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The effect of cultivation methods on the yield and biological quality of potato

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Abstract. The effect of organic and conventional methods on the yield and biological quality of potato in two field crop rotations was identified. The field trials were performed in Central-Estonia in Olustvere (58º 33´ N, 25º 34´ E) during two years and in North-Estonia in Saku (59º 18´ N, 24º 39´ E) during three years. In Olustvere the following cultivation methods were compared: organic I – without manure, organic II – with cattle manure (at the rate 60 t ha^{-1}), and conventional (manure, mineral fertilizers and pesticides were used). In organic cultivation the fertilization with manure increased the potato yield on average 36.5%. At that, the dry matter content in tubers decreased and the nitrate content increased. In conventional farming the yield was 127% higher than in the variant organic II. In organic cultivation the tubers' content of dry matter, starch and minerals was higher than in conventional cultivation. As to the content of reducing sugars, crude protein and nitrates no significant differences were found between the cultivation methods.

In Saku, the yields and biochemical composition of potato were compared in trial areas fertilized with plant compost and mineral fertilizers. Equivalent rates of NPK to both trial variants were applied during three years. With compost the yield of potato was on average 32.1% lower than with mineral fertilizers. There were no significant differences in the effect of compost and mineral fertilizers on the biological quality of potato tubers.

Key words: organic and conventional cultivation, equivalent rates of NPK, starch, reducing sugars, crude protein, nitrates, minerals

INTRODUCTION

Over the last few decades, consumer demand for healthier food and government policies focused on environmentally sustainable agricultural systems have both promoted a rapid expansion of organic farming. Potato (*Solanum tuberosum* L.) represents a major food crop in many countries where the demand for organic products is gradually increasing (Maggio et al., 2008).

It is a widespread belief that organic farming improves the state of the environment, the health of people, and increases the quality of food products (Schuphan, 1974; Woese et al., 1997; Lundegårdh & Mårtensson, 2003). According to Köpke (2005), a potential advantage of organic agriculture in producing healthy foods is based on higher concentrations of beneficial secondary plant substances in organically grown crops compared to non organically grown crops.

Whether a difference indeed exists in the nutritional value of organic and conventional food products is a crucial question but with no definitive answer (Brandt

& Molgaard, 2001; Magkos et al., 2003). Nutrient concentrations in plants are often expressed on a dry matter basis. Nevertheless, non-significant differences between organically and conventionally grown foods on a dry matter basis may translate into significant differences on a fresh weight basis, if there are large enough differences in the percent dry matter between the two types of products. Thus, it is important that nutrient levels are reported and compared on a fresh weight basis (Magkos et al., 2003). Valid nutritional quality comparisons between organic and conventional foods require that the plants be cultivated in similar soils, under similar climatic conditions, be sampled at the same time and pre-treated similarly, and analysed by validated methods (Kumpulainen, 2001; Magkos et al., 2003).

Organic foods are generally considered healthier than conventionally-grown products. Nevertheless, an improved nutritional profile of organic vs. conventional crops has not been ascertained (Gennaro & Quaglia, 2003). In this respect, it is not known whether and how different cultivation systems may affect the nutrient composition of the final product. Comparison of organic and conventional foods in terms of nutritional value, sensorial quality and food safety, has often highlighted controversial results. As a consequence, a clear link between cultivation system and nutritional value of agricultural products is still missing (Woese et al., 1997; Bourn & Prescott, 2002). Research information about the differences in the quality of conventionally and ecologically cultivated potatoes is neither homogenous nor sufficient (Hamouz et al., 2005). In the opinion of experts the present knowledge is not sufficient to conclude that organically grown foods would have a positive effect on health (Kessen, 2003). The Swiss Association for Research and Nutrition concluded that from a scientific viewpoint, organic foods are neither healthier nor safer than conventional products. Some studies show that organic foods may contain more fungal toxins that foods produced by conventional methods (Bruulsema, 2002).

Many researchers state that organically grown crops contain less nitrates but higher concentrations of important nutritive substances (Schuphan, 1974; Varis et al., 1996; Granstedt & Kjellenberg, 1997; Rembialowska, 1999; Bruulsema, 2002; Maggio et al., 2008). Although a small number of studies have reported slightly higher contents of minerals and trace elements in organically grown plants, the majority of evidence has revealed no significant differences (Warman & Haward, 1996; Worthington, 1998; Magkos et al., 2003).

