CRAFT Project:

COOP-CT-2004-508458 BFPs

Ensuring the Quality of Innovative Crop Growth Inputs Derived from Biological Raw Materials (Biological Food for Plants)

Partner: Research Institute of Pomology and Floriculture, Skierniewice, Poland.

Departments: Fruit Plant Breeding Department, Department of Fruit Crop Management and Plant Nutrition, Plant Pathology Lab of Plant Protection Department, Fruit Storage and Processing Department

Instrument: Co-operative Research Project

Thematic Priority: Food, Safety and Quality

Activity Report year 2: Work Package 2

Period covered:
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Duration: 2 years

Project coordinator name: Ms. Danuta GOSZCZYNSKA
RESEARCH INSTITUTE OF POMOLOGY and FLORICULTURE

Introduction

'BFPs (Biological Food for Plants) are innovative organic soil or plant amendments containing one or more biologically active compounds that reinforce crop vigour. Above all, BFPs reduce the need to employ mineral fertilisers, but they also improve crop health, plant disease resistance and soil micro-life, thus decreasing the dependency on crop protection agents.' It is scientifically established that plants have defence mechanisms that kick into gear when attacked by disease or insects. Plants respond by releasing various chemical compounds that alert the rest of the organism. These responses are called 'systemic acquired resistance' (SAR) and 'induced resistance' (IR). For example, experiments in India in which seeds and seedlings were treated with salicylic acid were much more resistant to attack by downy mildew. Other experiments using polyunsaturated fatty acids (such as arachidonic and linoleic acids) to boost salicylic acid levels, showed similar results. Large chemical companies have discovered the potentials of such products, and have introduced products to the market such as Adjust™ from Stoller (USA), Bion™ (D) or Antigard™ (USA) from Novartis, and Messenger™ from Eden Bioscience (USA). Such products may boost growth, help to block a number of common plant diseases, and help repel insects and nematodes. The active ingredients are often naturally derived compounds such as proteins, glucosamines, *etc.* Currently, there is not a clear term for products that combine plant nutrients and plant protection agents. The latter can best be demonstrated by the product Milsana™ from BASF, first marketed as a foliar fertiliser, but currently sold as an effective spray protecting against powdery mildew on roses. For the sake of simplicity, we use the term BFP for those products. While there are currently BFPs on the European market that meet EC Reg 2092/91 which sets standards for organic production, there are no independent, internationally comparable evaluations of their safety, quality, reliability (efficacy), impact on the environment and economy of use. Hence, the global goal of this Project is to increase the knowledge about the production and characteristics of BFPs, both scientifically and practically (technically). More specifically, the actions in the Project will be: A) the evaluation and improvement of manufacturing procedures for BFPs, B) the scientific testing of BFPs to evaluate their composition, safety, efficacy, effects on end-product quality, and their impacts on soil life and drainage water quality, and C) testing of BFPs on-farm to evaluate their technical and economic performance. The specific scientific objectives (which also have technical implications) are to assess: 1) the effects of BFPs on crop growth and performance of some important temperate and Mediterranean crops, 2) the exact chemical, and biological composition of BFPs and their implications for human health, 3) the environmental effect of BFPs on deeper soil layers and the water table after application, 4) the effect of applied BFPs on plants and soil biological system, and 5) the quality and safety of BFP grown food. The technical objectives are 1 to apply the improved processing systems to three different BFP manufacturing systems, allowing the production of BFPs of standard efficacy and known quality, 2) translate the scientific data obtained in this Project into precise and factual information about BFPs for regulatory bodies, scientists, end-users and public, and 3) use the on-farm test results on BFPs to enlarge the critical mass of end-users. As a CRAFT project, this Project does not directly address wider societal or policy problems, but the Projects' activities certainly contribute to attain major societal and policy objectives, *e.g.* the Project strengthens the technical and economic competitiveness of bio-based industries taking into consideration the vulnerability of both the environment and resources, meanwhile coherently encompassing current and future markets, processes and production practices; the anticipated deliverables provide for sustainable, clean and efficient process technologies, which will lead to the delivery of new or improved products with high-value added and a lower impact on the environment; and the Project will lead to an expansion of the production and use base of

biological raw materials through integrating raw materials production with industrial and market needs, thus also contributing to the transparency of the BFP production-use chain. Moreover, research results from this Project may contribute to the development of coherent European wide regulations on natural product use in agriculture.

Within WPZ RIPF is conducting 3 exp. on perennial fruit crop species I strawberry, black and apple free.

All experiments are being conducted within the CRAFT project titled: **"Ensuring the Quality of Innovative Crop Growth Inputs Derived from Biological Raw Materials (Biological Food for Plants) financed by the European Commission over the period 2004-2006.** Project is divided into 4 Work Packages:

Strawberry

Materials and Methods

Within the CRAFT Project in 2005 the field experiment was carried out on two strawberry cultivars grown at the Pomological Orchard of the Research Institute of Pomology and Floriculture in Skierniewice, Poland. Each of mentioned below combinations consisted of 80 plants, i.e. four replications by 20 plants. Total 1280 strawberry plants (16 combinations x 20 plants x 4 replications) were used for each tested cultivar. Whole experiment included 2560 plants. Plant protection was applied according to recommendation for commercial strawberry plantations.

•RIPF Field Trials – Pomological Orchard, Skierniewice, Poland
•Strawberry – cvs. 'Elkat', 'Filon'

Frequency of treatments and concentrations of the applied BFPs:

Frequencies and concentrations of the applied solid BFPs (at the beginning of the vegetation – 04.04.05)

Frequencies and concentrations of the applied foliar BFPs (1,5 L of BFPs solutions per plot/20 plants):

- 3 x 2% BF-grow (weekly: 15.04.05, 22.04.05, 29.04.05)
  + 3 x 2% BF-quality (weekly: 12.05.05, 19.05.05, 26.05.05)

- 3 x 0,1% Ausma (21.04.05, 12.05.05, 30.05.05)

- 4 x 0,5% Glucos K (15.04.05, 29.04.05, 14.05.05, 28.05.05)

Solid and liquid treatments for all CRAFT trials at RIPF

- **1** - No fertilization
- **1a -** No fertilization + BF-grow + BF-quality
- **1b -** No fertlization + Ausma
- **1c -** No fertlization + Glucos K
- **2** - Standard fert.
- **2a** - Standard fert. + BF-grow + BF- quality
- **2b** - Standard fert. + Ausma
- **2c** - Standard fert. + Glucos K
- **3** - Bioilsa
- **3a** - Bioilsa + BF-grow + BF-quality
- **3b** - Bioilsa + Ausma
- **3c** - Bioilsa + Glucos K
- **4** - BF-Ecomix
- **4a** - BF-Ecomix + BF-grow + BF-quality
- **4b** - BF-Ecomix + Ausma
- **4c** - BF-Ecomix + Glucos K

Measurements and Observations – strawberry

- Visual assessment of the plant growth (ranking scale 1-9)
- Fruit yield [g/plot /20 plants]
- Fruit weight [g]
- Number of fruits [per plot]
- Number, length and weight of runners
- Number of runner plants
- Chlorophyll index of the leaves (30 leaves/plot) – SPAD
- Mineral content of soil, leaves and fruits
- Fruit samples were delivered to the Department of Fruit Processing and Storage for assessment of fruit quality
- Fruit, leaf and soil samples delivered to the Central Analytical Lab for analysis of mineral content
- Evaluation of plant resistance to diseases caused by biotic factors at Plant Pathology Lab

Application of solid BFP-s fertilizers – strawberry experiment – 4 April 2005 (directly after application the BFP-s were mixed with soil)

Flowering of plants - 20 May 2005

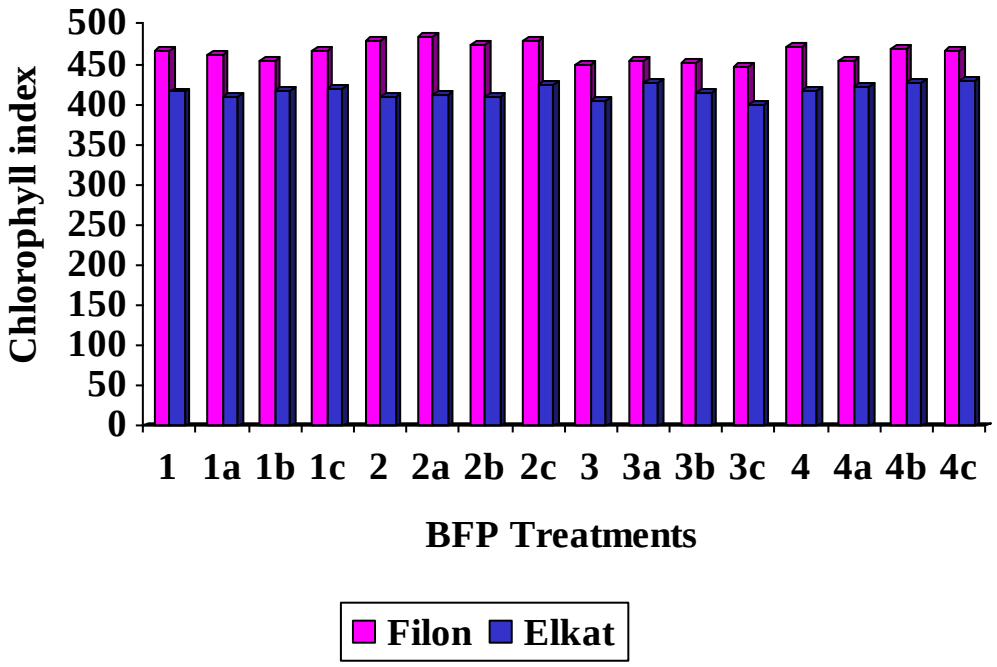
Mulching of the soil with straw before fruit harvest to keep clean fruits

Fruit harvesting

Fruit samples delivered to the Central Analytical Lab.

Results

Chlorophyll index of the leaves



- The obtained results revealed cultivar dependent chlorophyll index in the leaves.
- The leaves of ‘Filon’ cultivar had higher chlorophyll index than that of ‘Elkat’.
- In comparison to control plants, the highest chlorophyll index in ‘Filon’ cv. was measured after application of standard fertilization and BF-Ecomix.

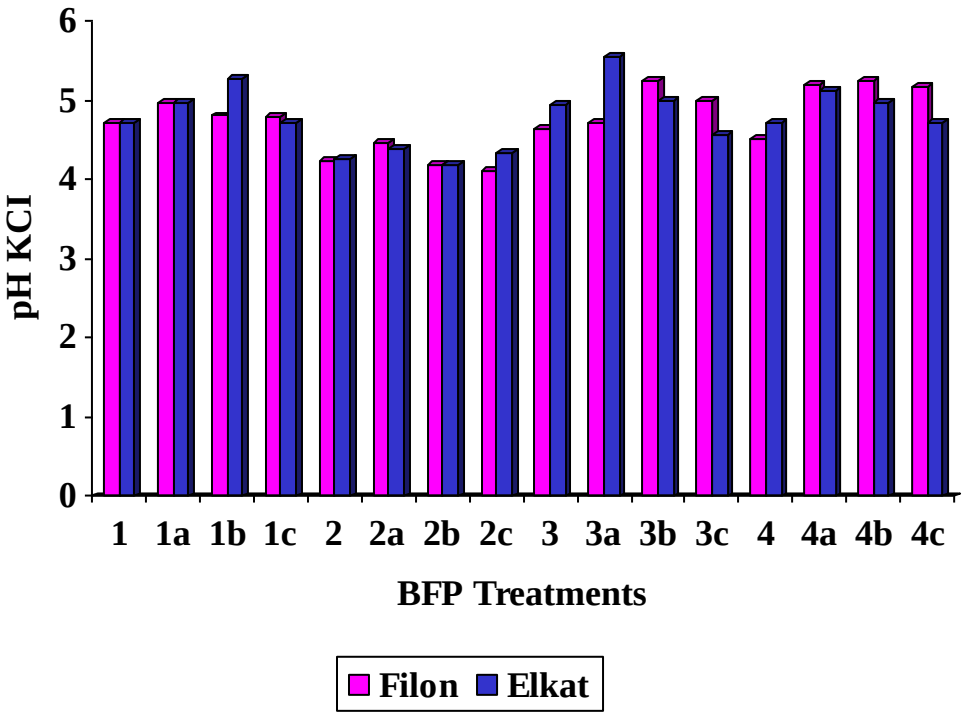
Makroelements content in BFP-s product

BFP-s produkt	Totol N	P	K	Mg	Ca
	%				
Bioilsa	12.6	0.08	0.09	0.24	0.59
Bio Feed Ecomix	7.8	2.01	3.16	0.40	4.33
Bio Feed Grow	0.02	0.02	0.15	0.006	0.048
Bio Feed Quality	0.02	0.00	0.16	0.005	0.013
Glucos K	4.14	2.08	13.5	0.024	0.024
Ausma	0.29	0.12	0.96	0.18	0.24

Microelements content in BFP-s product

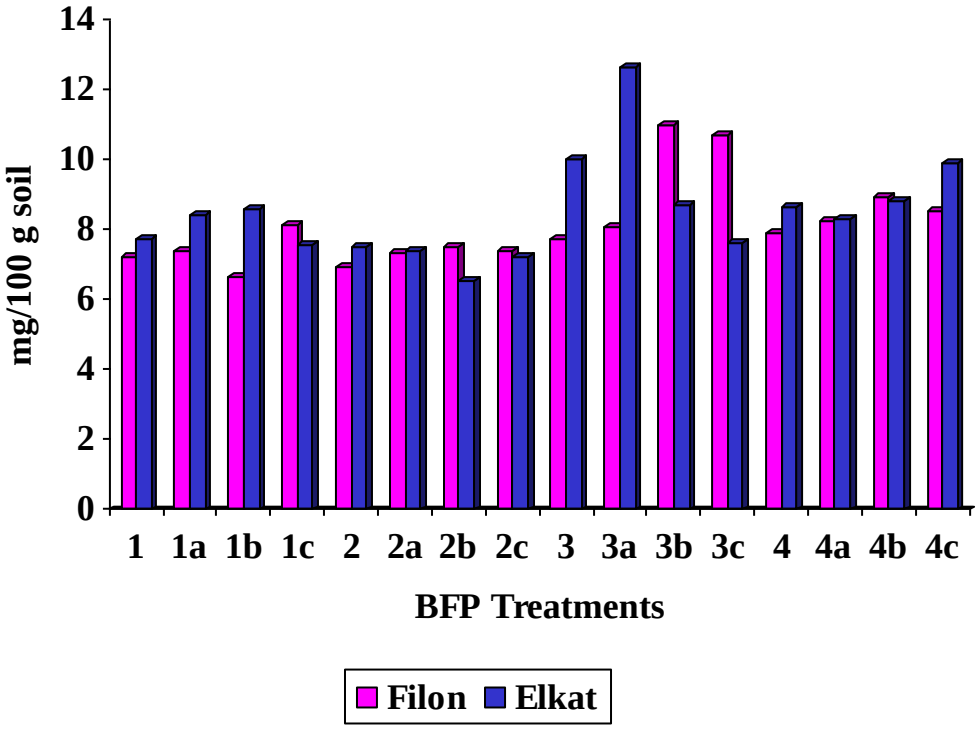
BFP-s produkt	B	Cu	Fe	Mn	Zn	Cd	Pb
	mg/kg or mg/l						
Bioilsa	33.7	14.2	1605	29.8	102	0.45	9.80
Bio Feed Ecomix	27.7	11.3	1611	41.4	86.2	<0.01	2.70
Bio Feed Grow	0.96	0.09	11.1	0.78	2.68	1.39	1.74
Bio Feed Quality	1.55	0.25	34.5	0.66	2.58	0.91	1.26
Glucos K	6.17	<0.01	36.0	5.02	15.8	<0.01	<0.01
Ausma	16.1	1.76	803	1184	54.6	1.31	2.60

Soil pH after second year of treatments

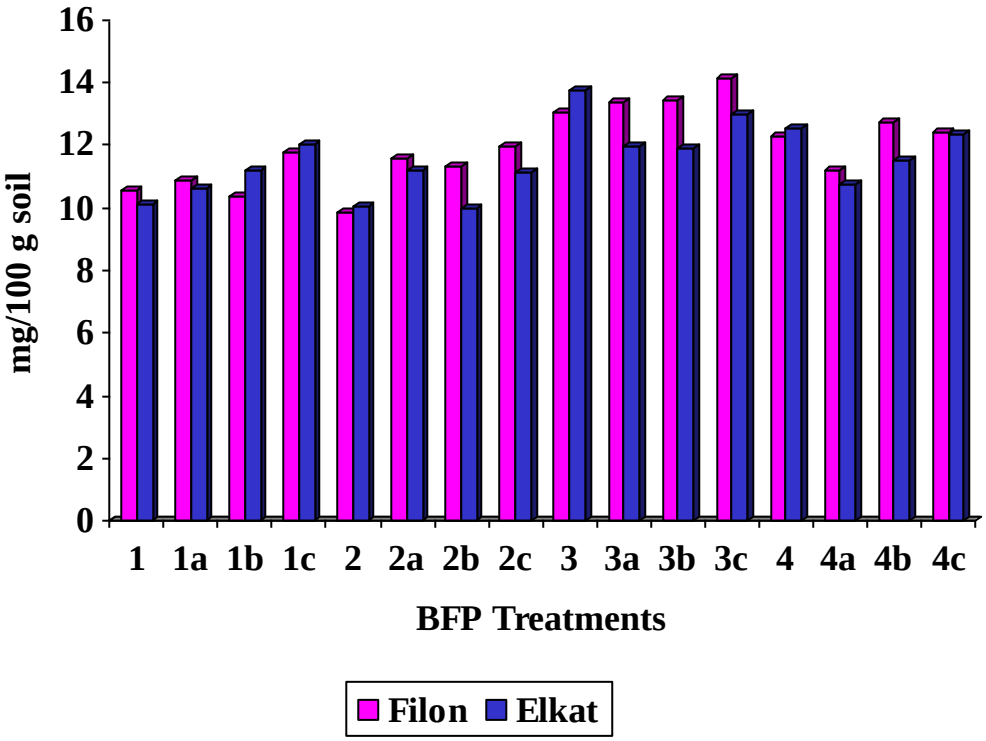


- In comparison to control, Standard NPK fertilization decreased the soil pH.
- Soil pH was the same in control and on the plots treated with Bioilsa i BF-Ecomix.

