

## Searching for products to control potato late blight in organic farming. On-farm field trials in Estonia

**One of the activities of the Maheklaster (Organic Cluster) NGO project "Innovation in organic farming" was to search for natural products suitable to control late blight in organic potato production. On-farm field trials were carried out in the fields of two organic growers - Kiltsimäe Farm (Harju County) and Fio Ltd (Põlva County).**

One of the major problems in organic potato production is late blight (*Phytophthora infestans*), which often results in significantly lower yields than in conventional potato production, even when using varieties more resistant to late blight and high quality disease-free seed. Therefore, as one of the innovation activities of the Organic Cluster, it was decided to investigate different tools that could slow down the onset of potato late blight and thus prolong the growing season and increase yields.

By working through the material, it was found that compost teas, as well as several biostimulants can have disease inhibiting and plant strengthening effects. Patentkali was also included in the trial on the basis of expert judgement, with the recommendation to divide the recommended fertiliser application rate per hectare over 4-5 application times during the growing season. In addition, a Bordeaux mixture was included in the comparison. It is used in many EU countries as a copper-containing formulation, but alternatives are being sought in organic production. It was included in the trial to compare the efficacy of using a more environmentally friendly products with a copper-containing product in addition to the control trial. All products were used according to the manufacturer's average recommended application rate.

On-farm field trials were carried out in the years 2021-2022 on the production fields of the two cluster members. In 2021, the trials were carried out at Kiltsimäe farm with the variety 'Gala'. In 2022, trials were carried out at Kiltsimäe farm with the varieties 'Baltic Rose' and 'Merle' and at Fio Ltd with the variety 'Teele'.

The products used in 2021 included Root Better, K-Amino, two compost teas, Patentkali and Bordeaux mix. The control variant (with no products applied) and the Patentkali fertilized variant were sprayed twice with water simultaneously with the application of the sprayed products in the experiment, so that the results would not be influenced by the water applied to the plants by spraying. All the variants had three repetitions. In the first year of the experiment, all the products were applied twice, while the amount of Patentkali fertiliser (in granules) was spread over four applications.

In the second year, the products used were Root Better, K-Amino and Bordeaux mix (all sprayed twice), compost tea (sprayed once) and Patentkali (quantity distributed similarly to the previous year's among four applications). In 2022, the two Better Organix compost teas were changed to the compost tea produced by Erto farm.

### **Results of the 2021 on-farm trials**

In 2021, June, July and August were all very dry and there was no potato late blight attack. The plants were stressed by the drought, which caused the leaves of the plants to be rapidly destroyed by the stress-induced diseases early blight and grey mold. The observation made on 28.07.21, showed that 20% of the lower leaves of some plants were destroyed by grey mold (*Bortrytinia fuckeliana*). The upper leaves were damaged by early blight (*Alternaria solani*), but not on all variants. The variant treated with Patentkali had the least damage (Photos 1 and 2). This was most likely due to the fact that the plants received supplementary fertilizer (4x fertilizer containing potassium and magnesium, essential nutrients for potatoes), which reduced stress, the plants were stronger and not as easily infected by early blight and grey mold. The rest of the plants in the trials had clearly deficient in Mg and other nutrients essential to the plant.



Photos 1 and 2. Potato plant from the Patentkali test plot (left). Potato plant from the Bordeaux mix test plot (right) is affected by early blight. Photo: 9.08.2021.  
All photos by M. Mikk

The total yield of the 'Gala' was low, ranging from 16.5 to 22.0 t/ha in six variants (including the control), with no credible difference between the yields of these variants. However, the Patentkali variant was significantly different from the other variants. The average total yield of its different repetitions was 31.7 t/ha, which was a lot higher than the yields of the other variants. As the disease incidence was significantly lower in this variant than in the others, it was possible to harvest the potatoes two weeks later, which contributed to a much higher yield. The share of the commercial (marketable) yield in the total yield was above 90% in all variants (90.7 - 96.2% depending on the variant), with yields ranging from 15.2-30.5 t/ha. Compared to the control variant, only the Patentkali variant had a statistically significantly higher marketable yield compared to the total yield (Figure 1).