The science shows that high quality food can be produced using either organic or inorganic nutrient sources. Crops produced with organic nutrient sources do not differ in quality from those produced with mineral fertilizers. Differences that occur usually result from differences in amount and balance of nutrients supplied (Schuphan, 1972; Schröder, 1984; Bruulsema, 2002). Unfortunately, the majority of studies aiming at the comparison of the effect of cultivation methods have not been conducted under equal terms. One of the few studies, in which organic and conventional practices were compared under similar conditions, was performed at the University of Naples. The equivalent organic vs. inorganic N fertilization rates on yield and quality of two potato cultivars grown under conventional or organic practices and different irrigation regimes were compared (Maggio, et al., 2008). Also the long-term field trials with potato and vegetables conducted at the Estonian Research Institute of Agriculture compared the effect of organic and conventional practices under similar conditions. The trial results indicated that when the amounts of basic nutrients (NPK) applied with

organic and mineral fertilizers were equivalent, there were no significant differences in the biological quality of yield (Järvan & Laitamm, 1998; Järvan, 2006).

The aim of this research was to identify the effect of organic and conventional methods on the yield and biological quality of potato in two field crop rotations.

MATERIALS AND METHODS

The field trials were performed in Central-Estonia in Olustvere (58º 33´ N, 25º 34´ E) during two years and in North-Estonia in Saku (59º 18´ N, 24º 39´ E) during three years. The soil type of the Olustvere field was loamy sod-podzolic soil according to the WRB 1998 classification (FAO, 1998). The agrochemical properties of the humus horizon at the beginning of trials were as follows: pH_{KCl} 5.7–6.2, P 86–113 mg kg^{-1} (AL method), K 107–130 mg kg^{-1} (AL method), C_{org} 2.5–2.9% (NIRS method). The soil type of the trial field in Saku was loamy Calcari-Mollic Cambisol (FAO, 1998), the agrochemical properties of soil were as follows: pH_{KCl} 6.8–7.1, P 120–145 mg kg^{-1}, K 110–124 mg kg^{-1}, C_{org} 4.4–4.9%.

In the field trials in Olustvere the effect of three cultivation methods on the yield and biological quality of potato were compared. The cultivation methods were as follows: organic I – without manure, organic II – with cattle manure, and conventional (manure, mineral fertilizer and pesticides were used). Manure at the rate of 60 t ha^{-1} was applied after the precrop harvesting prior to autumn ploughing and the total amounts of applied plant nutrients were as following: N 282 kg ha^{-1}, P 44.5 kg ha^{-1} and K 727 kg ha^{-1}. In the variant of conventional farming, a complex fertilizer NPK 10:10:20 at the rate of 600 kg ha^{-1} was applied during spring tillage in addition to manure providing thus additionally N 60 kg ha^{-1}, P 26 kg ha^{-1} and K 100 kg ha^{-1}.

Potato was grown in a five-field crop rotation, the crops being clover, winter rye, potato, oats and barley with undersown clover. In the trial area, the field crops have been grown according to the principles of organic farming since 2002. In 2007, potato was preceded by clover, in 2008 by winter rye. In the crop rotation the size of each field was 1.2 ha, which was divided into three equal parts (400 m^2 each) between the farming methods.

In 2007, the mid/late potato variety Laura was grown. In 2008, the early variety Angela was also included in the trial. Potato tubers were presprouted and planted by machine in the first half of May. Seed spacing was 0.25 m with a row width of 0.8 m. Intertillage was performed four times. In the conventional variant, chemical weed control was done with the herbicide Titus (rate 50 g ha^{-1}); late blight *(Phytophtora infestans)* control was carried out four times by using alternately the fungicides Shirlan, Ranman and Ridomil Gold.

Potato was harvested in September at the time of tuber maturity. Tuber samples were taken in four replications, 20 hills each. The samples were weighed and based on that the yield of trial variant was calculated (t ha^{-1}). Average tuber samples were composed for biochemical analyses, which were performed at the laboratories of the Agricultural Research Centre and the Estonian University of Life Sciences.

As to weather conditions, the years of 2007 and 2008 differed a lot. During the three months that are important for the potato growth, i.e. from the beginning of June to the end of August the amount of precipitation in 2007 in Olustvere was only 153 mm, whereas June and August of 2008 were extremely rainy. Within the three months

the total amount of precipitation was 414 mm, which is over 180% more than the average of many years. The summer months of 2007 were considerably warmer than usual, but June and July of 2008 were cooler than usual.