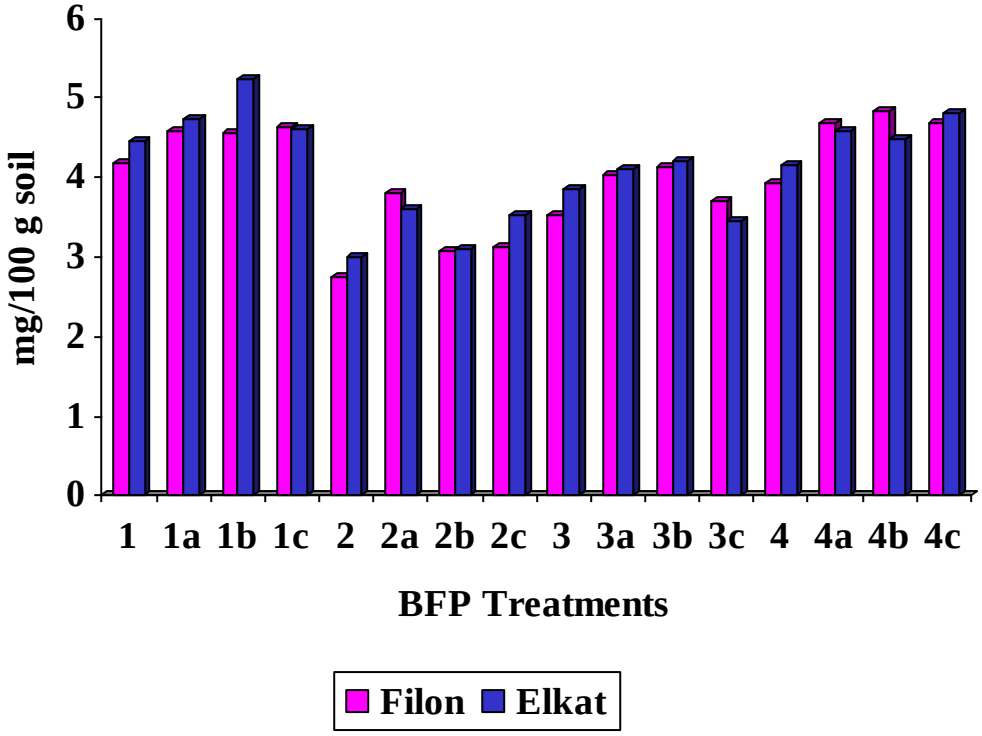
P content in soil after second year of treatments



K content in soil after second year of treatments

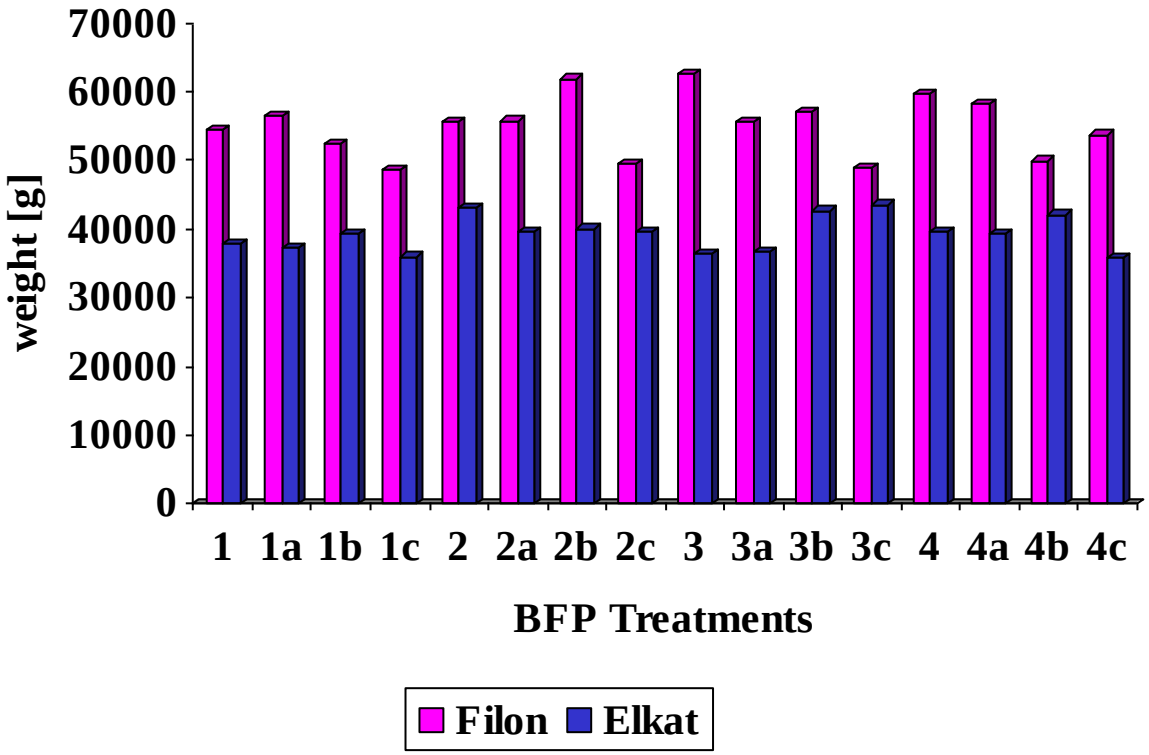


Mg content in soil after second year of treatments

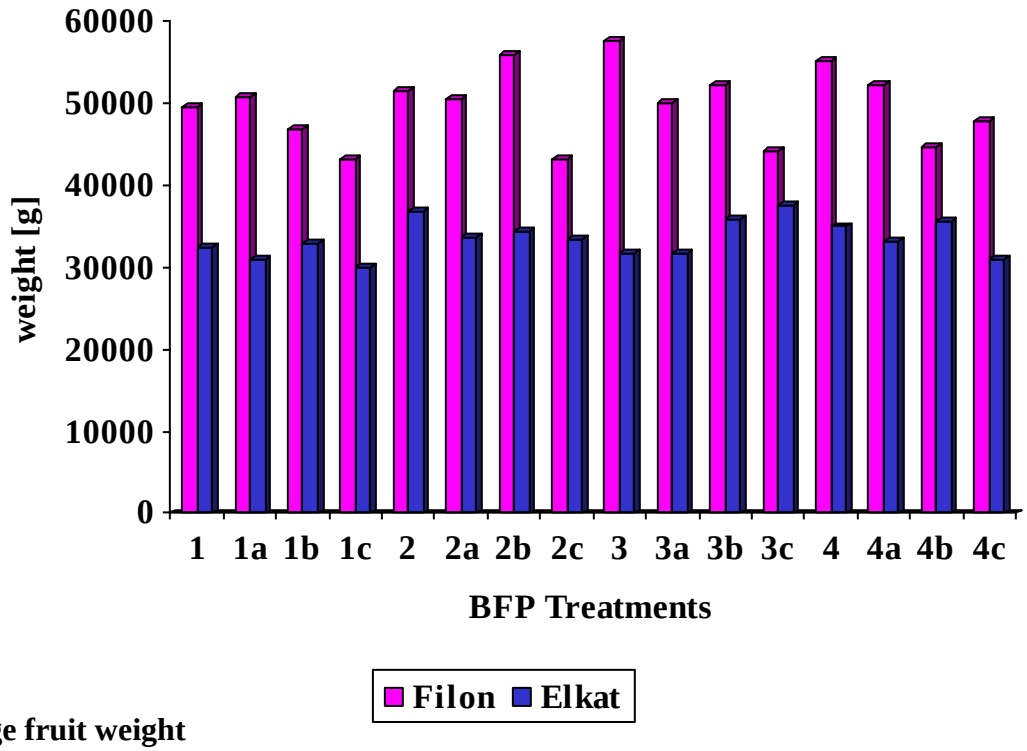


- In comparison to control, Bioilsa treatments significantly increased P, K and Cu content in the soil.
- Standard NPK treatments decreased Mg and Zn content in the soil, in comparison to control.
- Regardless of the applied BFPs, Fe and Mn content in the soil remained unchanged.
- This was observed for both cultivars.

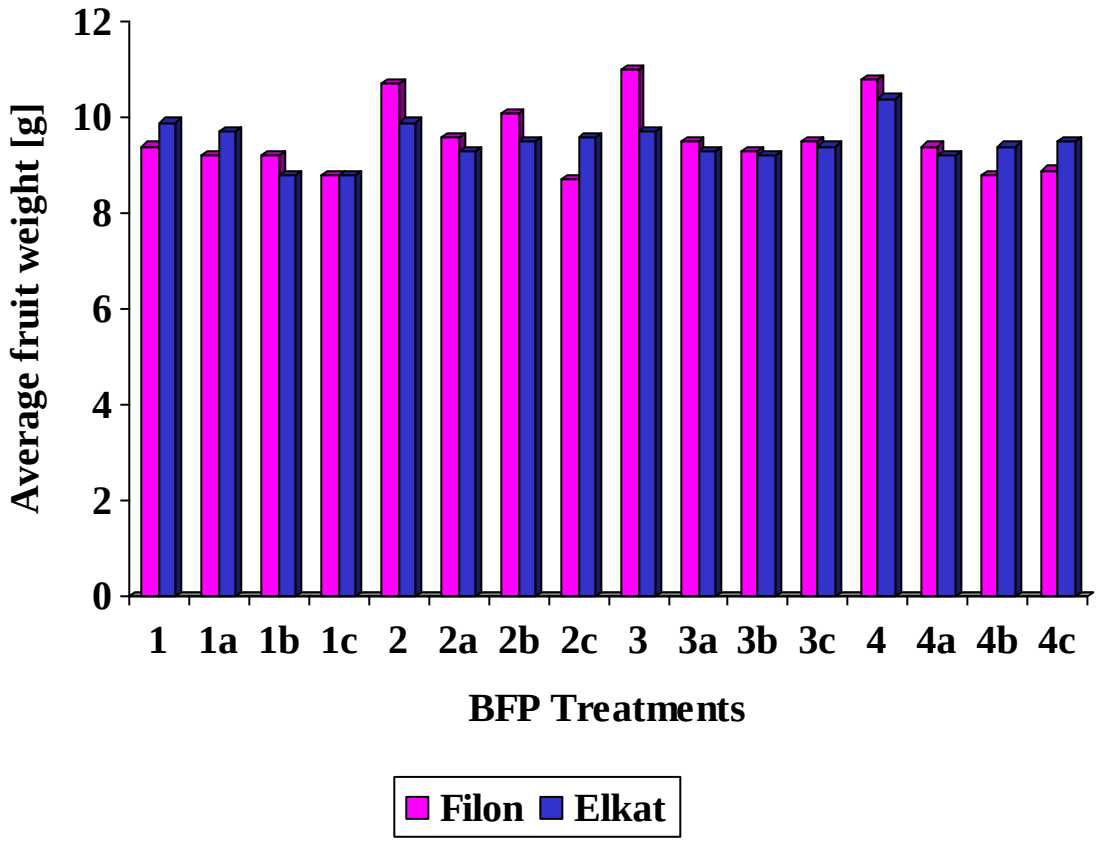
Total yield of strawberry cultivars [g/80 plants]



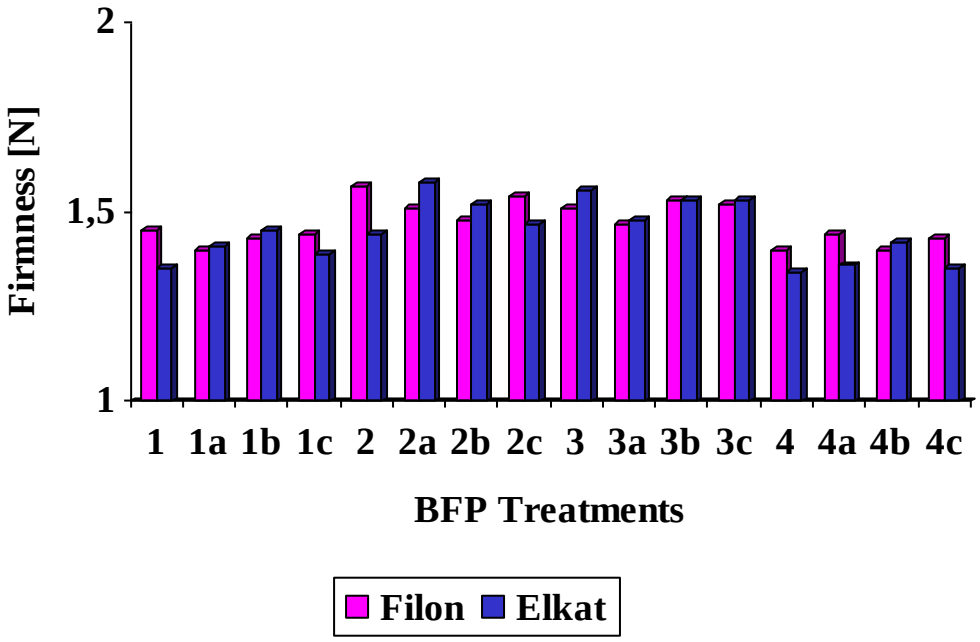
Commercial yield of strawberry cultivars [g/80 plants]



Average fruit weight



Fruit firmness of two strawberry cultivars



- Regardless of the applied BFPs, the higher yield was obtained for 'Filon'(688,5g/plant) than for 'Elkat'(492,0 g/plant).
- Average fruit weight was the same for both cultivars ('Filon' - 9.6 g, 'Elkat' 9.5 g).
- Treatments of the plants with BFPs revealed positive tendencies in total fruit yield, but the data are not statistically significant.
- The yield of 'Filon' was increased by Bioilsa, Standard NPK +Ausma, BF-Ecomix, BF-Ecomix +BF-grow+BF-quality.
- For 'Elkat' treated with BFPs less pronounced differences in yielding were obtained.
- Fruit firmness was enhanced by standard NPK and Bioilsa.

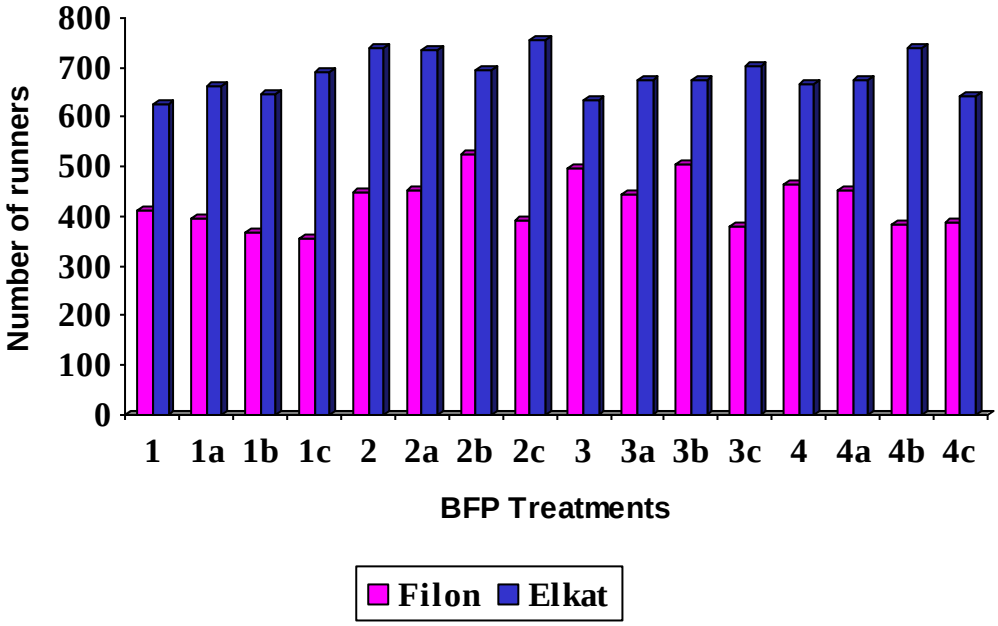
Methodology of microbiological tests on fruit

- Microbiological assessment was carried out twice (2nd and 4th fruit harvest)
- Fruit samples were tested in the Microbiology Laboratory of the Central Laboratory of Refrigerating Engineering in Lodz
- Fruits were tested for the presence of bacteria *(Listeria monocytogenes, Salmonella, Escherichia coli, Enterobacteriaceae)*, moulds and fungi on the surface of their skin and inside their flesh

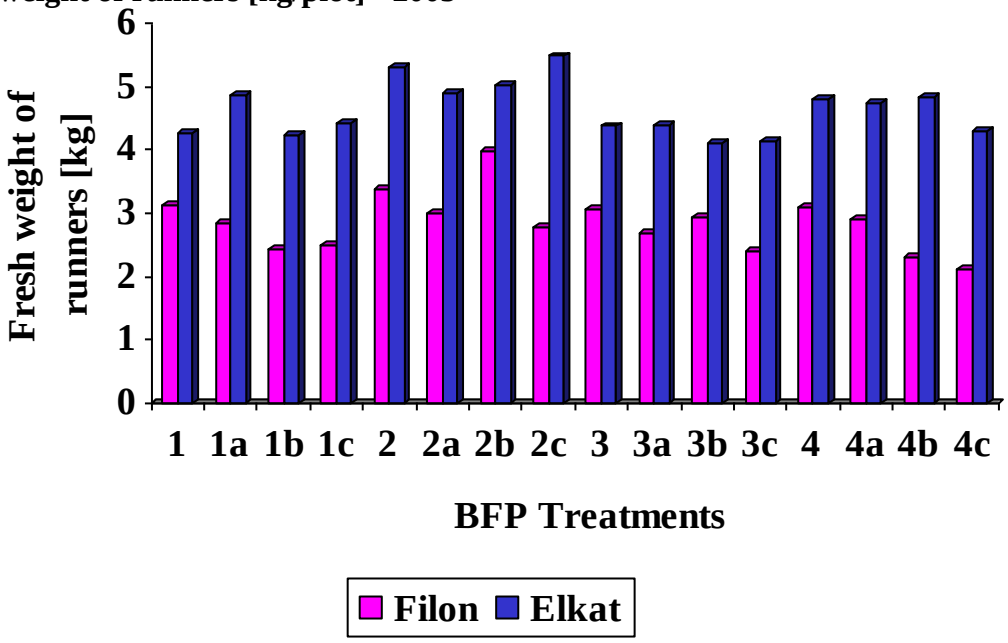
Results of microbiological assessment of strawberry fruits – 2005

- **No microorganisms posing a direct threat to human health such as *Listeria monocytogenes, Salmonella, Escherichia coli* were found in the strawberry fruits tested**
- **From the majority of strawberry fruit samples, bacteria from the family *Enterobacteriaceae* were isolated, but the size of their population was within the limits allowed by the standard**