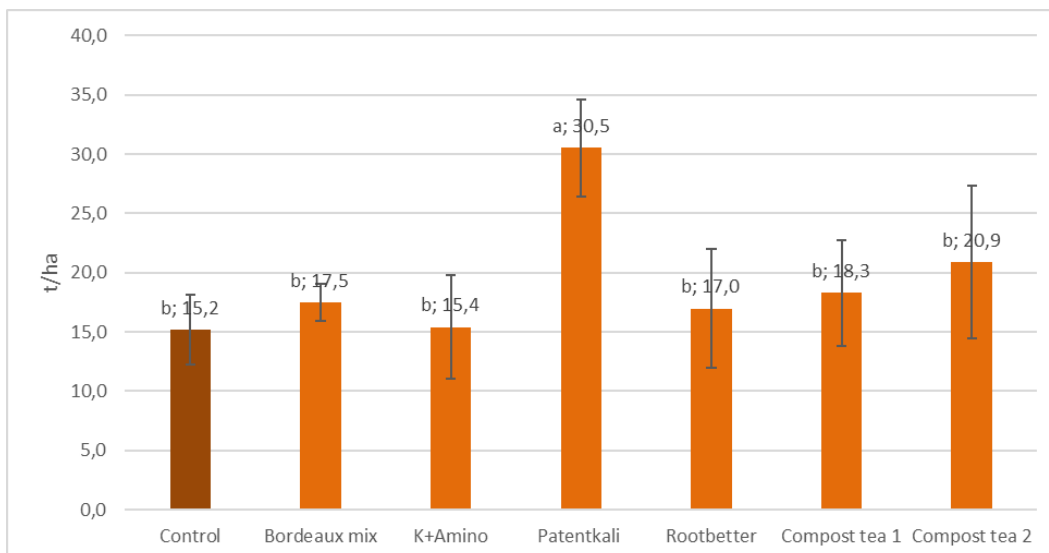


Figure 1. Marketable yield of the variety 'Gala' potatoes (t/ha) depending on different treatments in Kiltsimäe farm trials in 2021. The different letters denote statistically significant differences at PD95% and the "whiskers" in the figure denote the standard deviation.

Post-harvest tuber quality assessment showed that all variants showed a low level of infection (within 1 point, i.e. a few scabs per tuber) with common scab. Black scurf was also present in all sprayed variants to the extent of 1 point, and in the control variant to the extent of 2 points (covering about 10% of the tuber surface).

### **Results of the 2022 on-farm trials**

In 2022, a trial with two varieties - 'Baltic Rose' and 'Merle' - was carried out at Kiltsimäe farm. According to the variety description, both varieties have an average resistance to potato late blight, but the shape of the potato plant (bush), plays a role in the potato diseases. 'Merle' has an upright bush and strong stems, while 'Baltic Rose' has flattened bushes that are more exposed to disease in a wetter environment. At Fio Ltd it was carried out a trial with the variety 'Teele', but unfortunately there was a massive invasion of Colorado potato beetles in the test field, which, despite attempts to manually remove the potato beetles from the field, led to the destruction of a large part of the foliage and significantly affected the results of the trial. Therefore, the results of this experiment are not presented in the article.

At the Kiltsimäe farm, June-July was dry and hot, which stressed the plants. The variety 'Merle' is described as more resistant to the late blight, and at the time of the first thorough observation (19.08) the plants were mostly green and beautiful. It had affected all the variants, but only to a limited extent. On the control variant, 9.3% of the foliage had been destroyed, while 4.3% of the foliage was affected on the Bordeaux mix and Root Better sprayed plots. The lower leaves infested with grey mold were destroyed by 10% in four variants and less than 10% in the variants sprayed with Bordeaux mix and K+Amino. Early blight was most prevalent in the Patentkali variant. Within a week (second thorough observation on 26.08), late blight damage had developed by a few percent on 'Merle'. It was highest in the control plots, but there was no statistically significant difference. Less than 10% of the foliage was damaged in the K+Amino and Patentkali plots. Grey mold also had developed by only a few percent, but early blight had spread vigorously.