In the trial conducted in Saku, potato was grown for three years in a vegetable rotation in which the following crops were alternating: white cabbage, potato, garden beet, carrot and swede. In all years potato was preceded by cabbage.

The trial was established on the soil that in previous years had been under grass turf. There were three trial variants: I – unfertilized; II – fertilization with compost made of garden and household waste; III – fertilization with mineral fertilizers. The aim was to compare the organic and conventional methods on the basis of the equivalent amounts of nutrients (NPK), i.e. equal amounts of NPK were applied in the trial variants II and III. The nutrient content of compost was determined each year anew and it was applied during the spring tillage at the rate of 3 litres per square meter. The mineral fertilizers of the third variant were dosed according to the compost nutrients, and they were applied as ammonium nitrate, superphosphate and potassium sulphate. The variants of compost and mineral fertilizer received the following amounts of nutrients (g m^{-2}): the first year - N 10.2, P 3.40, K 2.72; the second year - N 10.7, P 3.40, K 2.77 and the third year - N 11.7, P 1.30, K 3.15. In the trial area no chemical plant protection products were used.

In Saku the trial variants were situated side by side as 8-meter wide long strips. The growth rows of garden crops were crosswise to the strips. The number of replications in the trials was 4 or 6 depending on the year. While harvesting the potato yield, 20 hills were taken from each replication, the tubers were weighed and the yielding ability of the trial variant was calculated. The average tuber samples were taken for biochemical analyses. In the laboratory, the contents of dry matter, starch, reducing sugars, crude fibre, crude protein and mineral substances (phosphorus, potassium, calcium, magnesium) were determined. The results were expressed as contents per the fresh weight of tubers.

For analyses the following methods were used: starch (%) and reducing sugars (%) - Methods in Agricultural Analysis (Faithfull, 2002); dry matter (%) – 71/393 ECC; nitrates (NO_3, mg kg^{-1}) – EVS-EN 12014-7:2000; protein (%) - Copper Catalyst Kjeldahl Method (AOAC, 1990); potassium (%) - Flame Photometric method (AOAC, 1990); phosphorus (%)- Kjeldahl Digest by Fiastar 5000, AN 5242 (ISO/FDIS 15681); calcium (%) - Kjeldahl Digest by Fiastar 5000, AN 5260 (ISO3696); magnesium (%)- Fiastar 5000, ASTN 90/92.

RESULTS AND DISCUSSION

In the Olustvere trial in 2007, potatoes suffered from quite severe drought during tuber formation. Therefore, the yields remained low both in the conventional variant and in the organic variants without manure (Org I) and with manure (Org II) (Table 1). In such conditions, the potato plants probably did not sufficiently uptake the nutrients to be used for tuber growth. In the organic variants with and without manure the yields of the variety Laura were practically equal. In the conventional variant in which manure was also applied the yield was 18.4 t ha^{-1}, i.e. 59.9% higher than in organic farming. The extra yield was received thanks to additional mineral fertilization and plant protection measures, in particular thanks to multiple spraying against late blight.

Table 1. The yield and the biological quality of organically and conventionally grown potato tubers in Olustvere.

Variety, year	Organic I	Organic II	Conventional	LSD_{05}
Yield t ha^{-1}				
Laura 2007	10.38	11.53	29.97	2.83
Laura 2008	11.67	18.85	64.03	5.72
Angela 2008	29.82	40.42	67.23	5.24
Dry matter, %				
Laura 2007	2.9	21.2	19.8	1.5
Laura 2008	2.5	20.8	18.6	1.9
Angela 2008	2.3	20.1	19.3	1.1
Reducing sugars, %				
Laura 2007	0.27	0.29	0.30	0.04
Laura 2008	0.31	0.34	0.34	0.04
Angela 2008	0.46	0.38	0.42	0.05
Starch, %				
Laura 2007	13.0	13.1	11.0	1.7
Laura 2008	14.6	13.2	9.9	1.3
Angela 2008	14.3	10.9	11.7	0.9
Crude protein, %				
Laura 2007	2.30	2.33	2.00	0.21
Laura 2008	1.45	1.52	1.57	0.14
Angela 2008	1.38	1.77	1.52	0.19
Nitrates, mg kg^{-1}				
Laura 2007	24.0	55.9	92.9	17.2
Laura 2008	12.9	13.8	8.2	3.7
Angela 2008	10.3	87.1	45.1	13.5

Even in the conditions of 2008, the yields of the mid/late variety Laura remained relatively low in the organic farming variants. One of the reasons for that was certainly the early development of late blight. Manure application (Org II) was effective, because the yield increased 7.2 t ha^{-1}, i.e. 61.5%. This year precipitation did not limit the formation of potato yield, in the conventional variant the tuber yield was on average 64 t ha^{-1}, i.e. 3.4 times higher than in the organic variant (Org II).