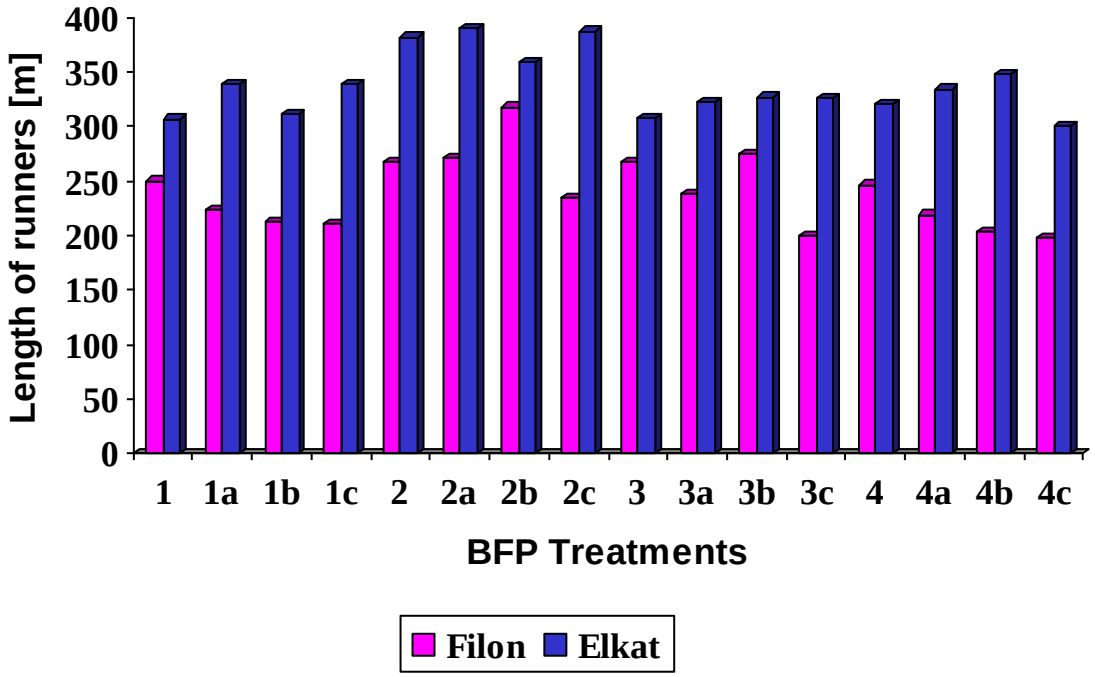
Number of runners per 20 plants - 2005



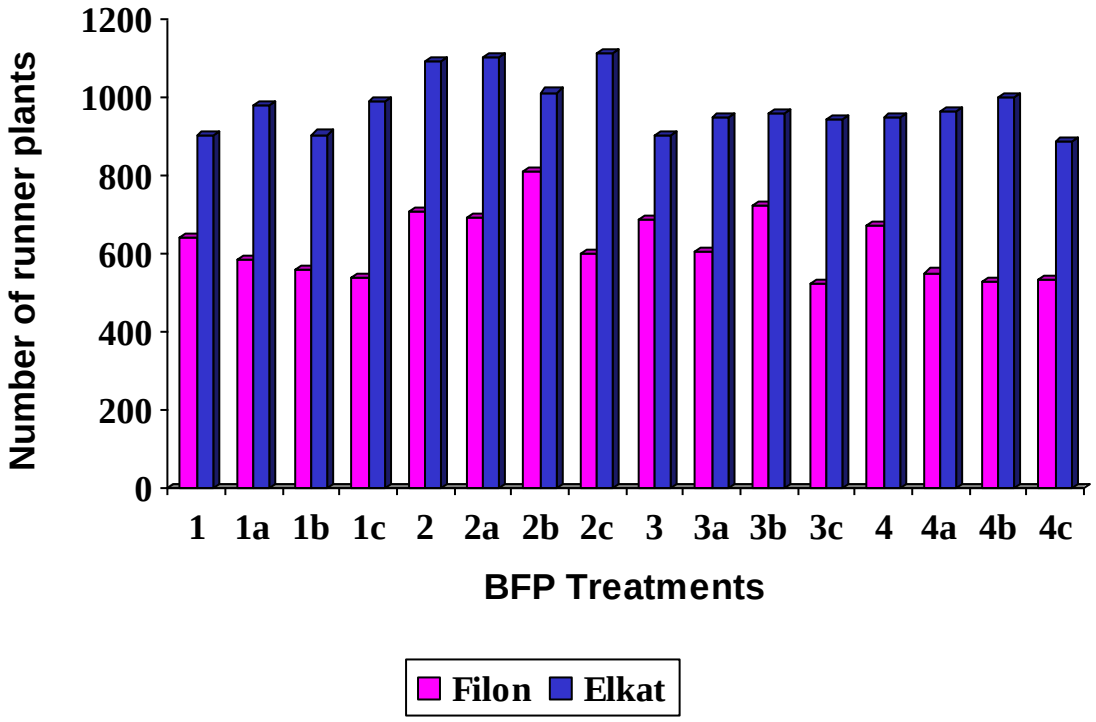
Fresh weight of runners [kg/plot] - 2005



Length of runners [m/ plot]- 2005



Number of runner plants per 20 plants - 2005



Strawberry Vegetative Growth

- Treatments of the plants with BFPs revealed positive tendencies in vegetative growth of both examined cultivars.

- In comparison to control, solid fertilizers increased all the vegetative parameters in ‘Elkat’ cv. However, these differences were not statistically significant.

- Regardless of the applied BFPs, ‘Elkat’ cv. was more productive than ‘Filon’.

Conclusions

- **‘Filon’ cultivar was more sensitive to the applied BFPs than ‘Elkat’, indicating cultivar dependent response of strawberry plants to the applied BFPs.**

- **Treatments of strawberry plants with BFPs in the second year gave positive inluence on total fruit yield and vegetative growth parameters, but the data are not statitically significant.**

- **Fruit firmness was enhanced by standard NPK and Bioilsa.**

Blackcurrant

Materials and methods

The field experiment is situated in the Experimental Orchard of Research Institute of Pomology and Floriculture (RIPF) at Dąbrowice near Skierniewice, Central Poland. The field soil on which experiment is located is characterized as a mineral sandy–clay soil with medium fertility of mineral nutrients (pH 6.0- 6.5).

In the spring and summer of 2005, the 3-year-old shrubs were fertilized with ecological **soil fertilizers** (Bioilsa, BF-Ecomix) and **foliar fertilizers** (BF-grow, BF-quality, Ausma, Glucos K). The standard fertilization involved the use of ammonium nitrate (80 kg N/ha), triple super-phosphate (70 kg P_2O_5/ha) and potassium sulphate (120 kg K_2O/ha). In total, 16 combinations of BFP fertilizers including the standard NPK fertilization were applied. The control shrubs were not fertilized.

Plant material and plot design

Two newly bred by RIPF blackcurrant cultivars 'Tisel' and 'Tiben' were chosen and planted in the experimental plots. They are grown in two separate, parallel rows, each about 200 m long. The trail was designed as a split plot design including 64 plots (4 solid treatments x 4 liquid applications x 4 replications). Each plot is consisting of 6 bushes, surrounded with one border plant on each side. So the total number of experimental plants was 384 for each investigated cultivar. The plants are planted at the distance of 3.5 m x 0.5 m. For each cultivar, 2 experimental rows, both about 200 m in length, were nominated, in which the individual plots were randomly chosen. In this experiment two replications were designed in each row.

The experiment and research work are being carried out as part of the same CRAFT project for the years 2004-2005. The aim is to assess the effect of ecological organic and mineral fertilizers, both soil and foliar, on the vegetative growth, yield size and yield quality of blackcurrant shrubs.

Treatments

The following treatments were applied in black currant experiment in 2004 -2005:

1 - No fertilization
1a - No fertilization + BF-grow + BF-quality
1b - No fertlization + Ausma
1c - No fertlization + Glucos K
2 - Standard fert.
2a - Standard fert. + BF-grow + BF- quality
2b - Standard fert. + Ausma
2c - Standard fert. + Glucos K
3 - Bioilsa
3a - Bioilsa + BF-grow + BF-quality
3b - Bioilsa + Ausma
3c - Bioilsa + Glucos K
4 - BF-Ecomix
4a - BF-Ecomix + BF-grow + BF-quality
4b - BF-Ecomix + Ausma
4c - BF-Ecomix + Glucos K

Solid applications included non fertilized plots, standard NPK fertilization, Bioilsa and BF-Ecomix. The application and mixing with the soil of solid BFPs was done on April 29 2005 (fig. 1).

Figure 1. General view of field experiment and the application and mixing with the soil of solid BFPs on April 29, 2005.

The liquid fertilizers (BF-grow, BF-quality, Ausma and Glucose K) were applied abundantly on the leaves according to recommended dose of 1,5 L of BFPs solutions per plot/6 plants (fig. 2).
Frequency of treatments and concentrations of the applied BFPs:

From the practical implementation by users, in season of 2005 the number and concentration of BF-grow and BF-quality was modified as suggestion and agreement of the producer (Agrobio Products B.V, the Netherlands) and the coordinator of the project and other Management Team. As a result 16 sprayings (8 x BF-grow plus 8 x BF-quality) in the concentration of 1% applied in 2004 were changed into 6 sprayings (3 x BF-grow plus 3 x BF-quality) in the higher concentration of 2% in 2005. Detailed information on foliar applications is given below:
3 x 2% BF-grow (applied weekly on **10.05, 18.05 24.05**)
3 x 2% BF-quality (applied weekly on **7.06, 14.06, 21.06)**
3 x 0,1% Ausma (applied on 3, 6, 9 week, before harvest - **18.05, 7.06, 21.06)**,
4 x 0,5% Glucose K (applied on 2, 4, 6, 8 week, before harvest - **10.05, 24.05, 7.06, 21.06)**.

Figure 2. Foliar application of BFPs , starting at the full of vegetation season – May, 2005

Measurements and observations:

The same parameters like in 2004 were determined:

1. Visual observation of the plant growth and appearance
2. The size of bushes in m^2 (height × width)
3. Ripening time, harvest date,
4. Yield in kg/shrub,
5. Fruit size expressed as the weight of 100 randomly chosen berries from each plot or shrub,
6. Chlorophyll index in the leaves. The intensity of the green colour of leaves determined by means of N-tester, a meter manufactured by HYDRO (Japan),
7. Mineral content of soil, leaf and fruit,
8. Fruit quality. Fruit samples were delivered to the Department of Fruit Processing and Storage for assessment of fruit quality (included in the WP4 report of RIPF).

Methodology of microbiological tests on fruit

Microbiological assessment was done once, samples fresh harvested fruits were tested in the Microbiology Laboratory of the Central Laboratory of Refrigerating Engineering in Lodz .Fruits were tested for the presence of bacteria (*Listeria monocytogenes*, *Salmonella, Escherichia coli*, *Enterobacteriaceae*), moulds and fungi on the surface of their skin and inside their flesh

The results were analyzed using the statistical method of a two-factor analysis of variance. The significance of the differences between the average parameters of the cultivars was determined by t-Duncan's test at the 5% level of significance.

RESULTS

Plant growth and appearance

In both years (2004 – 2004) at the beginning of vegetation season and during fruit harvest (first half of July) the applied BFP fertilizers did not have any effect on the appearance of the shrubs of the two black currant cultivars. At the end of July 2004, shrubs of cv. 'Tiben' treated with bio-fertilizers had typical green leaves. In contrast, leaves of the cultivar 'Tisel' turned yellow as a result of using BFPs, in comparison to the control plants. In 2005 during vegetation season (June – September) plants of 'Tiben' and 'Tisel' showed yellowish symptoms on the leaves – as result of two-spotted spider mite pest infestation plants of both cultivars. It is suggested that BFPs, especially, foliar applications had probably some effect on the plant appearance of both cultivars.

Bush size

Irrespective of the applied BFPs and mineral fertilization, the cultivar 'Tiben' produced longer shoots and larger shrubs than the cultivar 'Tisel'. The bush size [m^2] of cv. 'Tiben' was significantly bigger than those of cv. 'Tisel'; in 2004 on average it was 0,52 m2 and 0,43 m2; in 2005 - 1,31 m2 and 0,88 m2, respectively (tab. 1, fig. 3). In 2005, similar like in 2004, applied BFPs did not influence significantly the bush size in comparison to control and standard NPK fertilization.

Table 1. Bush size [m^2] of two blackcurrant cultivars, Experimental Orchard, Dabrowice, near Skierniewice, Central Poland, 2005.

'TISEL'					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	*Average*
1. Control	0,77 a	0,88 a	0,89 a	0,91 a	*0,87 a*
2. Standard	0,77 a	0,85 a	0,82 a	0,86 a	*0,83 a*
3. Bioilsa	0,86 a	0,83 a	1,02 a	0,81 a	*0,88 a*
4. BF-ecomix	0,96 a	0,86 a	0,86 a	1,12 a	*0,95 a*
Average	***0,84 a***	***0,85 a***	***0,90 a***	***0,93 a***	**0,88 a**
'TIBEN'					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	*Average*
1. Control	1,21 ab	1,29 ab	1,15 a	1,24 ab	*1,22 a*
2. Standard	1,29 ab	1,24 ab	1,23 ab	1,38 ab	*1,28 ab*
3. Bioilsa	1,38 ab	1,30 ab	1,25 ab	1,45 ab	*1,34 ab*
4. BF-ecomix	1,52 b	1,37 ab	1,38 ab	1,36 ab	*1,40 b*
Average	***1,35 a***	***1,30 a***	***1,25 a***	***1,36 a***	**1,31 b**

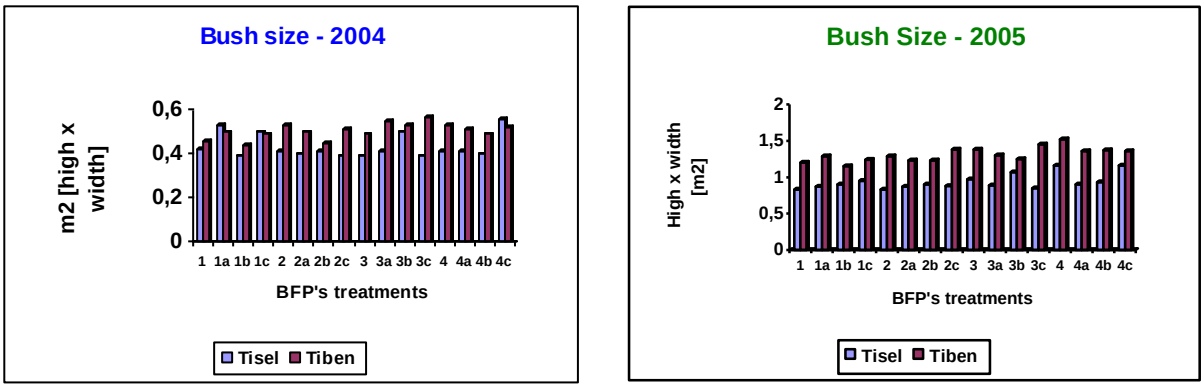


Fig. 3. Bush size of investigated blackcurrant cultivars in 2004 and 2005

Ripening time

In both years (2004 -2005) fruit of cultivar 'Tisel' ripened earlier than those of 'Tiben'. Fruit of 'Tisel' were harvested about one week earlier than 'Tiben'. In 2004 fruits of cv. 'Tisel were ready to harvest on July 6 and for 'Tiben' on July 15. In the second year of studies (2005) fruits were harvested few days later than in 2004 due to weather conditions. Fruit of 'Tisel' were harvested on July 11 and 'Tiben' on July 18.

Fruit yield

In 2004, the plants of 'Tisel' produced higher yields (0,52 kg/bush) than 'Tiben' (0,45 kg/bush), irrespective of the applied fertilization (tab. 2 and 3, fig. 4). The cultivar 'Tisel' gave the highest yields following fertilization with: BF-Ecomix, BF-Ecomix +Glucos K, Bioilsa +Ausma, BF-Ecomix +Ausma, Bioilsa +BF-grow +BF-quality. The same result was obtained for the shrubs of 'Tiben' when the following fertilizers had been applied: BF-Ecomix +Glucos K, Bioilsa, BF-Ecomix, Bioilsa +BF-grow+ BF-quality, Bioilsa +Ausma. Regardless of the applied foliar fertilization, the soil fertilizers BF-Ecomix and Bioilsa increased fruit yield of both cultivars to the greatest extent.

In 2005 both cultivars produced higher yields than in 2004. On average, 'Tiben' produced the significantly higher yield (3,69 kg/bush) than 'Tisel' (2,13 kg/bush), regardless of the BFP treatments (tab. 2 and 3, fig. 4). The highest yield of 'Tisel' was obtained from the plants treated with: Bioilsa +Ausma, BF-Ecomix + BF-grow +BF-quality and BF-Ecomix + Glucos K. For 'Tiben' the best were: Bioilsa +Ausma, Bioilsa + Glucos K, BF-Ecomix + Glucos K. Detailed analyses of results showed that all the applied BFPs did not significantly influenced the total fruit yield of both cultivars in comparison to control or standard NPK fertilization. It is expected that greater differences in fruit yielding of the shrubs will be obtained in 2006 or next years as a result of the successive effect of applying the bio-fertilizers in 2004 and 2005.

Results of microbiological assessment of blackcurrant fruits – 2005

No microorganisms posing a direct threat to human health such as *Listeria monocytogenes, Salmonella, Escherichia coli* were found in the blackcurrant fruit.

