

Use of biostimulants in organic vegetable production

On-farm field trials in Estonia

'One of the activities of the Maheklaster NGO (Organic Cluster, Estonia) project "Innovation in organic plant production" was to study the effectiveness of biostimulants in organic vegetable production. The efficacy of the authorised substances in organic production was investigated for carrots, swede, various cabbages and onion. On-farm field trials were carried out in the fields of three organic vegetable growers – Tarvastu Saariku farm (Viljandi County), Erto farm (Tartu County) and Kiltsimäe farm (Harju County). The results of the carrot and swede trials are presented below.

There are many biostimulants approved for use in organic production and offered by many input suppliers. Due to the wide range of available products, organic growers have difficulties in selecting the most suitable ones, and there is not enough information on how effective they are for different vegetables. Therefore, in one of the activities of the Organic Cluster it was decided to investigate the effects of the selected biostimulants on both the total and marketable yield of selected vegetables. Prior to the selection of the products to be used in the trials, the available biostimulants were thoroughly studied, on the basis of which a selection of products potentially suitable for vegetable production was selected for testing. A list of the biostimulants used in the trials, together with their recommended application rates, are given in Table 1.

Below we present the experiments on carrots and swede carried out in the production fields of two organic vegetable growers (Tarvastu Saariku farm and Kiltsimäe farm).

Table 1. Biostimulants used in the experiments

Product	Content	Recommended application rates
Rhizocell	<i>Bacillus</i> IT45 and yeast product	soil and crop spraying: 1 kg/ha, water consumption 500 L/ha, 2-3 times.
Megafool	Amino acids, vitamins	2-3 L/ha, water consumption 200-400 L/ha, by 10-15 days.
Aminosol	Amino acids + N 9.4% + K ₂ O 1.1% + S 0.25%	2-5 L/ha, water consumption 200-400 L/ha , 2-4 times
Raskila (BioOrg VH)	Vermi humus: humic and fulvic acids; NPK + ME	3.5-4 L/ha, water consumption 350-400 L/ha , 4-8 times
Bactoforce	<i>Bacillus subtilis</i>	1- 2 L/ ha, 2-3 times
ILSAM N90	Amino acids >10% + N 8.9%	1-2 L/ha 4 times at 10-15 day intervals during periods of intensive growth.
Amalgerol Essence	40 plant based essential and mineral oils, seaweed and plant extracts + N 3% + K ₂ O 3%	3 L/ha, 3-5 times, water consumption 200-600 L/ha. Spray 14 d after sowing/emergence, 10 days interval.
Lithovit Amino 25	Amino acids + N 3% + MgO 1.8% + Fe, Mn, etc.	1 kg/ha 2 to 3 times at 14-day intervals during periods of intensive growth.

Carrot

Field trials with carrots were carried out in 2017-2020 in the production fields of Tarvastu Saariku and Kiltsimäe farms with Nantes-type varieties. All the growing season maintenance of the experimental plots (flame weeding, interrow cultivation, hand weeding, etc.) was carried out by the producers as needed. Biostimulants were sprayed using a backpack sprayer according to the average recommended application rate of the manufacturer (Table 1) and the spraying was carried out three or four times during the growing season, depending on the product. All variants had three repetitions and in all years, there was a control variant in the trials that was not treated. Harvesting of the carrots took place in October in all years.

In 2017, the following biostimulants were tested: Rhizocell, Megafol, Aminosol, Raskila (BioOrg VH), Bactoforce, ILSAMin N90 and Amalgerol Essence. In 2018, the biostimulant trial with carrots was repeated at Tarvastu Saariku farm, using products that had shown good results in the previous year: Megafol, Amalgerol, Bactoforce and their mixture (Megafol+ Bactoforce+Amalgerol).

In 2019 the following products were used: Megafol, Bactoforce, Raskila and their mixture (Megafol+ Bactoforce+Raskila) and Ilsamin N90. In 2020, the test was repeated with the same products and Lithovit Amino25 was added as a new product. Lithovit Amino25 was not sprayed in a mixture of different products this year.

Results

In 2017 and 2018 the field trials were held at Tarvastu Saariku farm. In 2017, carrot yields were average for Estonian conditions, ranging from 3.85 to 5.29 kg/m² (i.e. 38.5-52.9 t/ha), but the commercial (marketable) yield was only 68-75% of the total yield. The marketable yield varied between 2.7 and 3.71 kg/m² (Figure 1). Compared to the control, spraying with Bactoforce gave a reliably higher yield, with 28% more marketable carrots. There was no statistically significant effect on carrot yield when other products were applied compared to the control.