The tuber formation of the early variety Angela started earlier and was not so much affected by the late blight infestation. In the organic variants, the yielding ability of Angela was over twice that of the late variety Laura. In the conventional variant the yields of the both potato varieties were practically the same under the conditions of 2008. These potato varieties, in which the tuber formation starts early, are more suitable for organic farming (Neuhoff & Köpke, 2002). Thereby, it is also important that the majority of plant nutrients would be available already at the beginning of growth. It is noted that the effect of manure on the potato yield depends considerably on the yearly conditions. During years with early late blight infestation or unfavourable conditions for manure mineralization in soil, the yields remained low (Kolbe, 1996; Neuhoff & Köpke, 2002). During years with higher precipitation, when conditions

were more conductive for the mineralization of nitrogen in organic manure, organic treatments tended to outperform the conventional ones (Granstedt & Kjellenberg, 1997).

In field experiments carried out in Poland, to define the effect of various organic fertilizers, it was concluded that potato cultivation with manure ensured the highest yields and, at the same time, it was not conductive to accumulation of nitrates in the tubers. The best tuber health status after harvest and after storage was recorded due to fertilizing potato with manure (Boligłowa & Gleń, 2003).

Organically cultivated crops have higher dry matter content than those grown conventionally. This finding, however, was evident only for the plants that grow above the ground (leafy vegetables), whereas no clear picture emerged for those plants that grow below the ground, such as potatoes and root vegetables (Schuphan, 1974; Rembialkowska, 1998; Magkos et al., 2003). The results of Hamouz et al. (2005) did not confirm an increase in the dry matter of tubers in the ecological way of growing.

In our trials, the dry matter content of tubers was always higher in the organic variant without manure (Org I) than in the conventional variant. When to compare the dry matter contents of the manure fertilized organic variant (Org II) and the conventional variant that was fertilized with manure and mineral fertilizers, the difference was statistically reliable in 2008 in the case of the variety Laura. In other cases, there was a tendency towards the decrease of dry matter content in the conventional variant.

The method of cultivation affected the starch content of potato. As a rule, organically grown tubers contained more starch than conventionally grown tubers. There were practically no differences in the contents of reducing sugars, except in 2008 in the case of the variety Angela. Several other scientists have also studied the effect of cultivation method on the carbohydrate content of potatoes. In the experiments of Hamouz et al. (2005), a trend (no significant difference) to lesser reducing sugar content in the three-year average results in potatoes from ecological growing in comparison with conventional variant was established. With the exception of fructose, the potatoes carbohydrate content (i.e. starch, sucrose, glucose, reducing sugars) was not affected by the cultivation regime (Maggio et al., 2008).

The protein content in potato tubers is usually around 2%. The potato protein is of significantly higher biological value than that of cereals, because the share of irreplaceable amino acids in it is higher (Eggum, 1969). In our trials in Olustvere, the potato variety Laura contained much more protein in 2007 than in 2008. One of the reasons was certainly the difference in preceding crops. In 2007, potato was preceded by clover that was ploughed into soil as green fertilizer. In 2008, the preceding crop was winter rye. In 2007, the organically grown potato tubers contained more protein than those conventionally grown. In the following year, no such differences became evident.

In the literature, quite different data about the effect of cultivation method on the protein content of potatoes can be found. According to Schulz (2000), mineral fertilizers in comparison with the organic fertilizer (cattle manure) increased both the potato yield and the protein content. In long-term field experiments in Sweden, the crude protein content of potatoes was lower in the organic treatments, but protein quality was higher (i.e. relatively pure protein and essential amino acids, lower amount of free amino acids) (Granstedt & Kjellenberg, 1997).

The total protein content was higher in organically grown tubers and it also corresponded to higher amino acid contents. Specifically, organic farming increased only threonine, whereas it significantly reduced most of the other amino acids (Maggio et al., 2008).