'Baltic Rose' seems to be quite drought sensitive and due to the stress on the plants, various diseases had already hit the foliage of 'Baltic Rose' with the early August rains. The attack was very rapid. While the first signs were found on August 10th, by August 15th 'Baltic Rose' was already severely affected by diseases and by the time of the more detailed survey on August 19th, 3-15% of the foliage was affected by late blight, 12-23% by grey mold and 30-37% by early blight, depending on the experiment variant.

Photographs of the field at different times are shown below (Photos 3-6).



Photo 3. Kiltsimäe farm trial field on 13.07.2022

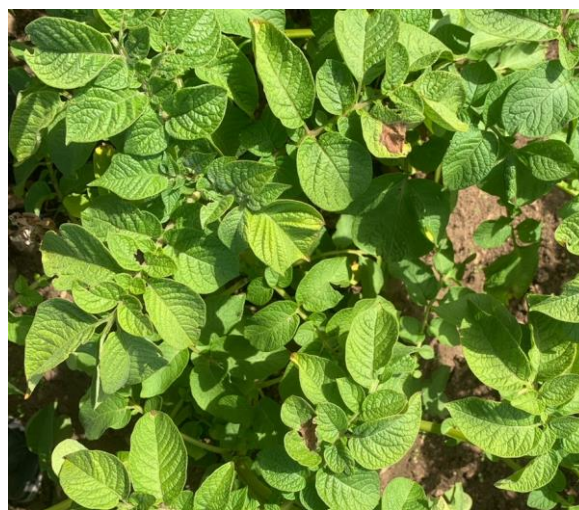


Photo 4. First signs of grey mold and early blight at the Kiltsimäe farm trial on 10.08.2022





Photos 5 and 6: Difference in plants of two varieties ('Merle' on the left, 'Baltic Rose' on the right) on 15.08.2022.

The total yield of variety 'Merle' was quite good for organic production, reaching 29.1 t/ha. This was the yield of the compost tea and Patentkali treated variants, however, the yield of these variants was not statistically significantly higher than that of the control. The marketable yield as a percentage of total yield was between 87.3% (control) and 90.8% (Patentkali). The marketable yield of the variety 'Merle' ranged from 23-26.4 t/ha (Figure 2). The variant with Patentkali was statistically significantly higher from the control variant. The compost tea variant was also higher from the control variant, but the difference was not statistically reliable.

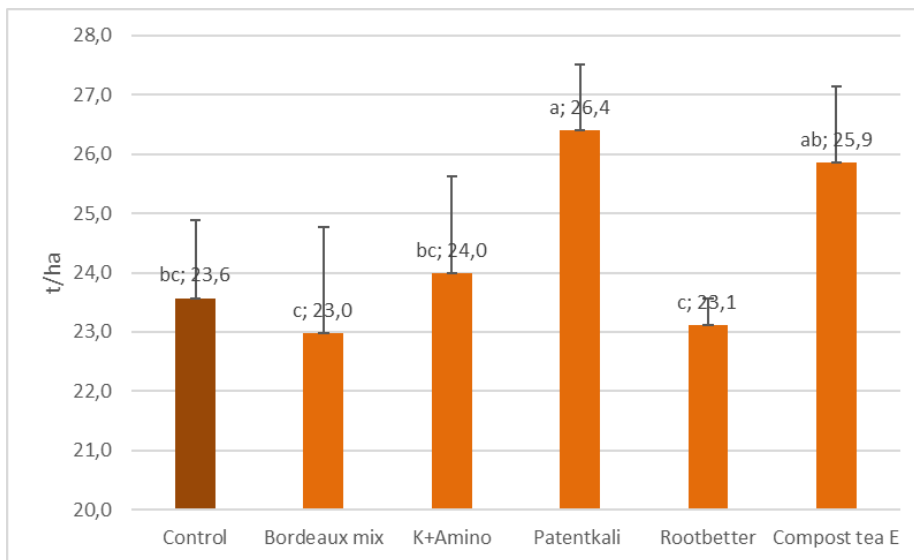


Figure 2. Marketable yield of the variety 'Merle' potatoes (t/ha) depending on different treatments in Kiltsimäe farm trials in 2022. The different letters denote statistically significant differences at PD95% and the 'whiskers' in the figure denote standard deviations.

