% as compared to the control tubers (Fig. 3.). The most favourable changes of this element induced by Poteitin were stated in the tubers of Ruta, Lotos, Elida.

A significant decrease of Vit. C concentration occurred in the tubers of only two cultivars, that is Sokól and Aster.

The other regulator- Mival had an equally beneficial effect on Vit. C content as it also increased its concentration. A statistically significant growth of Vit. C content in the tubers was noted in twenty of cultivars studied, yet in eight varieties the changes were by 16%-45% as compared to this vitamin content in the control(Fig. 4.).

In six other cultivars Mival decreased vit. C content and the greatest drop was recorded for Sokól cv. (29,5%).

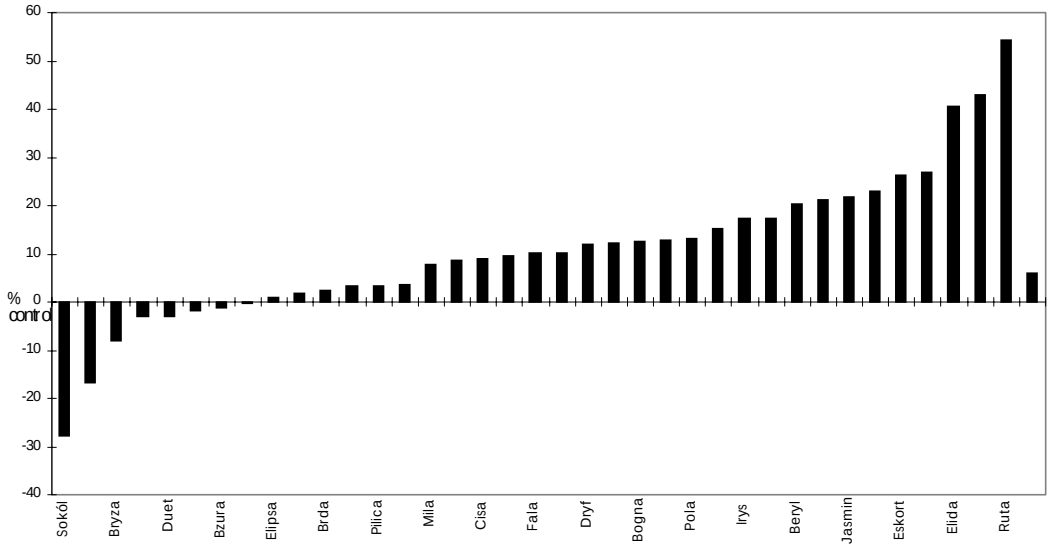

Fig. 3: Influence of Poteitin on the content of vitamin C in potato tubers of different varieties (% of control).

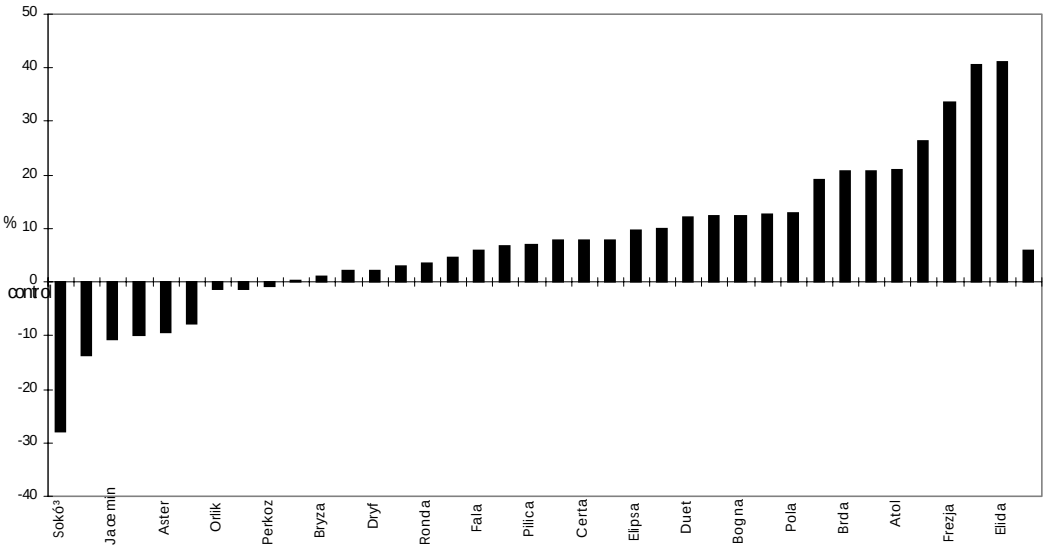

Fig. 4: Influence of Mival on the content of vitamin C in potato tubers of different varieties (% of control)

Phenol compounds content

The potato tubers with growth regulators ue showed a decrease of phenol compounds content by 11,9 mg for Pola cv. to 56,2mg in 100g of Diamanta tubers fresh mass. Out of both growth regulators used, Poteitin proved to change phenol compounds content to a greater degree. This regulator increased their content in the tubers of twenty cultivars, and in fifteen of them a growth by

20%-50% was noted as against the control. In the tubers of other eight varieties there was recorded a drop of 10%-20% of the phenol compounds, that is significant statistically(Fig. 5.).

The effect of Mival on the compounds concentration in potato tubers was smaller than that of Poteitin. This regulator has significantly increased phenol compounds in the tubers of 12 cultivars, still only in seven of them an increase was over 20%. In the tubers of 12 other cultivars there was a significant decrease of phenol compounds content due to Mival use(Fig. 6.). Both, an increase of the compounds content and their decrease did not depend on the vegetative period length. Such a response of the cultivars to the regulators use was an individual trait of a cultivar.