Potatoes from organic cultivation have a slightly lower crude protein and free amino acid content than conventionally grown potatoes (Schuphan, 1974; Woese et al., 1997; Bourn & Prescott, 2002). The higher crude protein content of conventional crops probably reflects the greater nitrogen availability from conventional than from organic fertilizers (Magkos et al., 2003).

The nitrate content of potato tubers is very variable; it depends on many factors. According to Kolbe (1996), the proportion of different factors in tubers' nitrate content formation is as following: weather (including precipitation, sunshine duration, temperature) 30–40%, nitrogen fertilization 35–45% and variety properties 20–30%. When potato tops die due to early late blight infestation, the nitrate content in tubers may be approximately two times higher than usual (Kolbe, 1996).

The yield's nitrate content is not determined by the cultivation system, but by the total amount of nitrogen received with fertilizers and released from the soil. It is determined by the way the mineralization processes take place in the soil, by the humidity, warmth and other conditions. It is possible to reduce the accumulation of nitrates in the yield both in the case of organic and conventional methods only by reducing the amount of nitrogen available to the plants (Järvan, 1982). According to Marschner (1984), the type of nitrogen (organic or mineral) used in different cultivation methods is of secondary importance; as a rule, organically-grown plant produce contains as much of nitrates than conventionally-grown. The experiments of Hamouz et al. (2005) did not prove the effect of the way of growing on nitrate content, but, in all years, an apparent trend to its reduction in potatoes from ecological cultivation appeared.

In our trial in Olustvere in 2007, the tubers of the variety Laura contained most nitrates in the conventional variant. In 2008, the nitrate content of this variety was extremely low. Probably all nitrogen taken up by roots could metabolise and did not remain in tubers as unreduced nitrates. On the other hand, the tubers of the early variety Angela contained more nitrates in the variants fertilized with manure (Org II and conventional). Probably the nitrogen that was released during manure mineralization became available for the tubers of the fast developing variety too late and could not reduce as much as needed before yield maturity. Nitrate accumulation in the tubers of the variant Org II was certainly enhanced also by the early dying of tops due to late blight.

The content of minerals (Table 2) in the conventionally grown tubers was, as a rule, lower than in the organically grown variants. To a certain extent, it could be caused by so-called attenuation of minerals due to bigger yields of the conventional method. When the comparison of cultivation methods is based on the mineral content in dry matter, the differences would be significantly smaller. As the consumption of potatoes is relatively big, the minerals in potato cover the major part of human needs for minerals. The importance of potato as a source of potassium is particularly emphasized.

Table 2. The content of minerals in organically and conventionally grown potato.

Element, variety, year	Content in raw substance, mg 100 g^{-1}			
	Organic I	Organic II	Conventional	LSD_{05}
Phosporus (P)				
Laura 2007	59.0	63.6	43.6	12.2
Laura 2008	77.6	64.5	50.2	14.0
Angela 2008	58.0	54.3	48.3	11.7
Potassium (K)				
Laura 2007	504	519	475	47
Laura 2008	519	478	415	56
Angela 2008	459	468	382	33
Calcium (Ca)				
Laura 2007	17.5	19.1	13.9	3.4
Laura 2008	18.8	12.5	6.5	3.7
Angela 2008	11.2	12.1	13.5	2.6
Magnesium (Mg)				
Laura 2007	35.0	33.9	27.7	4.3
Laura 2008	35.2	29.1	27.0	4.0
Angela 2008	26.8	26.1	23.1	3.2

The yields of mid/late variety Paola grown in Saku in vegetable rotation remained relatively modest. One of the reasons was the fact that as no late blight control was performed, the tops died relatively early. In the comparison with the unfertilised variant, the fertilization with compost increased the potato yield over the average of three years by 37.8% and the fertilization with mineral fertilizers by 82.0% (Table 3). When comparing the yields in the variants with compost and mineral fertilizers, in which case equal amounts of NPK were applied to soil, on the average of years the yield in the mineral fertilizer variant was 32.1% higher. Similar results have been obtained also by several other scientists.

In Finland, in a trial that compared cultivation methods, the potato yields grown organically were on average 36% lower than those grown conventionally (Varis et al., 1996). In the trials of the Czech University of Agriculture Prague, significantly less yield was obtained from potatoes cultivated by the ecological way in comparison to the conventional way of growing. The decrease amounted to 35.9% over the average of three years (Hamouz et al., 2005), which fully confirms the results of Böhm (1999). Maggio et al. (2008) stated that organic farming reduced the fresh marketable yield by 25%.