2018 was a good year for carrot growth and yields were above average, ranging from 5.78 to 6.98 kg/m². The share of the marketable harvest was also higher than in the previous year, at 83-90%. Yields of marketable carrots varied between 5.09 and 6.5 kg/m² (Figure 2). In terms of total yield, spraying with the mixture of different products and Bactoforce gave higher yields than the control, but in terms of marketable yield, only the mixture of different products gave statistically significantly higher yields.

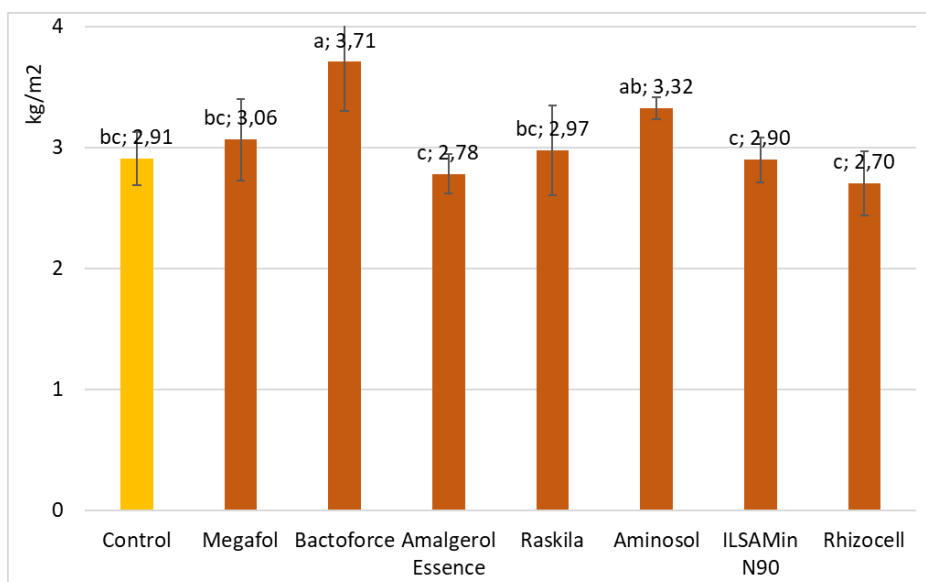


Figure 1: Marketable carrot yield (kg/m²) depending on the use of biostimulants in 2017 at Tarvastu Saariku farm trials. Here and in the following figures: the different letters indicate statistically significant differences at PD95% and the "whiskers" in the figure indicate the standard deviation.

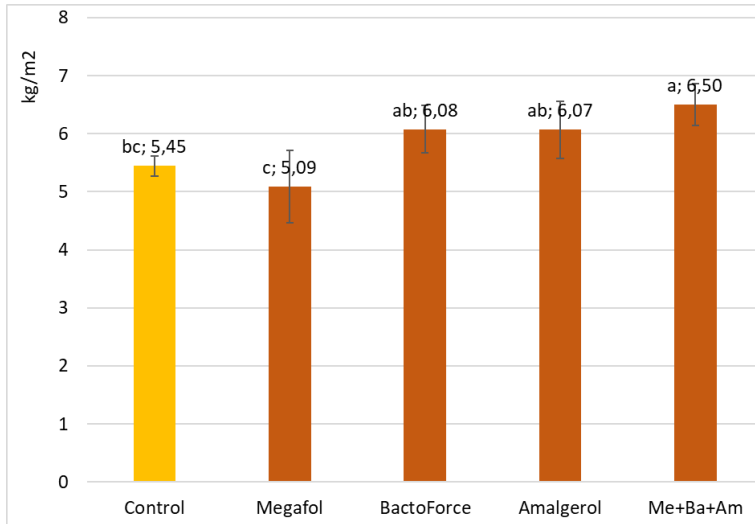


Figure 2: Marketable carrot yield (kg/m²) depending on the use of biostimulants in 2018 at Tarvastu Saariku farm trials.

In 2019 and 2020, the field trials took place at Kiltsimäe farm. In 2019, the carrot yield was average, varying between 3.5 and 4.35 kg/m² depending on the trial variation. All products used increased the total yield (17-24%). The share of marketable yield varied between 80-92%, ranging from 3.0-4.0 kg/m² (Figure 3). The control variant had an average yield of 3.0 kg/m² and all products used individually increased yield (19-33%), with the exception that the marketable yield was not affected by the use of a mixture of products.

In the 2020 trial, yields were slightly higher, with the average total carrot yield varying between 4.17 and 5.16 kg/m² depending on the trial variation. Statistically significantly higher yields were obtained with Megafol, Lithovit Amino 25 and Bactoforce. The marketable yield in 2020 trial varied between 89-95%, ranging from 3.82-4.82 kg/m². The higher marketable yield was obtained by using the same products as for the total yield (Figure 4).