From the majority of blackcurrant fruit samples, bacteria from the family *Enterobacteriaceae* were isolated, but the size of their population was within the limits allowed by the standard

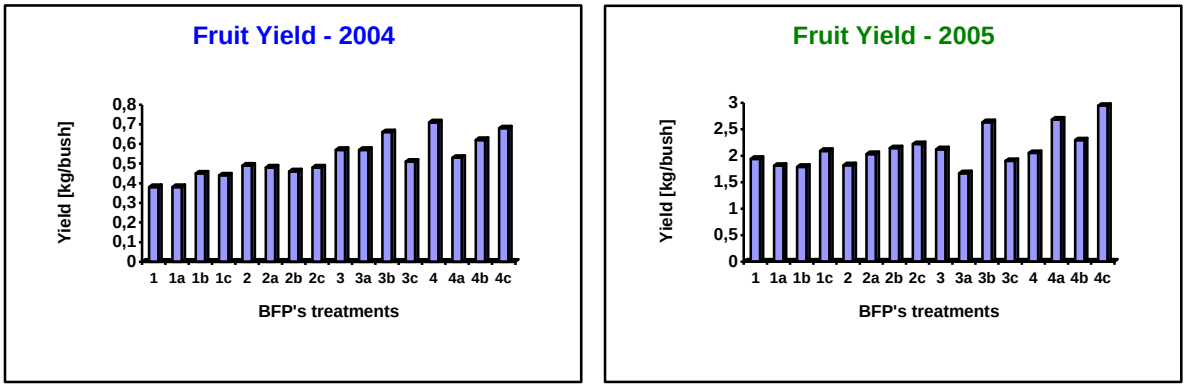
Table 2. Summarized results of fruit yield of two blackcurrant cultivars fertilized with BFP products at the Experimental Orchard, Dabrowice, 2005

'TISEL'					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	*Average*
1. Control	1,94 ab	1,81 ab	1,79 ab	2,09 ab	*1,91 a*
2. Standard	1,82 ab	2,03 ab	2,14 ab	2,22 ab	*2,06 ab*
3. Bioilsa	2,12 ab	1,67 a	2,63 ab	1,90 ab	*2,08 ab*
4. BF-ecomix	2,05 ab	2,68 ab	2,29 ab	2,94 b	*2,49 b*
Average	***1,98 a***	***2,05 a***	***2,21 a***	***2,29a***	**2,13 a**
'TIBEN'					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	*Average*
1. Control	3,74 a	3,39 a	3,43 a	3,69 a	*3,56 a*
2. Standard	3,44 a	3,54 a	3,29 a	3,91 a	*3,54 a*
3. Bioilsa	3,86 a	3,72 a	4,03 a	4,00 a	*3,90 a*
4. BF-ecomix	3,61 a	3,77 a	3,79 a	3,86 a	*3,69 a*
Average	***3,66 a***	***3,60 a***	***3,64 a***	***3,87 a***	**3,69 b**

Table 3. Fruit yield of two black currant cultivars as an effect of all BFP products (solid and foliar application), standard NPK fertilization and control, Experimental Station, SD Dabrowice, 2004- 2005

No	**Treatment**	**Yield [kg/plot]**			
		2004		**2005**	
		TISEL	**TIBEN**	**TISEL**	**TIBEN**
1	1. No fertilization – control	0,38	0,44	1,94	3,74
2	1a. No fertilization + BF-grow + BF-quality	0,38	0,46	1,81	3,39
3	1b. No fertilization + Ausma	0,45	0,47	1,79	3,43
4	1c. No fertilization + Glukos K	0,44	0,45	2,09	3,69
5	2. Standard fertilization	0,49	0,45	1,82	3,44
6	2a. Standard fertilization+BF-grow+BF-quality	0,48	0,43	2,03	3,53
7	2b. Standard fertilization + Ausma	0,46	0,36	2,14	3,29
8	2c. Standard fertilization + Glukos K	0,48	0,34	2,22	3,91
9	3. Bioilsa	0,57	0,55	2,12	3,86
10	3a. Bioilsa + BF-grow + BF-quality	0,57	0,48	1,67	3,72
11	3b. Bioilsa + Ausma	0,66	0,47	2,63	4,03
12	3c. Bioilsa + Glukos K	0,51	0,45	1,90	4,00
13	4. BF- ecomix	0,71	0,50	2,05	3,61
14	4a. BF- ecomix + BF-grow + BF-quality	0,53	0,39	2,68	3,77
15	4b. BF- ecomix + Ausma	0,62	0,44	2,29	3,79
16	4c. BF- ecomix + Glukos K	0,68	0,59	2,94	3,86
AVERAGE		**0,52**	**0,45**	**2,13**	**3,69**

A/ TISEL



B/ TIBEN

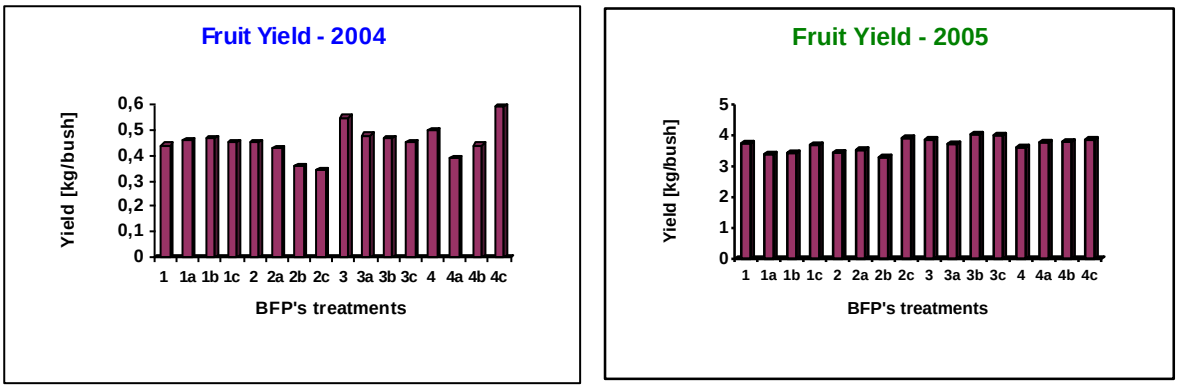


Figure 4. Fruit yield of blackcurrant cultivars in 2004 - 2005, **A** – Tisel, **B**- Tiben

Fruit size

In the fist year of investigation (2004) 'Tisel' produced larger fruits than 'Tiben'; an average weight of 100 berries was 139,9 g for 'Tisel' and 118,6 g for 'Tiben'. The largest fruits of 'Tisel' produced by the shrubs were as a result of the following fertilizer combinations: control +Ausma, control +BF-grow +BF-quality, standard NPK fertilization, standard NPK fertilization +Ausma, standard NPK fertilization +BF-grow +BF-quality The cultivar 'Tiben' produced largest fruits following the application of: BF-Ecomix, BF-Ecomix +Ausma, standard NPK, Bioilsa +Glucos K, standard NPK +BF-grow +BF-quality (tab. 4 and tab. 5, fig. 5). Irrespective of the applied soil fertilizers, the foliar fertilizers Ausma and BF-grow +BF-quality caused the largest increase in the size of fruits of the two cultivar.

In 2005 regardless of the applied BFPs, 'Tisel' produced again larger fruits (98,9 g/100 fruits) than 'Tiben' (88,0 g/100 fruits). These differences were significantly proved (tab. 4 and tab. 5). The largest fruits of 'Tisel' were harvested from the plants treated with: BF-Ecomix, Standard NPK + Glucos K, BF-Ecomix + BF-grow +BF-quality. For 'Tiben' the best were: Bioilsa + BF-grow +BF-quality, BF-Ecomix +BF-grow +BF-quality, Ausma. Generally, all the applied BFPs did not significantly influenced the fruit weight of both cultivars in comparison to Standard NPK fertilization and control.

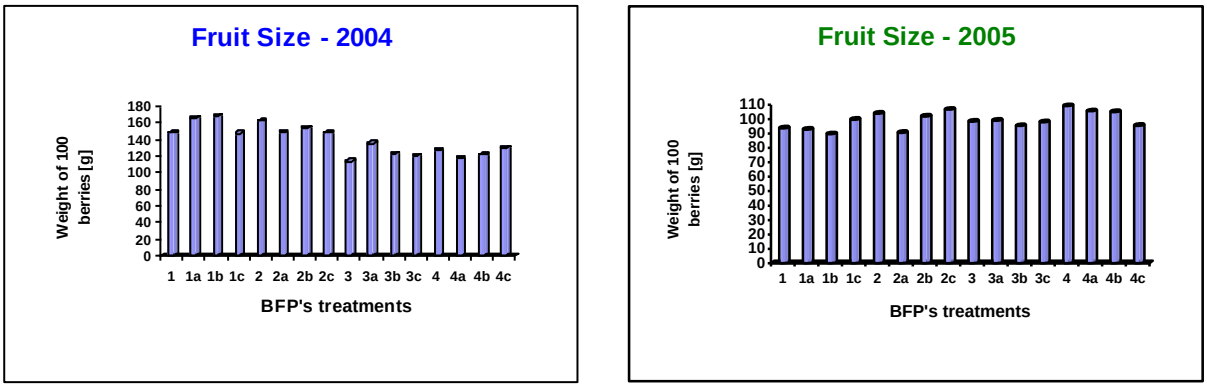
Table 4. Fruit size (as weight of 100 berries in g) of two black currant cultivars fertilized with BFP products at the Experimental Station, SD Dabrowice, 2004 - 2005.

'TISEL'					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	*Average*
1. Control	93,5 a	92,7 a	89,5 a	99,6 a	*93,8 a*
2. Standard	103,8 a	90,4 a	101,7 a	106,5 a	*100,6 ab*
3. Bioilsa	98,2 a	98,9 a	95,2 a	97,8 a	*97,5 ab*
4.BF-ecomix	109,0 a	105,4 a	104,9 a	95,4 a	*103,7 b*
Average	***101,1 a***	***96,8 a***	***97,8 a***	***99,8 a***	**98,9 b**
'TIBEN'					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	*Average*
1. Control	89,2 a	84,0 a	92,3 a	88,1 a	*88,4 a*
2. Standard	88,9 a	89,7 a	89,6 a	84,9 a	*88,3 a*
3. Bioilsa	88,4 a	93,3 a	91,2 a	86,8 a	*89,9 a*
4.BF-ecomix	87,7 a	92,7 a	87,4 a	89,4 a	*89,3 a*
Average	***88,6 a***	***89,9 a***	***90,1 a***	***87,3 a***	**89,0 a**

Table 5. Fruit size (as weight of 100 berries in g) of two black currant cultivars treated with all BFP products (solid and foliar application), standard NPK fertilization and control, Experimental Station, SD Dabrowice, 2004- 2005

No	**Treatment**	**Fruit size [weight of 100 berries in g]**			
		2004		**2005**	
		TISEL	**TIBEN**	**TISEL**	**TIBEN**
1	1. No fertilization – control	148,7	106,0	93,5	89,2
2	1a. No fertilization + BF-grow + BF-quality	166,7	106,8	92,7	84,0
3	1b. No fertilization + Ausma	168,4	106,7	89,5	92,3
4	1c. No fertilization + Glukos K	147,6	107,2	99,6	88,1
5	2. Standard fertilization	163,2	127,4	103,8	88,9
6	2a. Standard fertilization +BF-grow +BF-quality	149,0	125,6	90,4	89,7
7	2b. Standard fertilization + Ausma	154,0	114,9	101,7	89,6
8	2c. Standard fertilization + Glukos K	148,3	112,5	106,5	84,9
9	3. Bioilsa	114,0	115,4	98,2	88,4
10	3a. Bioilsa + BF-grow + BF-quality	135,6	124,7	98,9	93,3
11	3b. Bioilsa + Ausma	123,1	119,8	95,2	91,2
12	3c. Bioilsa + Glukos K	121,0	125,9	97,8	86,8
13	4. BF- ecomix	128,1	136,2	109,0	87,7
14	4a. BF- ecomix + BF-grow + BF-quality	118,5	117,7	105,4	92,7
15	4b. BF- ecomix + Ausma	122,4	130,2	104,9	87,4
16	4c. BF- ecomix + Glukos K	129,7	120,2	95,4	89,4
AVERAGE		**139.9**	**118,6**	**98,9**	**89,0**

A/ TISEL



B/ TIBEN

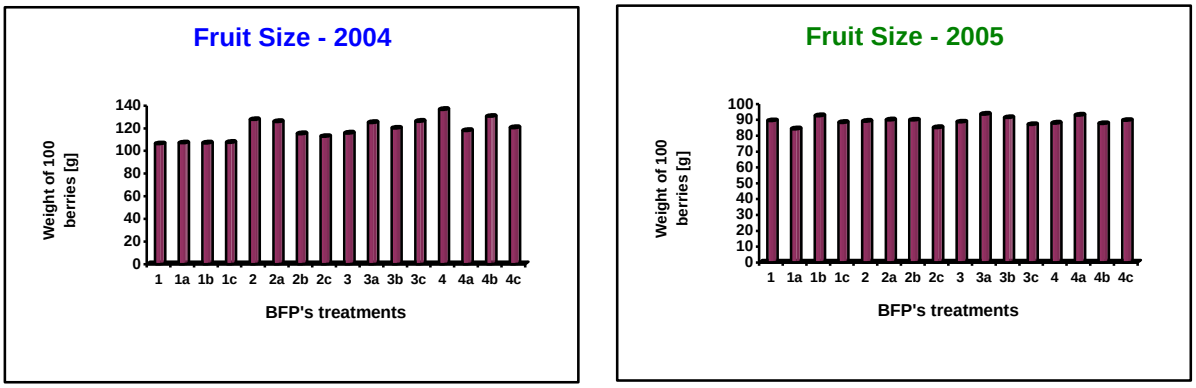


Figure 5. Fruit size of blackcurrant cultivars in 2004 - 2005, **A** – Tisel, **B**- Tiben

Chlorophyll index in the leaves.

In both years (2004-2005) the intensity of the green colour of 30 randomly chosen fully developed leaves (located in the middle young shoots) was determined in 3 replications by means of N-tester, a meter manufactured by HYDRO (Japan), for each combination.

In 2004 leaves of the cultivar ‘Tiben’ had a more intensive green colour than those of ‘Tisel’ (tab. 6 and fig. 5). The greener colour of the leaves of cv. ‘Tiben’ was obtained after the application of the following fertilizers: standard NPK, BF-Ecomix +BF-grow+ BF-quality, BF-Ecomix +Ausma, Bioilsa +Ausma, standard NPK +Ausma. In this respect, for the cultivar ‘Tisel’ the best BFPs and fertilizers proved to be: BF-Ecomix +Glucos K, Bioilsa +Glucos K, Bioilsa +Ausma, standard NPK +Ausma, control +Ausma. Irrespective of the applied soil fertilization, Ausma had the greatest effect on intensifying the green colour of the leaves of the two cultivars.

In 2005 cultivar ‘Tiben’ had again higher chlorophyll index in the leaves than ‘Tisel’. For ’Tiben’ the best were: BF-Ecomix + Ausma, Bioilsa + Glucos K, Bioilsa and for ‘Tisel’: Ausma, Standard NPK+ BF-grow + BF-quality, BF-Ecomix +Ausma (tab. 6 and fig. 5).

Generally, in 2004 and 2005 all applied BFP’s did not significantly influenced the intensity of green colour (chlorophyll index) of leaves of both cultivars in comparison to Standard NPK fertilization and control.

Table 6. Intensity of green colour of leaves (Chlorophyll index) of of two black currant cultivars fertilized with BFP products at the Experimental Station, SD Dabrowice, 2004 - 2005.

'TISEL'					
Treatment	**Single treatment**	**BF-grow + BF-quality**	**Ausma**	**Glucos K**	***Average***
1. Control	494 a	472 a	487 a	458 a	*478 a*
2. Standard	471 a	476 a	463 a	464 a	*466 a*
3. Bioilsa	468 a	446 a	438 a	440 a	*448 a*
4. BF-ecomix	468 a	467 a	475 a	451 a	*465 a*
Average	***475 a***	***465 a***	***465 a***	***453 a***	**464 a**
'TIBEN'					
Treatment	**Single treatment**	**BF-grow + BF-quality**	**Ausma**	**Glucos K**	***Average***
1. Control	510 a	516 a	529 a	504 a	*515 a*
2. Standard	518 a	517 a	520 a	519 a	*518 a*
3. Bioilsa	538 a	530 a	520 a	538 a	*531 a*
4. BF-ecomix	521 a	509 a	541 a	514 a	*521 a*
Average	***522 a***	***518 a***	***528 a***	***519 a***	**522 b**

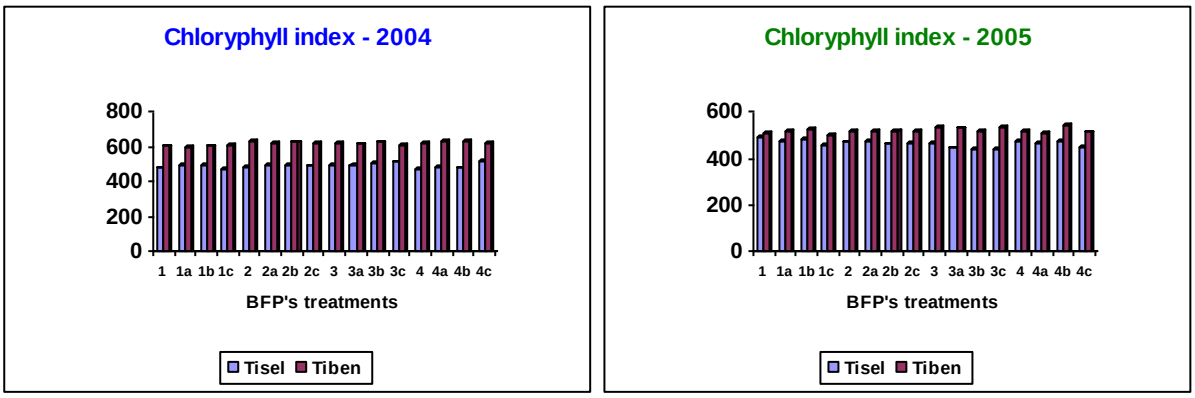


Figure 5. Chlorophyll index of both investigated blackcurrant cultivars in 2004 and 2005.

Mineral content of soil, leaf and fruit.

In 2004 and 2005 samples of soil, leaf and fruits collected from each combination with 4 replications (2004) or 2 replications (2005) were delivered to the Central Analytical Lab of RIPF for analysis of N, P, K, Mg. Obtained results from analysis are described below and presented on figures 6 – 8.

Mineral content of the soil

In 2004 applications of BFPs decreased soil pH by 0.3 - 0.5 in comparison to the initial pH (6,1). Treatments with BFPs modified the mineral content of the soil, but these differences were not statistically significant.

In 2005 applications of BFPs decreased soil pH by 0.3 – 1.2 unit in comparison to the initial pH (6,1). In two cases pH level was increased by 0.2-0.4 unit (Bioilsa and Bioilsa+Glucos K) Treatments with BFPs (solid) modified the mineral content of the soil, depending on cultivar and year of investigation. Detailed analysis of results showed than in 2004, the content of P, K and Mg in the soil samples was higher for 'Tisel' than for 'Tiben'. The different results were in 2005, where Mg and K content in the soil was higher for 'Tiben' than for 'Tisel'.

Mineral content in the leaves

The results obtained in 2004 and 2005, revealed cultivar dependent differences in mineral content of the leaves. In both years, 'Tiben' had higher content of N, Ca and Mg in the leaves, whereas 'Tisel' - P and K**.**

Applications of BFPs in 2004 and 2005 did not affect significantly the mineral content in the leaves of both tested cultivars.