In all trial years, the dry matter content of tubers was the highest in the unfertilised variant the yield of which was the lowest. Although many authors (Schuphan, 1974; Rembialkowska, 1998; Bruulsema, 2002; Magkos et al., 2003) indicate that organically grown potato tubers have higher dry matter content than those grown conventionally, our trials provided no such evidence, because equivalent amounts of basic nutrients (NPK) were applied to potato with compost and mineral fertilizer.

Table 3. The effect of the application of compost and mineral fertilizers in equivalent rates of NPK on the yield and the biological quality of potato (on average three years) in Saku.

Mesured parameter	Without fertilizer	Compost	Mineral fertilizer	LSD_{05}
Yield, t ha^{-1}	15.6	21.5	28.4	3.1
Dry matter, %	18.0	16.9	16.9	0.8
Reducing sugars, % r.s.	0.73	0.82	0.88	0.06
Crude protein, % r.s.	1.78	2.00	1.95	0.15
Crude fiber, % r.s.	0.53	0.51	0.51	0.03
Nitrates, mg kg^{-1} r.s.	108	174	183	37
Minerals, mg $100g^{-1}$ r.s.				
phosporus (P)	34.0	37.3	38.0	3.0
potassium (K)	409	424	411	34
calcium (Ca)	22.2	18.2	19.0	1.9
magnesium (Mg)	29.1	30.4	31.7	2.9

r.s. – in raw substance

The content of reducing sugars was the highest in the tubers fertilized with mineral fertilizer and the lowest in the unfertilised variant. The content of crude protein was also the lowest in the tubers of the unfertilised variant. In the content of crude fibre there were no significant differences between the variants. Our earlier studies (Järvan & Laitamm, 1998) have indicated that with compost fertilization the potato tubers were on average 14.7% higher in vitamin C than with mineral fertilization. Also several other authors (Varis et al., 1996; Bruulsema, 2002) have found that organically grown potatoes were higher in vitamin C than those grown with mineral fertilization.

As expected, potatoes had the lowest nitrate content when grown without fertilizers. When comparing the effect of compost and mineral fertilizers applied in the equivalent amounts of NPK, no difference in the nitrate content of the yield was found. Thus, the results of earlier research are once more confirmed: the yield's nitrate content does not depend so much on the cultivation method (organic or conventional), but on the amount of nutrients supplied (Schuphan, 1972; Järvan, 1982; Schröder, 1984).

The content of mineral substances in tubers over the three-year average did not depend on the use of compost or mineral fertilizer. Other researches have shown too that the mineral content of potatoes did not depend on the fact whether organic or mineral fertilizers were used (Warman & Haward, 1996; Worthington, 1998; Magkos et al., 2003). Schulz (2000) states, however, that in the comparison with the organic fertilizer (cattle manure), the mineral fertilizers reduced the content of phosphorous, potassium and magnesium in tubers.

CONCLUSIONS

- In organic cultivation, fertilization with manure (at the rate 60 t ha^{-1}) increased the potato yield on average 36.5%. The dry matter content in tubers decreased and the nitrate content increased.
- The conventional cultivation method, in which potato was fertilized with manure and mineral fertilizer and chemical plant protection means were used, produced an average 127.4% higher potato yield than organic cultivation (with

manure). In organic farming, the tubers of mid/late variety Laura had higher dry matter and starch contents. As to the content of reducing sugars, crude protein and nitrates, no clear differences were found between the cultivation methods.

- The content of minerals (P, K, Ca, Mg) in the fresh weight of tubers was, depending on the element, 15.8–34.5% higher in organically grown potatoes than in potatoes grown conventionally. To a certain extent, this difference can be a result of the so called attenuation of minerals due to significantly bigger yield in the conventional method, in which considerably larger amounts of plant nutrients were applied during fertilization than in the variant of organic cultivation.
- When the effect of cultivation methods on potato was compared on the background of equivalent NPK-fertilization, the differences in results were much more moderate. In a long-term trial that was conducted in similar conditions, the potato yield was on average 32.1% lower than with mineral fertilizers. There were no reliable differences in the biochemical composition of tubers (in the content of dry matter, crude fibre, crude protein, nitrates and mineral substances).

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