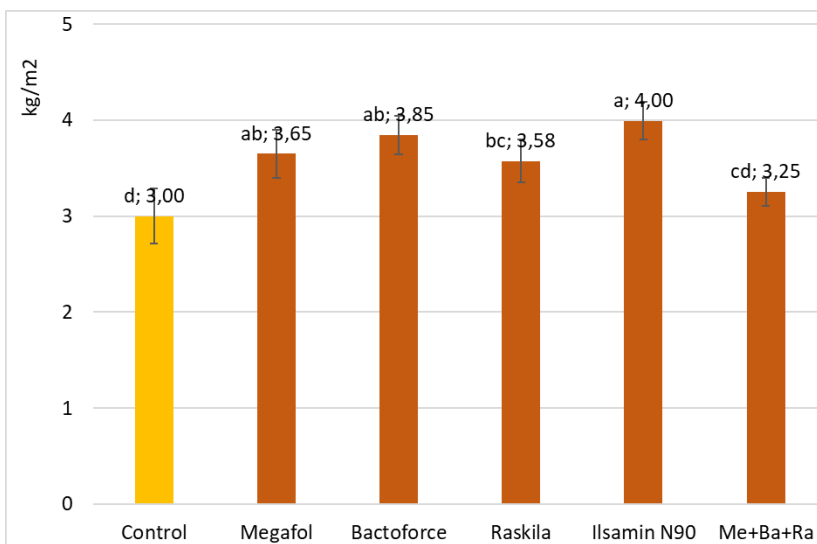


Figure 3: Marketable carrot yield (kg/m²) depending on the use of biostimulants in 2019 at Kiltsimäe farm trials.

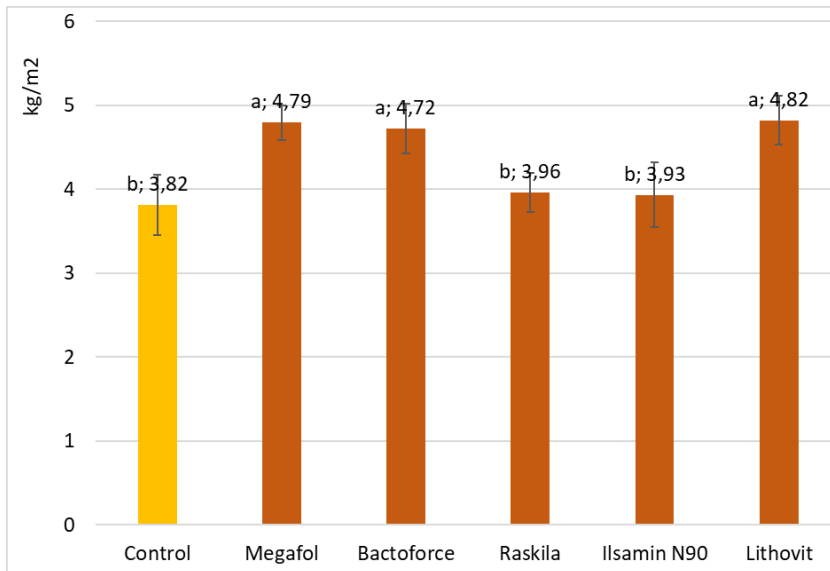


Figure 4: Marketable carrot yield (kg/m²) depending on the use of biostimulants in 2020 at Kiltsimäe farm trials.

Spraying carrots with different biostimulants during the growing season 2017-2020 gave varying results and therefore it is difficult to give clear preference to any particular product. In different test sites, the effects of different products on yield were different. For example, the use of Megafoli gave good results at Kiltsimäe farm, while the results at Tarvastu Saariku farm were close to the control. As an average of the trial years, it can be shown that both total and marketable yields were positively affected by spraying with Bactoforce. In 2020, Lithovit Amino 25 showed good results, but as this product was introduced in the last year of the trial, it is not possible to make a recommendation and its effects should be further investigated.

Swede

Field trials with swede were carried out in 2017 and 2018 on the production field of Tarvastu-Saariku farm with the swede variety 'Local blue'.

In 2017, similar to the carrot trials of the same year, the following biostimulants were included in the trial: Megafol, Aminosol, Raskila (BioOrg VH), Bactoforce, ILSAMin N90, Amalgerol Essence and Rhizocell. The control plots were not sprayed. The application rates of the biostimulants are given in Table 1.

In 2018, the test was repeated using Megafol, Amalgerol Essence, Bactoforce and a mixture of these products (Megafol+Bactoforce+Amalgerol). Plants were sprayed with these products either three or four times during the growing season in both years, depending on the product.