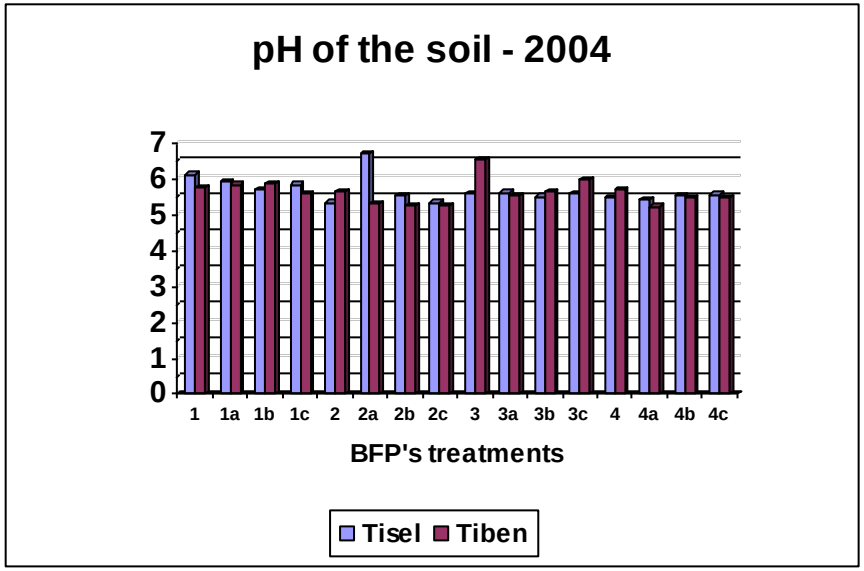
Mineral content in the fruits

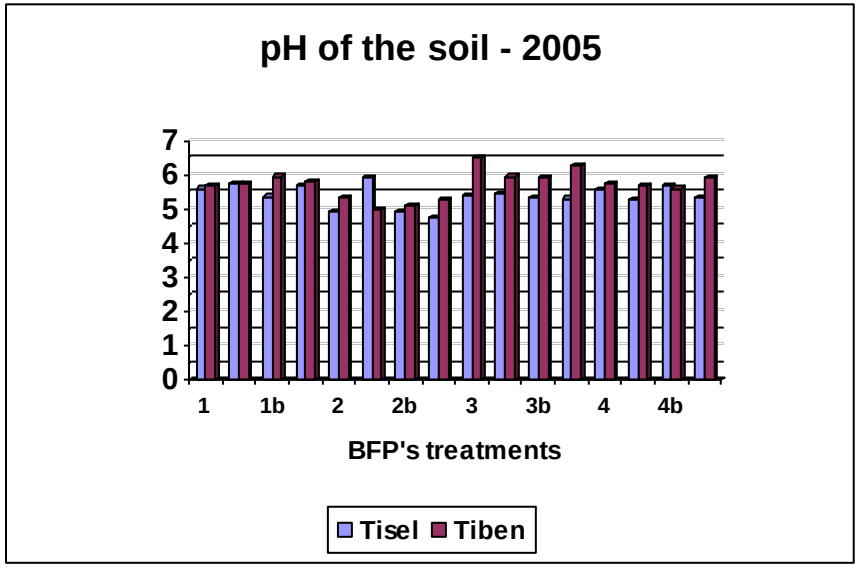
In 2004 the content of N, P, K, Ca and Mg in the fruits was not significantly modified by the cultivar and the applied BFP. However, Mg content in the fruit was significantly higher for 'Tiben' than 'Tisel'. Content of N, P, K and Ca in the fruits was increased by BF Ecomix in comparison to the other treatments

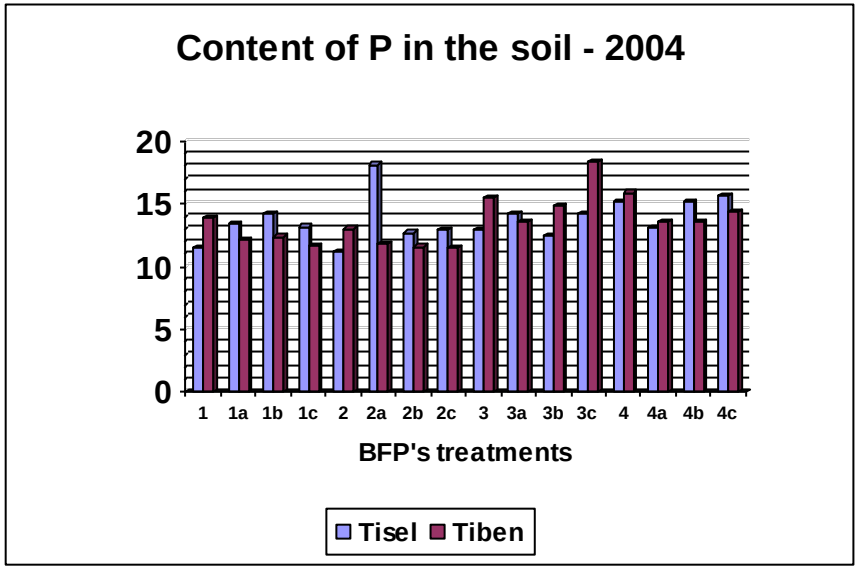
In 2005 content of N, P, K, Ca and Mg in the fruits of 'TIBEN' was generally higher than in fruits of 'TISEL'. It indicates on cultivar dependent macroelement content in the fruits.
The effect of BF Ecomix on increased mineral content in fruit samples was less pronounced in 2005 due to the positive influence of other treatments

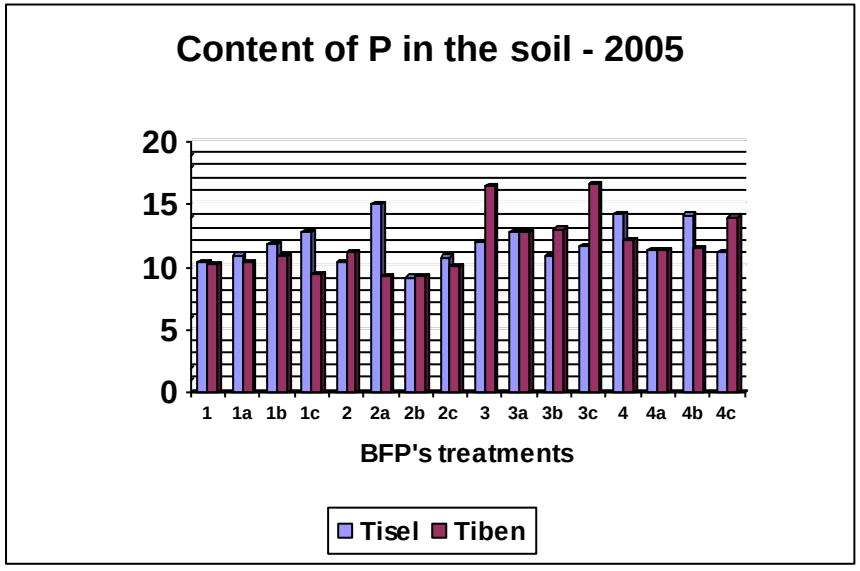
CONCLUSIONS:

1. Applied BFPs did not significantly increased the fruit yield and weight of berries of both investigated blackcurrant cultivars, in comparison to control or standard NPK fertilization,
2. Bush size and chlorophyll index in the leaves of both cultivars were more dependent on the genotype than on the applied BFPs.
3. The same relationship was obtained for macroelements (N, P, K, Mg and Ca) content in soil, leaves and fruits of both tested cultivars.
4. **In both years, but especially in 2005, plants of both cultivars treated with all BFPs showed yellowish symptoms on the leaves in June – September – as the result of two-spotted spider mite infestation. So three extra applications with acaricides were applied to control this pest.**
5. **The obtained results suggest that further investigation on BFPs is required to reveal more pronounced successive effects of BFPs for blackcurrant plants.**


pH of the soil - 2004
7
6
5
4
3
2
1
0
1 1a 1b 1c 2 2a 2b 2c 3 3a 3b 3c 4 4a 4b 4c
BFP's treatments
Tisel
Tiben


pH of the soil - 2005
7
6
5
4
3
2
1
0
1 1b 2 2b 3 3b 4 4b
BFP's treatments
Tisel
Tiben


Content of P in the soil - 2004
20
15
10
5
0
1 1a 1b 1c 2 2a 2b 2c 3 3a 3b 3c 4 4a 4b 4c
BFP's treatments
Tisel
Tiben


Content of P in the soil - 2005
20
15
10
5
0
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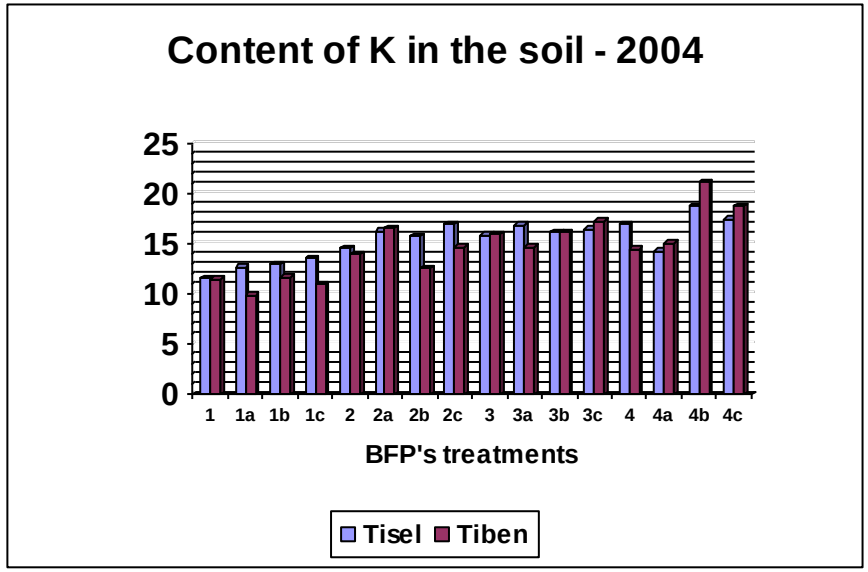
BFP's treatments
Tisel
Tiben


Content of K in the soil - 2004
25
20
15
10
5
0
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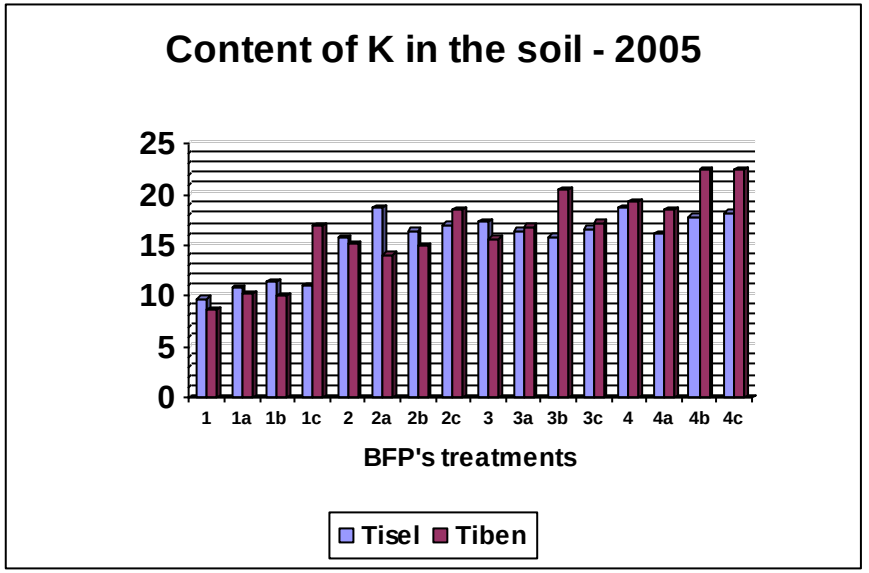
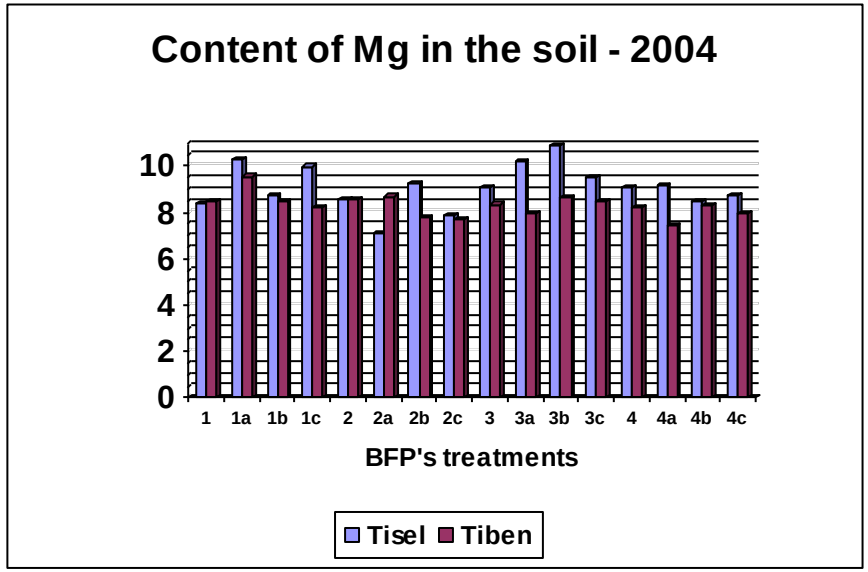
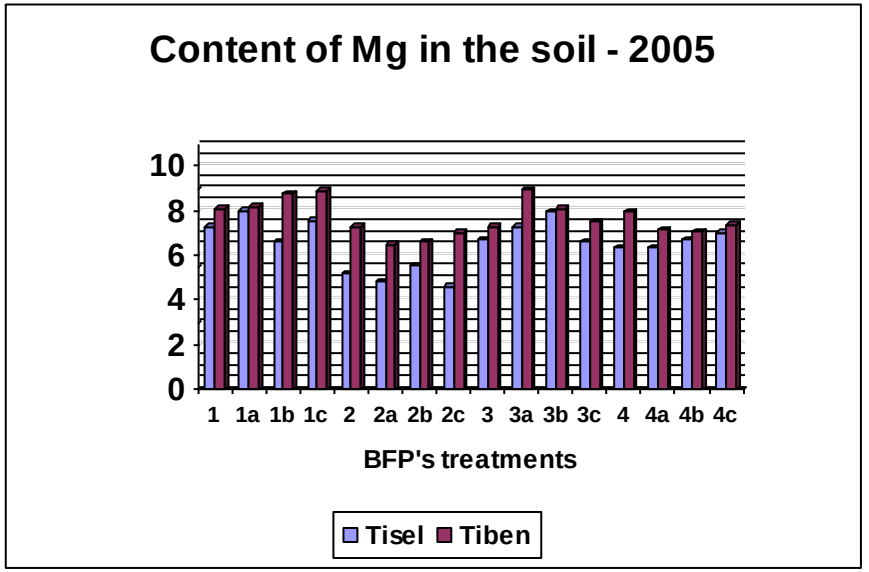
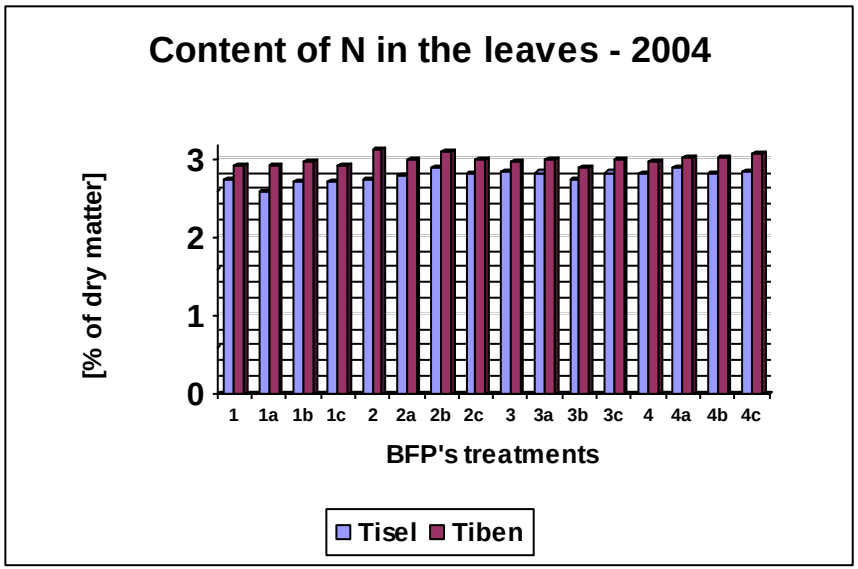
BFP's treatments
Tisel
Tiben


Content of K in the soil - 2005
25
20
15
10
5
0
1 1a 1b 1c 2 2a 2b 2c 3 3a 3b 3c 4 4a 4b 4c
BFP's treatments
Tisel
Tiben


Content of Mg in the soil - 2004
10
8
6
4
2
0
1 1a 1b 1c 2 2a 2b 2c 3 3a 3b 3c 4 4a 4b 4c
BFP's treatments
Tisel
Tiben


Content of Mg in the soil - 2005
10
8
6
4
2
0
1 1a 1b 1c 2 2a 2b 2c 3 3a 3b 3c 4 4a 4b 4c
BFP's treatments
Tisel
Tiben