The total yield of the variety 'Baltic Rose' in Kiltsimäe farm trials was between 21.4-26.2 t/ha. The highest yields were obtained by the compost tea (26.2 t/ha) and Patentkali (25.9 t/ha) treated variants. Yields of these variants were statistically different from those of the Bordeaux mix (21.4 t/ha) and Root Better (21.7 t/ha) variants, but not from the control variant. The marketable yield was slightly higher for 'Baltic Rose', ranging from 92.5% to 94.8%. The marketable yield of 'Baltic Rose' ranged from 19.8 to 24.6 t/ha (Figure 3), with the Bordeaux mix treated variant yielding even less than the control variant. For the Patentkali and compost tea treated variants, the average yield was higher than the control, but no statistically reliable difference was found.

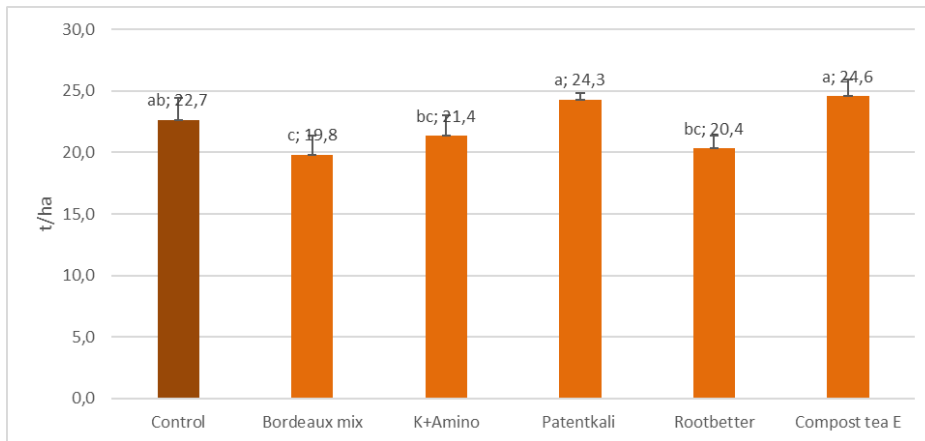


Figure 3. Marketable yield of the variety 'Baltic Rose' potatoes (t/ha) depending on different treatments in Kiltsimäe farm trials in 2022. The different letters denote statistically significant differences at PD95% and the 'whiskers' in the figure denote standard deviations.

Samples taken after harvesting (3 kg from each replicate of each variety) were stored, and a month and a half later, the most important diseases affecting the quality of the potato were determined. In 2022 harvest, no tubers with common scab and black scurf were found in either of the two varieties grown at Kiltsimäe farm. There were no tubers infected with rot in compost tea variant of the variety 'Merle' and in Patentkali variant of the variety 'Baltic Rose'. In the other variants, 1-4 tubers were infected with rot. 'Baltic Rose' did not show any dry rot infestation in the compost tea variant. To limit the spread of diseases affecting the quality of the tubers, treatment with the products tested cannot yet be recommended, as further trials would be necessary.

### Summary

Unfortunately, none of the sprayed products used in the trials gave a reliably better result than the control. Spraying with compost tea did give a yield gain for all the potato varieties in trials, but it was not statistically significantly better than the control. Further trials with compost teas are needed. A copper-based preparation (Bordeaux mix), currently still allowed in organic production, reduced the spread of late blight in one year, but did not give a yield increase in any of the varieties in trials. None of the products also did not have a reliable effect in reducing the incidence of other diseases that destroy potato foliage in summer. However, the trials in the very dry year 2021 clearly showed that the Patentkali (recommended application rate spread over four applications) treated variant considerably increased the yield and delayed the rapid increase in diseases damage, because the plant received a steady supply of the necessary nutrients and this helped to keep stress levels lower, with fewer diseases damaging the vigorous plant. In 2022 trials, one of the varieties also had a reliably better marketable yield with Patentkali, while the other two varieties had a higher but not statistically significantly higher yield. Both years of the trials were very dry and this affected the results of the trials and therefore the further research would be necessary.

Trials also confirmed the well-known knowledge that varieties that are more resistant to potato late blight and other diseases are better suited to organic farming.

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