Results

Swede yields were very low in 2017, varying between 1.85 and 2.31 kg/m². In terms of total yield, none of the sprayed products differed statistically significantly from the control variant, but marketable yield was plausibly higher for variants treated with Rhizocell, Bactoforce, Megafol and Amalgerol Essence (Figure 5). Marketable yield varied between 1.12 and 1.58 kg/m². The use of biostimulants increased the marketable yield of swede by 3-41%.

In 2018, swede yields were average (for organic swede), with total yields ranging from 2.86 to 3.68 kg/m² and marketable yields from 2.41 to 3.23 kg/m². In both total and marketable yields, spraying with Bactoforce and a mixture of products gave statistically reliable yield gains (Figure 6). Compared to the control variant, these variants yielded 33 and 34% higher yields, respectively.

In the light of the results of two years trials, the use of Bactoforce can also be recommended for swede.

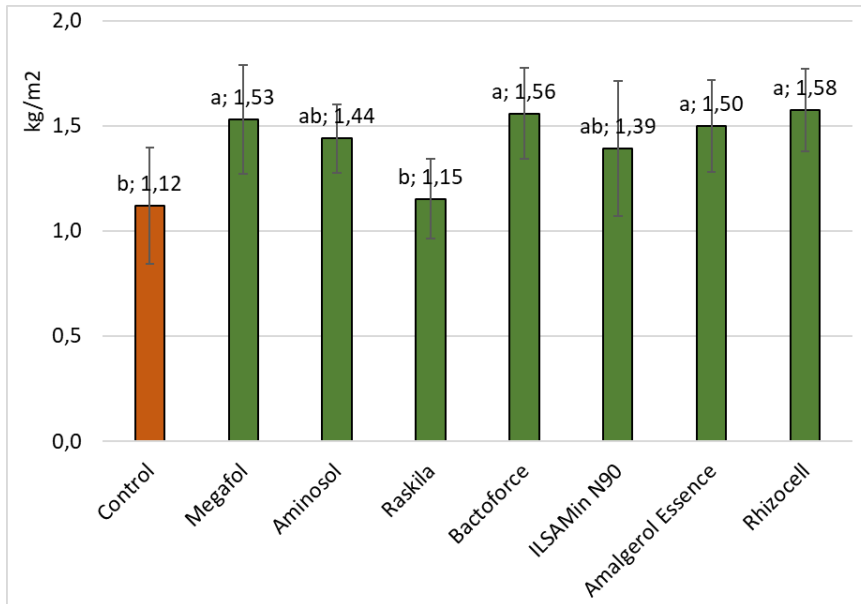


Figure 5: Marketable swede yield (kg/m²) in 2017 depending on the use of biostimulants at Tarvastu Saariku farm trials.

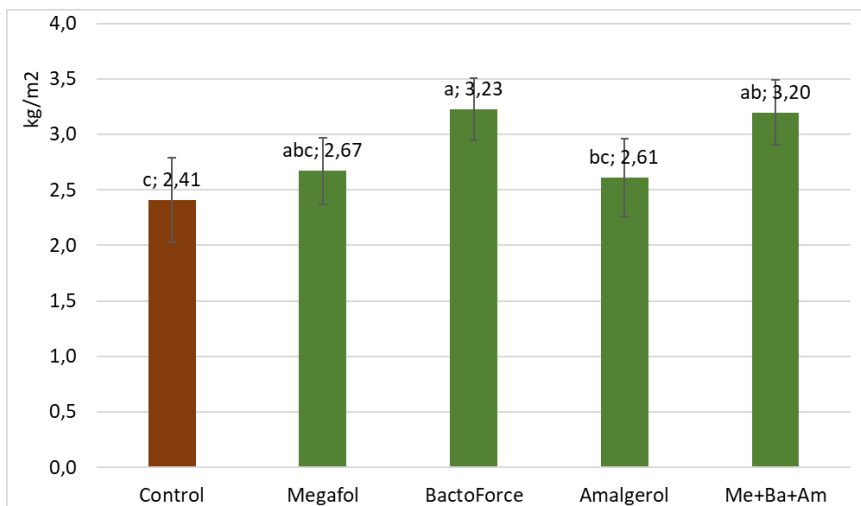


Figure 6: Marketable swede yield (kg/m²) in 2018 depending on the use of biostimulants at Tarvastu Saariku farm trials.

Summary

The use of biostimulants had some effect on carrot and swede yields. Bactoforce gave the best results in the experiments. The results of the other products used varied between years and/or between test sites.

The cost per hectare of the products used in the trials ranged between €50 and €200/ha. Smaller areas can be sprayed with a backpack sprayer, while larger areas can be sprayed with a tractor-hitched sprayer. The use of backpack spraying is very time consuming, but trials have shown that the use of some biostimulants can give 5-10 tonnes higher yields per hectare, and in such cases the time-consuming backpack spraying could be justified.

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