Content of N in the leaves - 2004
[% of dry matter]
0
1
2
3
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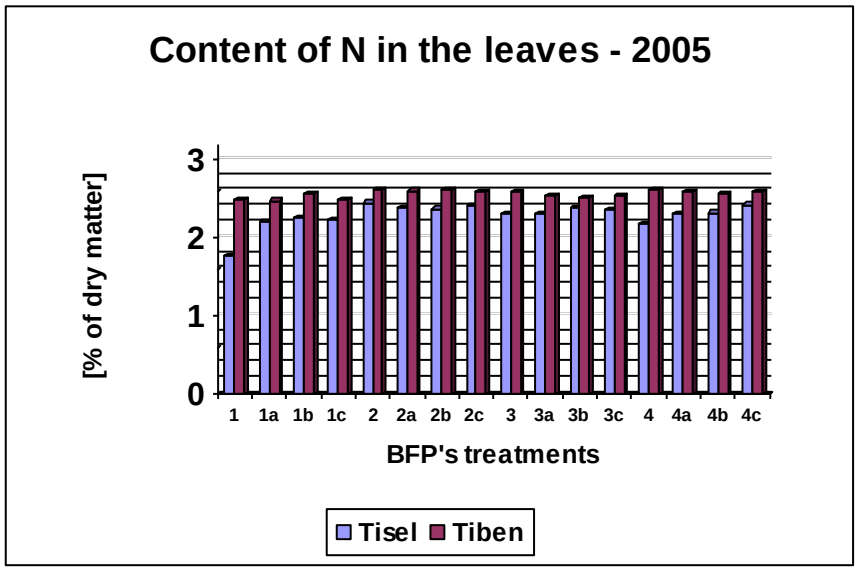
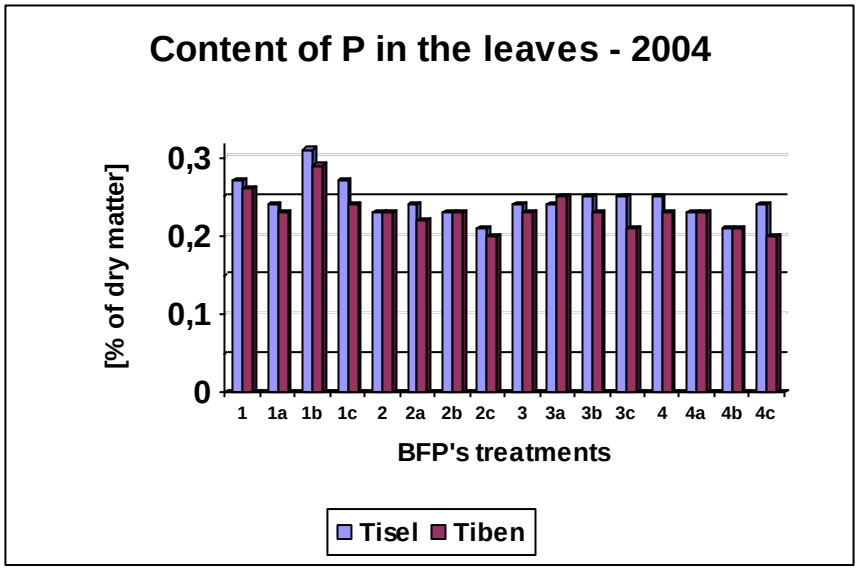
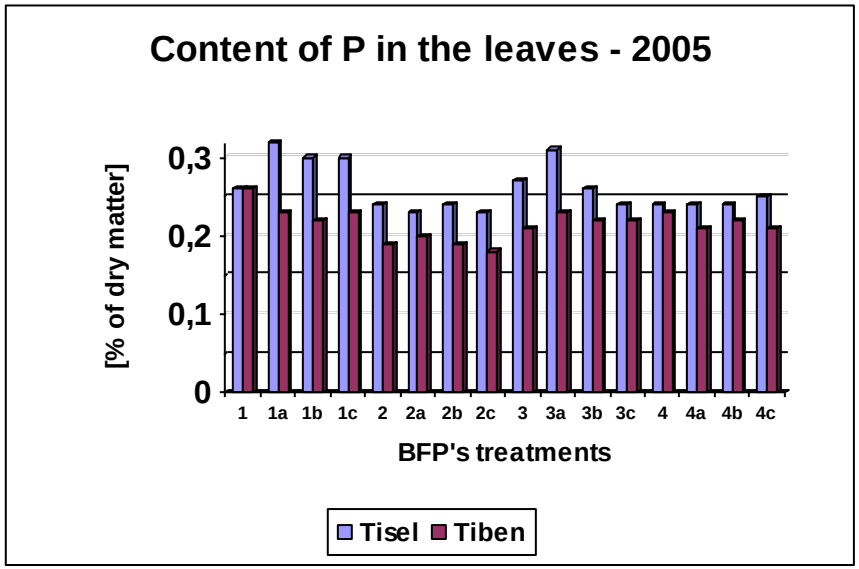
BFP's treatments
Tisel
Tiben


Content of N in the leaves - 2005
[% of dry matter]
0
1
2
3
1 1a 1b 1c 2 2a 2b 2c 3 3a 3b 3c 4 4a 4b 4c
BFP's treatments
Tisel
Tiben


Content of P in the leaves - 2004
[% of dry matter]
0
0,1
0,2
0,3
1 1a 1b 1c 2 2a 2b 2c 3 3a 3b 3c 4 4a 4b 4c
BFP's treatments
Tisel
Tiben


Content of P in the leaves - 2005
[% of dry matter]
0
0,1
0,2
0,3
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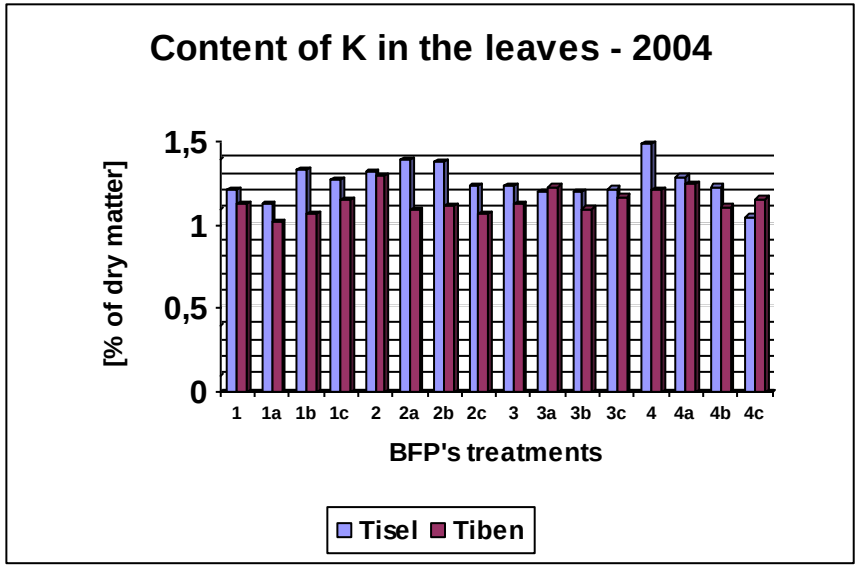
BFP's treatments
Tisel
Tiben


Content of K in the leaves - 2004
[% of dry matter]
1,5
1
0,5
0
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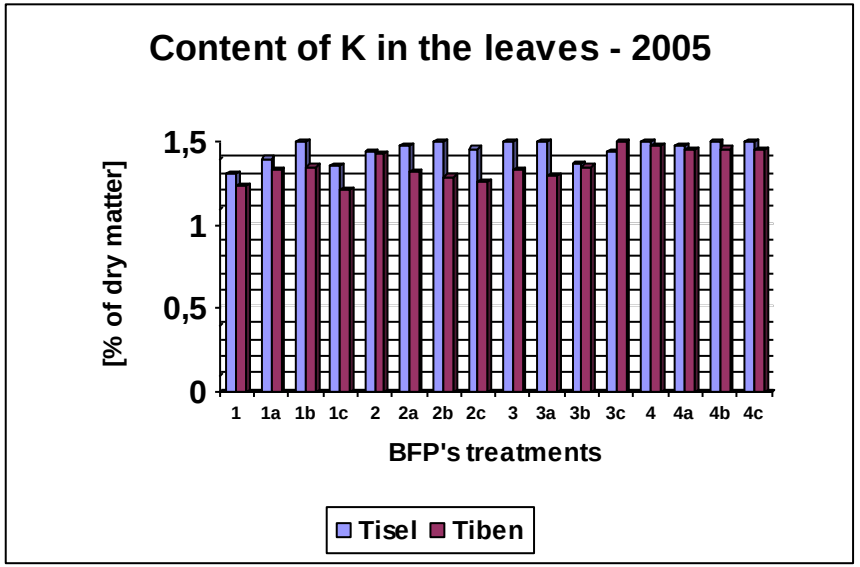
BFP's treatments
Tisel
Tiben


Content of K in the leaves - 2005
[% of dry matter]
1,5
1
0,5
0
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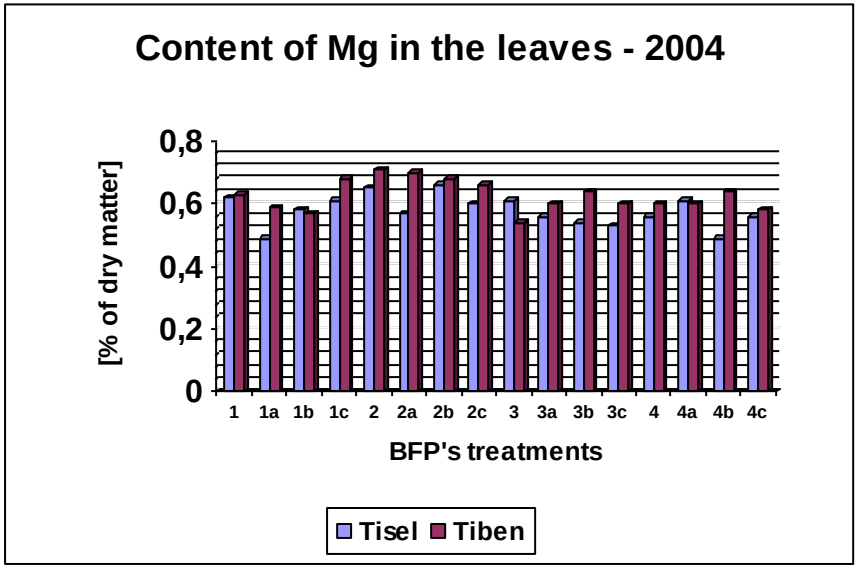
BFP's treatments
Tisel
Tiben


Content of Mg in the leaves - 2004
[% of dry matter]
0,8
0,6
0,4
0,2
0
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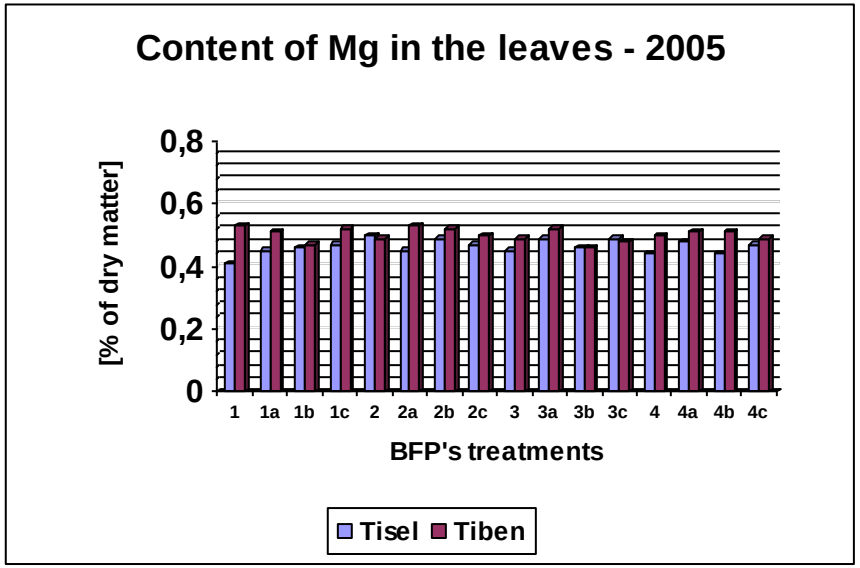
BFP's treatments
Tisel
Tiben


Content of Mg in the leaves - 2005
[% of dry matter]
0,8
0,6
0,4
0,2
0
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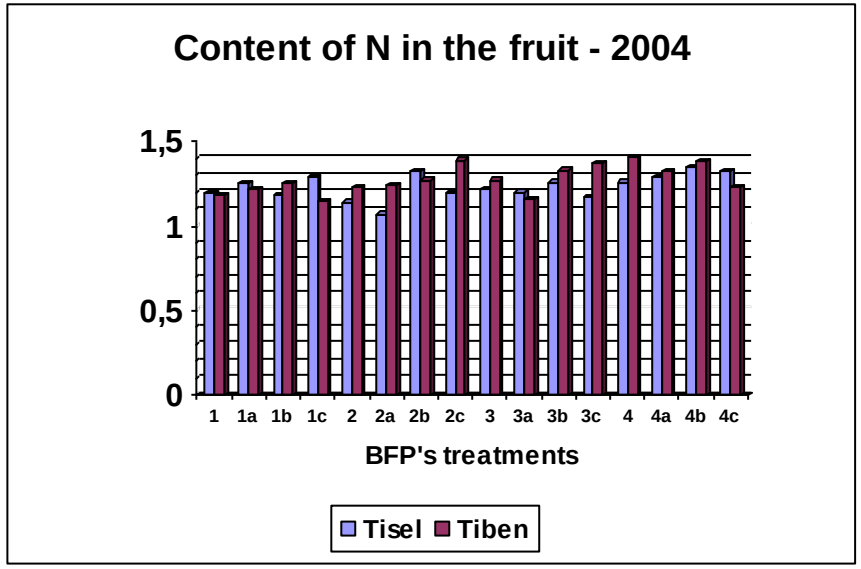
BFP's treatments
Tisel
Tiben


Content of N in the fruit - 2004
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1
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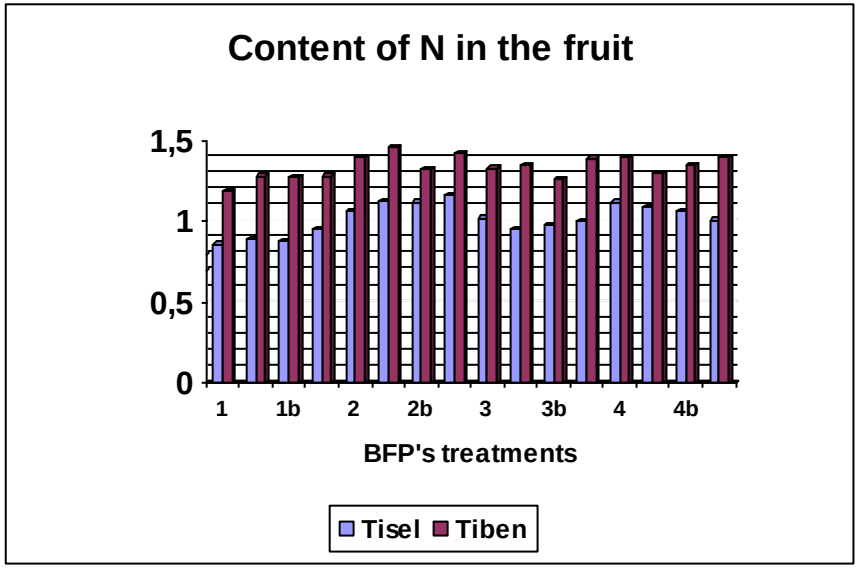
BFP's treatments
Tisel Tiben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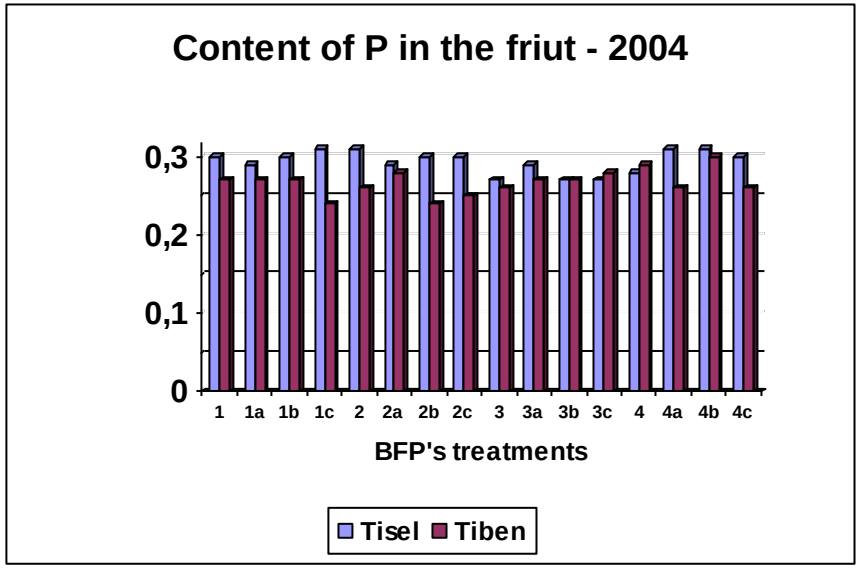
BFP's treatments
Tisel Tiben


Content of P in the friut - 2004
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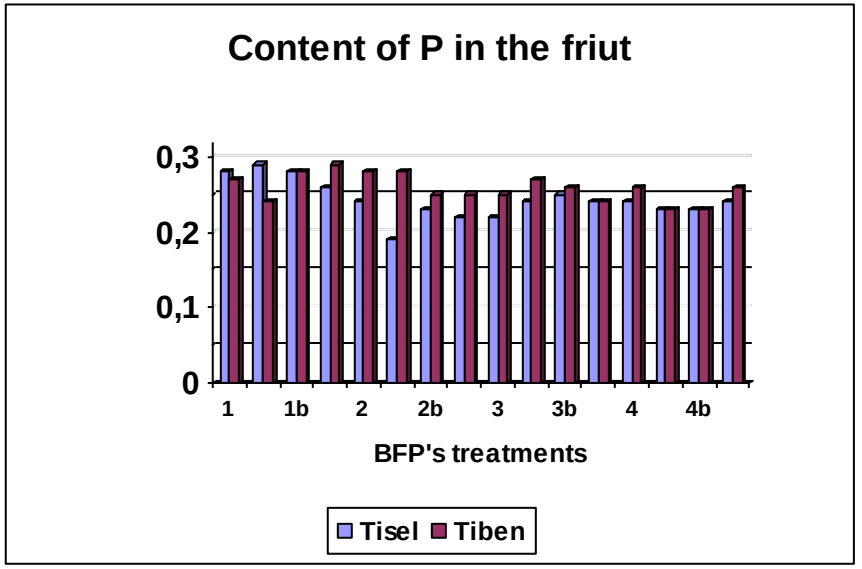
BFP's treatments
Tisel Tiben


Content of P in the friut
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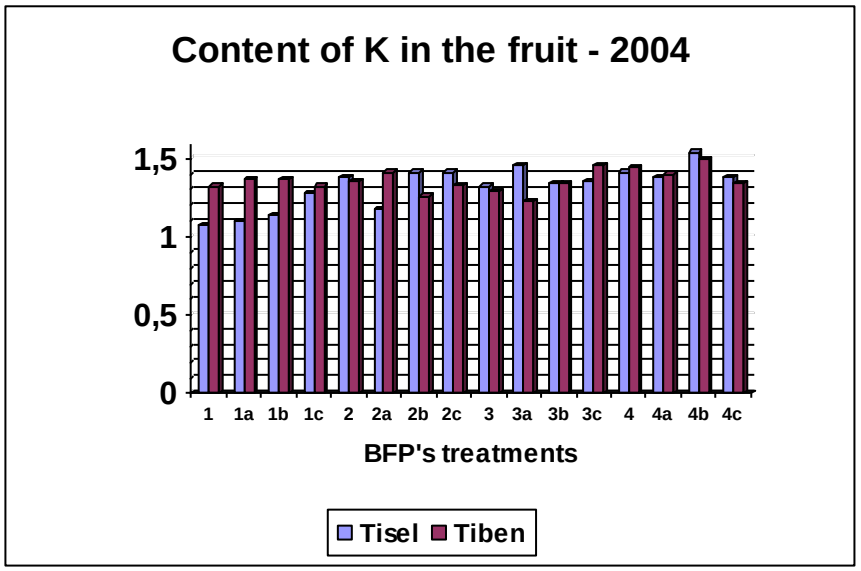
BFP's treatments
Tisel Tiben