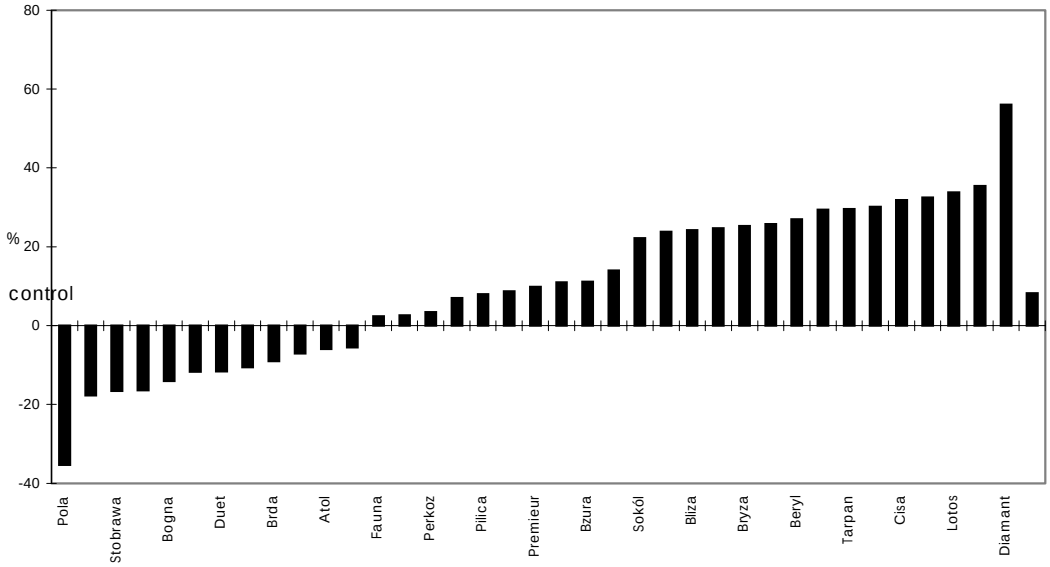

Fig. 5: Influence of Poteitin on the content of phenol compounds in potato tubers of different varieties (% of control).

Assessment of the effect of the synthetic growth regulators produced in Russia and Ukraine on the chemical composition changes in potato tubers showed that the changes were conditioned by cultivar character of plant and not by the vegetative period length.

The studies on Poteitin use for potato cultivation were conducted by the Ukrainian researchers [2, 4] and on Mival by Russian ones [1, 5] and the investigations covered only the regulators influence on the crop growth or starch content in tubers. Evaluation of the other elements content was not made, hence it is difficult to explain various directions of the changes of the same component content in different cultivars.

The agrotechnical assessment of Mival and Poteitin was performed by Sawicka [3]. Poteitin increased the tubers crop by 7,2% and Mival 9,4% on average. Generally, the preparations also increased starch content in the tubers.

Considering all the effects of changes caused by the regulators used it may be held that these preparations can be used for the cultivation of some potato varieties in Poland.

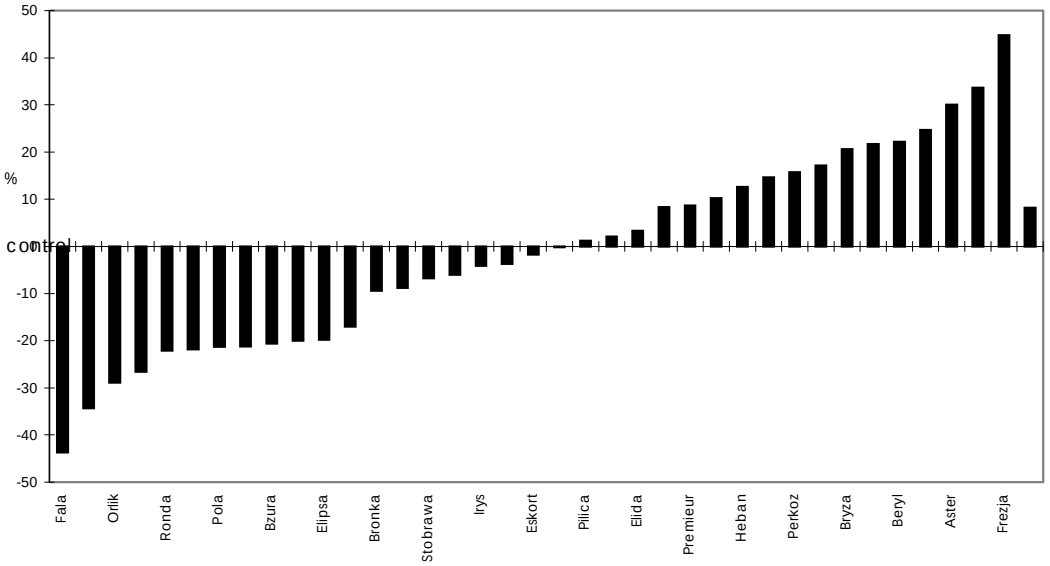

Fig. 6: Influence of Mival on the content of phenol compounds in potato tubers of different varietie (% of control)

Conclusions

The synthetic growth regulators Poteitin and Mival applied for 37 potato cvs gave the following results:

- an increase of vit. C and phenol compounds contents
- some groups of cvs responded with unfavourable changes in the chemical composition - drop of vit. C and phenol compounds and an increase of reducing sugars content
- this preparations may be recommended for cultivation of most potato cvs in Poland, that is, Poteitin
- particularly for the following cultivars: Bronka, Ceza, Cisa, Diamant, Elida, Fala, Lotos, Perkoz, Pilica. Mival - for Atol, Brda, Elida, Eskort, Frezja, Irys, Lotos, Stobrawa.

Literature

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