Content of K in the fruit - 2004
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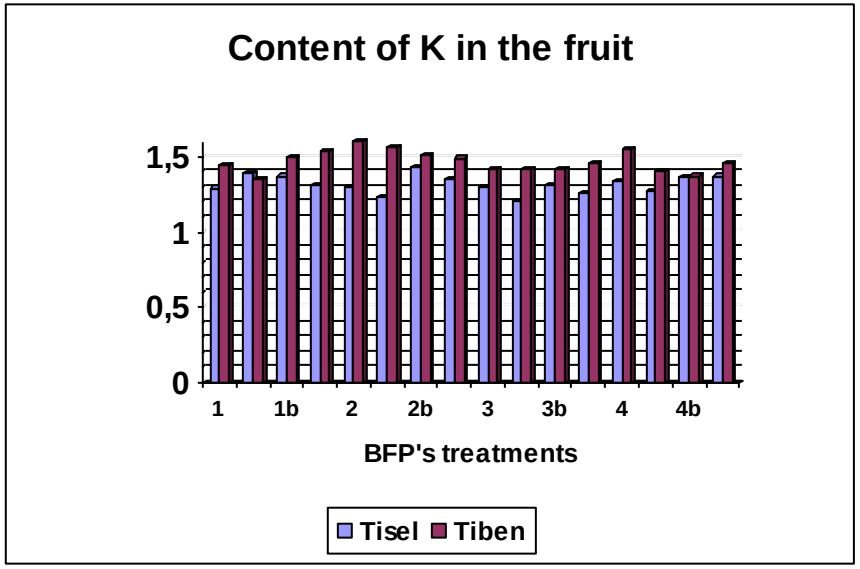
BFP's treatments
Tisel Tiben


Content of K in the fruit
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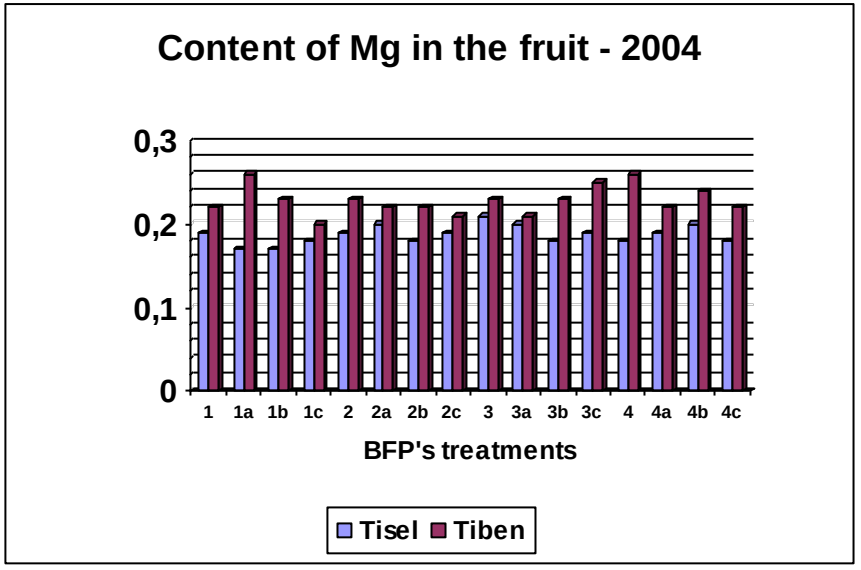
BFP's treatments
Tisel Tiben


Content of Mg in the fruit - 2004
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0,2
0,1
0
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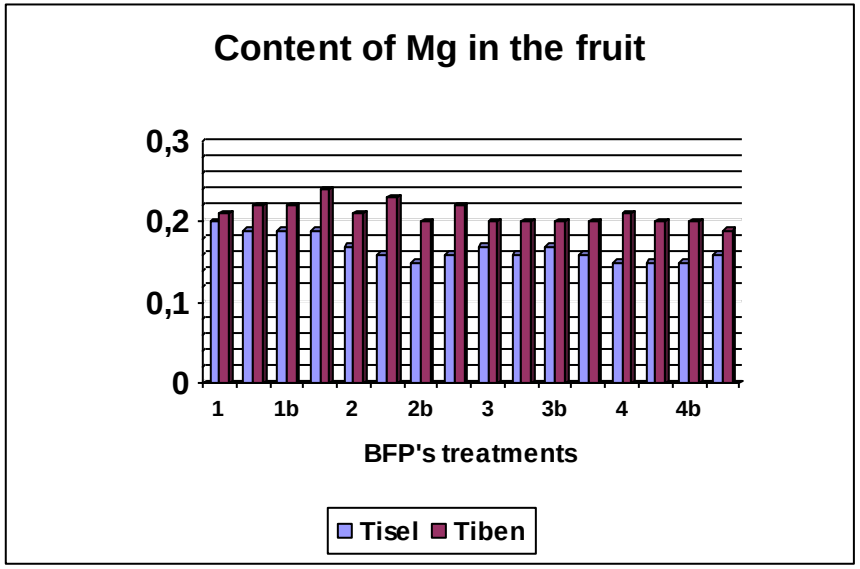
BFP's treatments
Tisel Tiben


Content of Mg in the fruit
0,3
0,2
0,1
0
1 1b 2 2b 3 3b 4 4b
BFP's treatments
Tisel Tiben

APPLE

Within the CRAFT Project in 2005 the field experiment was carried out on two apple cultivars: D-3 (‘Free Redstar’) and D-7 (‘Melfree’) grown at the Experimental Orchard of the Research Institute of Pomology and Floriculture at Dabrowice near Skierniewice, Poland. Trees were planted on 18 April 2005, and application of solid BFPs was done 26 April 2006.

16 experimental combinations were used for each cultivar:

1. No fertilization
1a. No fertilization + BF-grow (2, 4, 6 week before harvest) + BF-quality (8, 10, 12 week before harvest)
1b. No fertilization + Ausma (3, 6, 9 week before harvest)
1c. No fertilization + Glucos K (2, 4, 6, 8 week before harvest)
2. Standard NPK
2a. Standard NPK + BF-grow (2, 4, 6 week before harvest) + BF-quality (8, 10, 12 week before harvest)
2b. Standard NPK + Ausma (3, 6, 9 week before harvest)
2c. Standard NPK + Glucos K (2, 4, 6, 8 week before harvest)
3. Bioilsa
3a. Bioilsa + BF-grow (2, 4, 6 week before harvest) + BF-quality (8, 10, 12 week before harvest)
3b. Bioilsa + Ausma (3, 6, 9 week before harvest)
3c. Bioilsa + Glucos K (2, 4, 6, 8 week before harvest)
4. BF-ecomix
4a. BF-ecomix + BF-grow (2, 4, 6 week before harvest) + BF-quality (8, 10, 12 week before harvest)
4b. BF-ecomix + Ausma (3, 6, 9 week before harvest)
4c. BF-ecomix + Glucos K (2, 4, 6, 8 week before harvest)

Foliar treatments

Combinations + Product	**Time of fertilization**			
Combinations 1, 2, 3, 4	**No fertilization**			
Combinations 1a, 2a, 3a, 4a **BF-GROW** (60 ml/3 l) (2, 4, 6 week before harvest) – 12 trees	**10.05.2005**	**24.05.2005**	**7.06.2005**	
BF-QUALITY (60 ml/3 l) (8, 10, 12 week before harvest) – 12 trees	**21.06.2005**	**5.07.2005**	**19.07.2005**	
Combinations 1b, 2b, 3b, 4b **AUSMA** (3 ml/3 l) (3, 6, 9 week before harvest) – 12 trees	**17.05.2005**	**7.06.2005**	**28.06.2005**	
Combinations 1c, 2c, 3c, 4c **GLUCOS K** (7,5 ml/1,5 l) (2, 4, 6, 8 week before harvest) – 12 trees	**10.05.2005**	**24.05.2005**	**7.06.2005**	**21.06.2005**

Each experimental combination consisted of 12 trees, i.e. 4 replications by 3 plants. Total 192 apple trees (16 combinations x 12 plants) were used within each apple cultivar, and whole experiment included 384 apple trees. Plant protection was applied according to recommendations for commercial orchards.

Melfree (D-7) ('Melrose' x 'Freedom')

Fruits are medium to large, somewhat variable, the shape oblong-conical. Skin is non-axy, with red stripes overlaying green-yellow ground colour. Harvest time is in the second half of September, a few days before 'Freedom'. This cultivar is resistant to apple scab in field conditions, showing also a high level of resistance to powdery mildew, winterhardy.

Free Redstar (D-3)

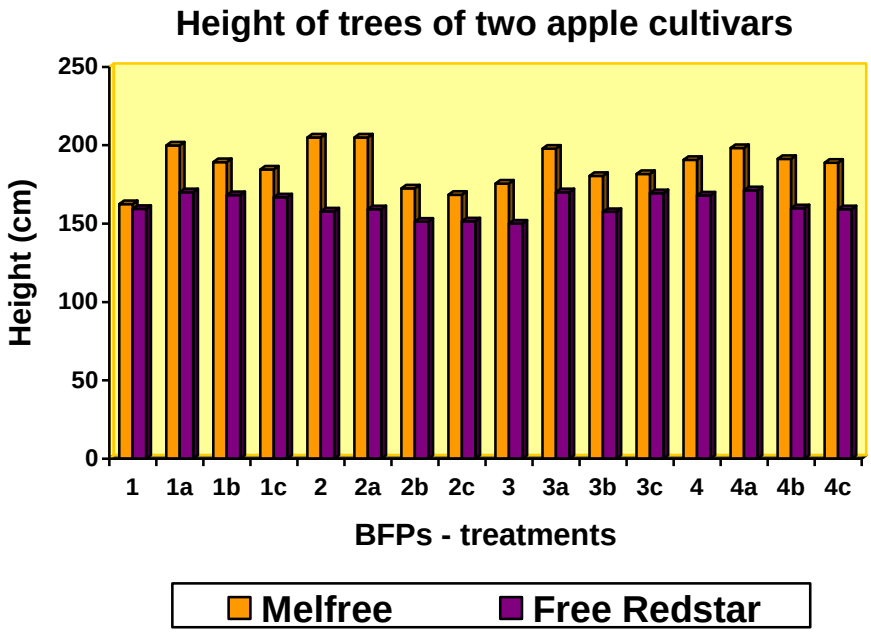
Fruits, formed mainly on spurs and shoot tips, are oblong-conical, with small ribs around the calyx. Their background colour is green-yellow with an intense red blush covering almost the entire skin surface. It ripens just after 'Freedom'. This cultivar is resistant to apple scab in field conditions, showing also a high level of resistance to powdery mildew and fire blight, winterhardy.

All trees were grown on M.9 rootstock and were planted at the distance of 1.25 x 3.5 m in a randomized block design in four replications (3 trees/plot).

The following measurements and observations were performed in 2005 year:

1. Intensity of flowering of trees – 13 May 2005
2. Chlorophyll index in the leaves (30 leaves/plot) – SPAD – 22 August 2005
3. Soil samples were collected on 24 August 2005 and delivered to the Central Analytical Lab for analysis of mineral content
4. Height of trees [cm] – 7 September 2005
5. Trunk diameter [mm] – 7 September 2005

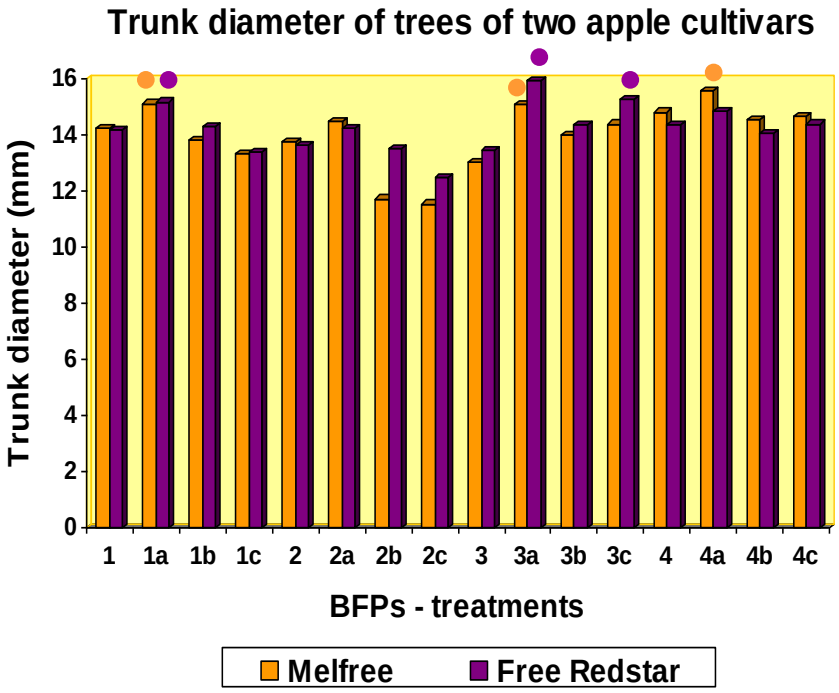
RESULTS



Height of trees of two apple cultivars, season 2005

MELFREE					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	Average
Control	162.5 a	200.0 de	189.3 b-e	184.5 a-e	184.1 a
Standard	205.0 e	205.0 e	172.5 a-c	168.5 ab	187.8 a
Bioilsa	175.5 a-d	197.8 c-e	180.5 a-e	181.8 a-e	183.9 a
BF-ecomix	190.8 b-e	198.3 c-e	191.3 b-e	188.8 b-e	192.3 a
Average	183.5 a	200.3 b	183.4 a	180.9 a	187.0
FREE REDSTAR					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	Average
Control	159.5 a-d	170.0 cd	168.3 a-d	166.8 a-d	166.2 b
Standard	157.8 a-d	159.3 a-d	151.3 ab	151.5 a-c	155.0 a
Bioilsa	150.0 a	170.0 cd	157.5 a-d	169.5 b-d	161.8 ab
BF-ecomix	168.0 a-d	171.3 d	159.8 a-d	159.3 a-d	164.6 b
Average	158.8 a	167.7 b	159.2 a	161.8 ab	161.9

- Regardless of the applied BFPs tree height was higher for ‘Melfree’ cv. than for ‘Free Redstar’.
- Trees of ‘Melfree’ cv. were more sensitive to the applied BFPs than ‘Free Redstar’.
- Tree height of ‘Melfree’ was the highest after treatments with: Standard NPK+BF-grow+BF-quality and Standard NPK.
  Tree height of ‘Free Redstar’ was significantly increased by BF-ecomix+BF-grow+BF-quality, Bioilsa+BF-grow+BF-quality and Control+BF-grow+BF-quality.



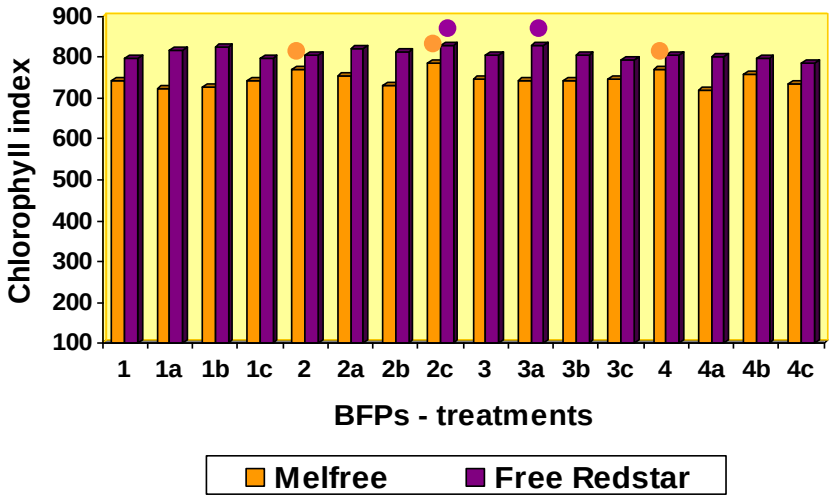
Trunk diameter of trees of two apple cultivars, season 2005

MELFREE					
Treatment	**Single treatment**	**BF-grow + BF-quality**	**Ausma**	**Glucos K**	**Average**
Control	**14.2 c-e**	**15.1 de**	**13.8 c-e**	**13.3 b-d**	**14.1 b**
Standard	**13.7 c-e**	**14.5 c-e**	**11.7 ab**	**11.6 a**	**12.9 a**
Bioilsa	**13.1 a-c**	**15.1 de**	**14.0 c-e**	**14.4 c-e**	**14.2 b**
BF-ecomix	**14.8 c-e**	**15.6 e**	**14.6 c-e**	**14.7 c-e**	**14.9 b**
Average	**14.0 a**	**15.1 b**	**13.5 a**	**13.5 a**	**14.0**
FREE REDSTAR					
Treatment	**Single treatment**	**BF-grow + BF-quality**	**Ausma**	**Glucos K**	**Average**
Control	**14.2 a-c**	**15.2 bc**	**14.3 a-c**	**13.4 ab**	**14.3 ab**
Standard	**13.6 ab**	**14.3 a-c**	**13.5 ab**	**12.5 a**	**13.5 a**
Bioilsa	**13.5 ab**	**15.9 c**	**14.4 a-c**	**15.3 bc**	**14.8 b**
BF-ecomix	**14.3 a-c**	**14.9 bc**	**14.1 a-c**	**14.4 a-c**	**14.4 b**
Average	**13.9 a**	**15.1 b**	**14.1 a**	**13.9 a**	**14.3**

- Trunk diameter of 'Melfree' cv. was significantly increased by treatment with: BF-ecomix+BF-grow+BF-quality, Control + BF-grow + BF-quality and Bioilsa+BF-grow+BF-quality.

- Trunk diameter of 'Free Redstar' was significantly increased by Bioilsa+BF-grow+BF-quality, Bioilsa+Glucos K and Control+BF-grow+BF-quality.

Level of chlorophyll index in the leaves of two apple cultivars



Level of chlorophyll index in the leaves of two apple cultivars, season 2005

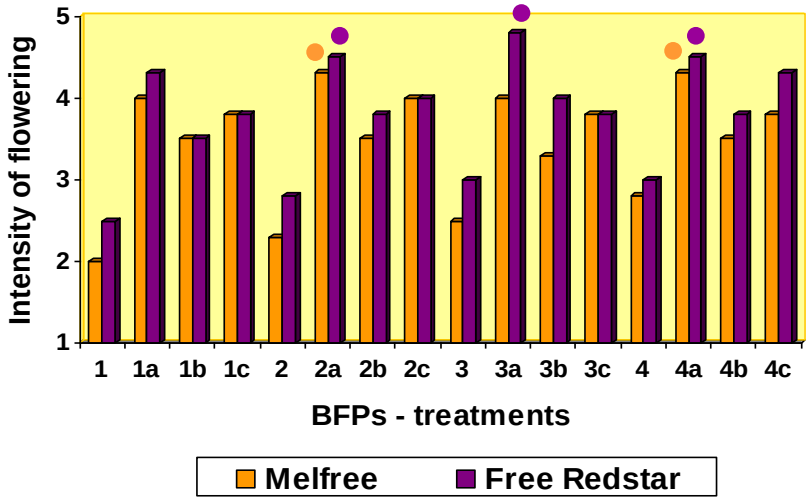
MELFREE					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	Average
Control	741.8 a-c	722.3 ab	726.0 ab	741.0 a-c	732.8 a
Standard	768.5 cd	752.8 a-d	728.5 ab	784.3 d	758.5 b
Bioilsa	747.5 a-c	743.3 a-c	743.8 a-c	745.5 a-c	745.0 ab
BF-ecomix	767.5 cd	718.3 a	756.0 b-d	735.5 a-c	744.3 ab
Average	756.3 c	734.1 a	738.6 ab	751.6 bc	745.2
FREE REDSTAR					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	Average
Control	796.3 a	816.0 a	822.8 a	798.0 a	808.3 a
Standard	804.8 a	820.5 a	812.5 a	828.0 a	816.4 a
Bioilsa	803.8 a	827.8 a	803.3 a	792.8 a	806.9 a
BF-ecomix	804.8 a	799.8 a	797.8 a	785.8 a	797.0 a
Average	802.4 a	816.0 a	809.1 a	801.1 a	807.2

Chlorophyll index 2 weeks after completion of the BFPs treatments – 2005:

- 'Free Redstar' had higher chlorophyll index in the leaves than 'Melfree' as a result of treatment with: Standard NPK+Glucos K and Bioilsa+BF-grow+BF-quality.
- For 'Melfree' the best were: Standard NPK+Glucos K, Standard NPK and BF-ecomix.

Intensity of flowering of two apple cultivars

13 May 2005 (ranking scale 1-5, where: 1 – no flowers, 2– up to 10 flowers, 3 – 11-20 flowers, 4 – 21-30 flowers, 5 – more than 31 flowers



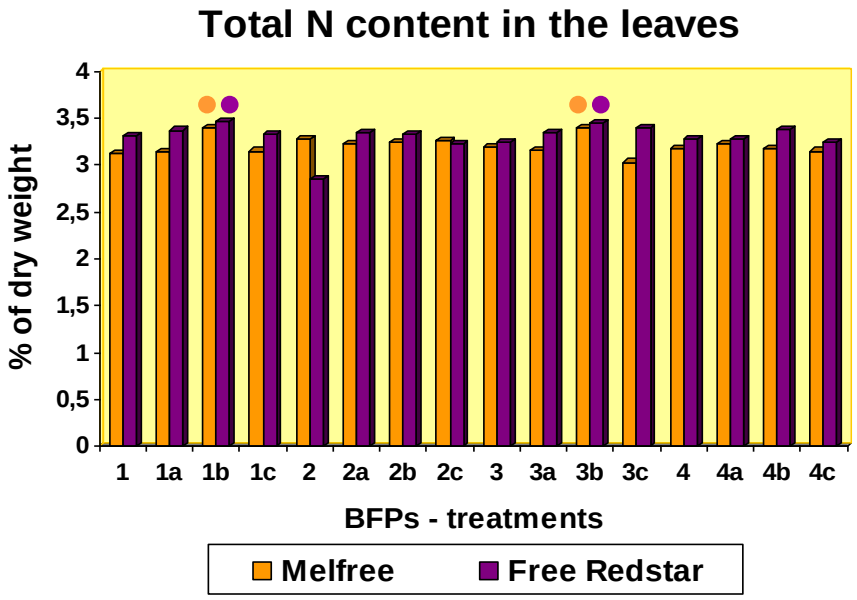
Intensity of flowering of two apple cultivars, season 2005

MELFREE					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	Average
Control	2.0 a	4.0 e	3.5 c-e	3.8 de	3.3 a
Standard	2.3 ab	4.3 e	3.5 c-e	4.0 e	3.5 a
Bioilsa	2.5 a-c	4.0 e	3.3 b-e	3.8 de	3.4 a
BF-ecomix	2.8 a-d	4.3 e	3.5 c-e	3.8 de	3.6 a
Average	2.4 a	4.2 c	3.5 b	3.9 bc	3.4
FREE REDSTAR					
Treatment	Single treatment	BF-grow + BF-quality	Ausma	Glucos K	Average
Control	2.5 a	4.3 de	3.5 b-d	3.8 c-e	3.5 a
Standard	2.8 ab	4.5 de	3.8 c-e	4.0 de	3.8 a
Bioilsa	3.0 a-c	4.8 e	4.0 de	3.8 c-e	3.9 a
BF-ecomix	3.0 a-c	4.5 de	3.8 c-e	4.3 de	3.9 a
Average	2.8 a	4.5 c	3.8 b	3.9 b	3.8

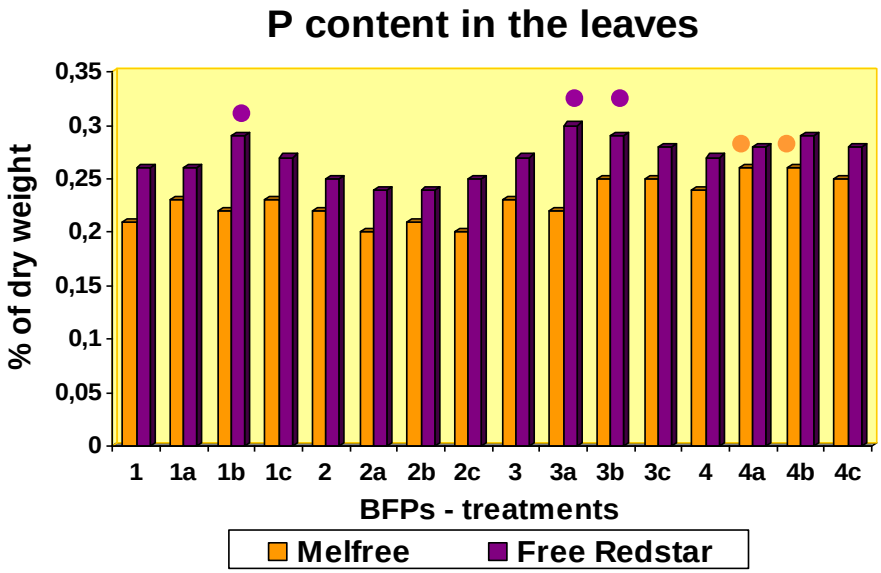
- Generally, intensity of flowering of ‘Free Redstar’ trees was higher than ‘Melfree’. The most intensive flowering of this cultivar was obtained as a result of treatment with: Bioilsa+BF-grow+BF-quality, BF-ecomix+BF-grow+BF-quality and Standard NPK+BF-grow+BF-quality.

- For ‘Melfree’ the best were: BF-ecomix+BF-grow+BF-quality and Standard NPK+BF-grow+BF-quality.

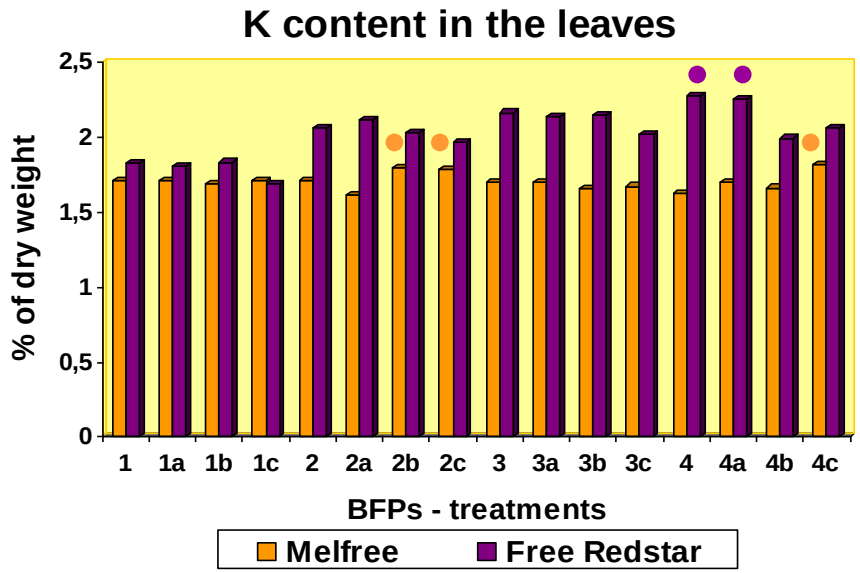
- Because of the late spring frost (5-7.05.05) causing lethal damages of all flowers, the fruit crop and its quality were not evaluated in 2005.



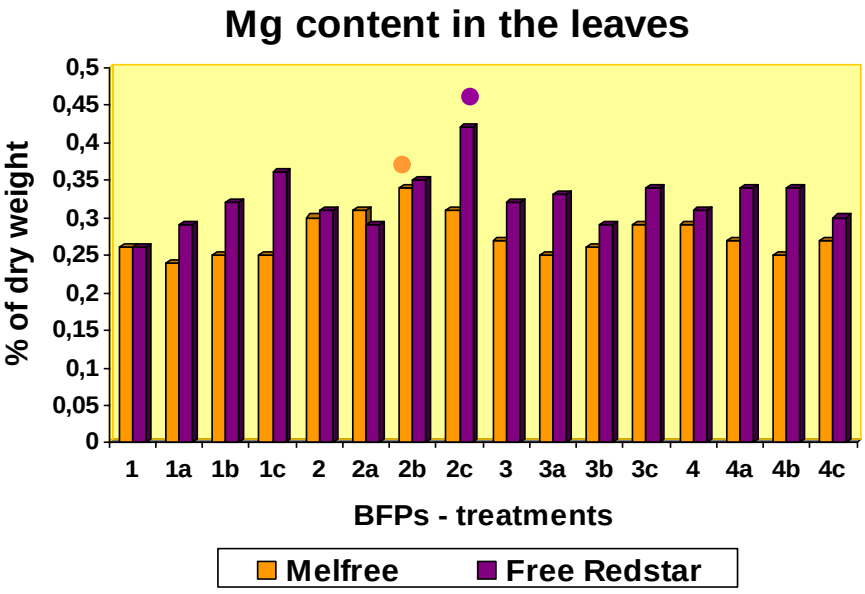
Total N content in the leaves of both apple cultivars was increased by Control+Ausma and Bioilsa+Ausma.



P content in the leaves of 'Free Redstar' was increased after application of Control+Ausma, Bioilsa+BF-grow+BF-quality and Bioilsa+Ausma. For 'Melfree' the best were BF-ecomix+BF-grow+BF-quality and BF-ecomix+Ausma.

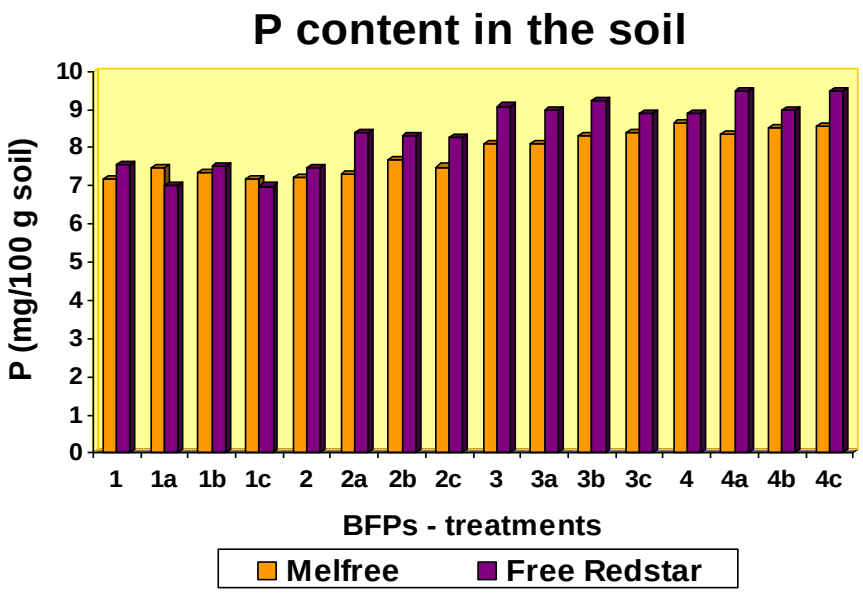


K content in the leaves of 'Free Redstar' was increased by BF-ecomix and BF-ecomix+BF-grow+BF-quality. For 'Melfree' the best were Standard NPK+Ausma, Standard NPK+Glucos K and BF-ecomix+Glucos K.

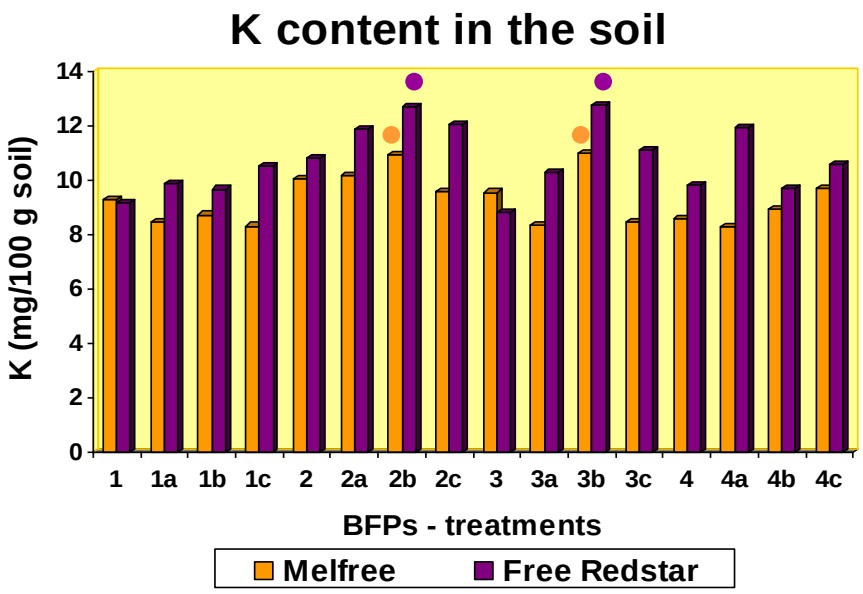


Mg content in the leaves of 'Free Redstar' was increased by Standard NPK+Glucos K whereas in 'Melfree' by Standard NPK+Ausma.

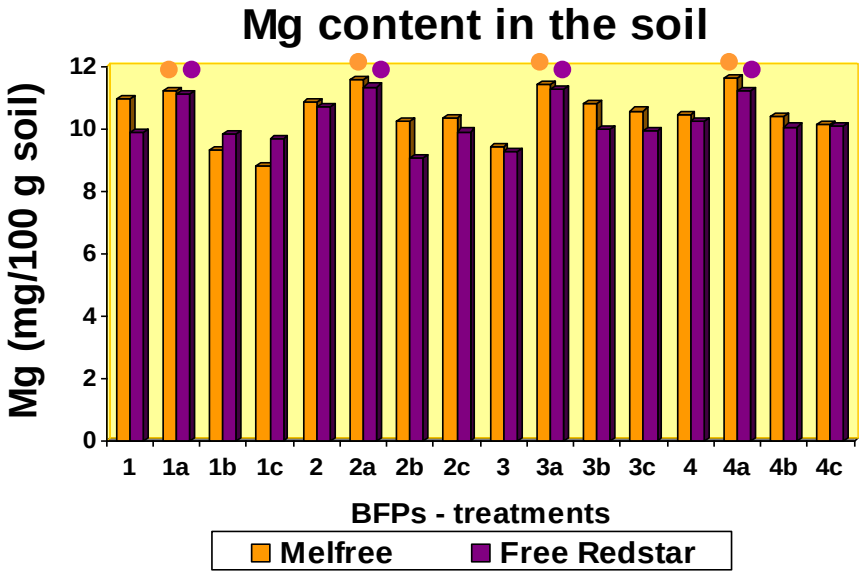
- The results revealed cultivar dependent differences in mineral content of the leaves. Generally, total N, P, K, Mg content in the leaves of 'Free Redstar' trees was higher than 'Melfree'. Only Ca content in the leaves of 'Melfree' was higher than in 'Free Redstar'.
- Applications of BFPs in 2005 increased the macro and micro-element content in the leaves of both examined cultivars.



Treatments of apple trees with BFP products was increased P content in the soil. P content in the soil was increased the most by Bioilsa and BF-ecomix applied alone and with imposed foliar treatments with BF-grow+BF-quality, Ausma and Glucos K.



Treatments of apple trees with BFP products increased K content in the soil. K content in the soil was higher after application of Standard NPK+Ausma and Bioilsa+Ausma.



Treatments of apple trees with BFP products was increased Mg content in the soil. Mg content in the soil was higher after application of Control+BF-grow+BF-quality, Standard NPK+BF-grow+BF-quality, Bioilsa+BF-grow+BF-quality and BF-ecomix+BF-grow+BF-quality.

CONCLUSIONS

- Regardless of the applied BFPs, 'Melfree' trees grew stronger than 'Free Redstar'.
- Irrespective of the applied solid fertilizers (Standard NPK, Bioilsa, BF-ecomix), foliar treatments with BF-grow+BF-quality highly increased the vegetative growth of both cultivars in comparison with the control.
- Regardless of the applied BFPs, Free Redstar' had higher chlorophyll index in the leaves than 'Melfree'.
- Generally, intensity of flowering of 'Free Redstar' trees was higher than 'Melfree'.
- Because of the late spring frost (5-7.05.05) causing lethal damages of all flowers, the fruit crop and its quality were not evaluated in 2005.
- Yield performance, number of flowers and fruitlets of apple trees treated with BFPs will be evaluated in 3-year-old trees in 2006.
- Applications of BFPs in 2004 and 2005 increased the macro and micro-element content in the soil and leaves of both examined cultivars.