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# **Influence of intensified mineral and organic fertilizer and biodynamic preparations on yield, quality and shelf life of potatoes**

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## **Introduction**

Since 2 years the Institute for Organic Agriculture in Bonn is investigating the influence of increased organic and mineral fertilizer and the influence of biodynamic preparations on yield, quality and shelf life of potatoes. The project will run five more years. Financiation in 1993 was given by the EDEN-Foundation, since 1994 money is supplied by the Deutsche Forschungsgemeinschaft, as the project is integrated in the DFG-Research-Group „Strategies to optimize Organic Agriculture“.

The trial is carried out on two experimental sites: one is situated on the experimental farm for organic agriculture „Wiesengut“ near Bonn, the second site is part of the 15 years old experimental plot at the „Institute for Biodynamic Research“ in Darmstadt. Both trial plots are factorial with four repetitions. One factor is an increasing fertilization, in Darmstadt within three and in Bonn four levels. In Darmstadt the kind of fertilizer is differentiated into mineral, organic and biodynamic fertilization.

The field in Bonn is only fertilized with composted cow manure, one half of this is prepared with biodynamic compost preparates, the other half remains untreated. Furthermore one half of the field is treated with biodynamic spray preparations, the other half, again, remains untreated. This gives the opportunity to observe single effects of the preparations as well as combination effects. The experimental plot in Bonn is installed every year on a new field, following the crop rotation. In Darmstadt moreover we can observe an accumulation effect of the preparations.

## **Results**

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In both trial years **total yield** in Darmstadt as well as in Bonn was enlarged due to increasing fertilization.

In Darmstadt in both years the mineral variant showed higher yields compared to the organic and the biodynamic variant. In both years the biodynamic variant in the average had a slightly higher yield than the organic, besides in the one with the most intensive fertilization, where in 1993 the yield was decreased. This might be a hint towards a compensative effect of the biodynamic preparations. In 1994 this effect did not occur.

The increasing fertilization enlarged the **average weight** of the single tubers in both years, too. Mineral fertilization in Darmstadt resulted in a 17% higher average weight in comparison to the other kinds of fertilization.

During the investigations some morphological parameters as well as tissue strength were determined.

The **relation between leaf surface and leaf dimension** of the potato plants in Bonn 1993 was significant 7% less after treatment with biodynamic compost preparates, that means this plants appeared to have a leaf surface with higher differentiated leaf edges. KLETT (1968) observed this effect after treating radish with biodynamic spray preparates. Up to now this effect was not registered when using compost preparates.

In the first trial year the **number of flowers per plant** was enlarged significantly by 13% due to the biodynamic spray preparates. But in 1994 these preparates reduced the number of flowers by 13%. In any case, this might be an indication towards an influence on reproductive processes of the biodynamic preparations.

In 1993 a penetrometer was used to determine the **tissue strength** of the tubers from the field in Bonn, grown under the lowest and the highest fertilizing level, on one hand treated with biodynamic preparations, on the other hand untreated. Tubers of the highest fertilizing level showed a significant smaller tissue strength than the others. Treatment with biodynamic spray preparates significantly enlarged tissue strength and accordingly the resistance against external injuries.

**Dry matter content** of the tubers was reduced due to increasing fertilizing levels.

The content of drymatter was reduced due to mineral fertilizer as opposed to organic (-10%) or biodynamic (-12%) fertilization. In both years the biodynamic version had a slightly higher content of drymatter than the organic.

Up to now the carbohydrates **glucose, fructose and saccharose** were determined as well as the content of **starch**. These analyses were only carried out on tubers from Bonn in the year 1993 and only on those grown on the least and the highest fertilizing level, treated respectively untreated with biodynamic preparations.

A higher level of fertilization resulted in an 10% increase of the content of total carbohydrates. The relation of saccharose to total carbohydrates in these tubers was 11% less. This might be an indication for a delayed ripening caused by strong fertilization. This tendency did not appear with the content of starch, which was equal in both variants.

The content of total carbohydrates was enlarged by the compost preparates, but the share of saccharose in these variants was decreased, as well as the content of starch. The spray preparates caused a 8% reduction of all of these carbohydrate fractions.

In order to be able to describe shelf life **weight loss** was determined during a 7-month storing period. No differences could be found concerning this parameter, besides a slightly increase of weight loss due to a more intense fertilization.

Further parameters of shelf life were the selfdigestion of potato shreds, conductivity of potato extracts and the tendency to build germs.

The **tendency to build germs** in tubers from Darmstadt was a lot higher (+15%) in mineral fertilized potatoes compared to organic or biodynamic fertilized ones. The potatoes grown in Bonn did not show these large differences.

The **selfdigestion** of potato shreds from Darmstadt showed in 1993 after 14 days of incubation a higher loss of drymatter in the mineral variant (37%) followed by the organic (35%) and the biodynamic one (32%). Tubers of the lesser fertilizing intensity had a 7% smaller loss of substance than those of the highest level. No clear differences concerning this parameter could be obtained from the potatoes from Bonn.

The determination of the **electrical conductivity** of potato extracts from Darmstadt as well as Bonn divided clearly the low fertilized potatoes from the more intensive fertilized ones.

While treatment with the biodynamic preparations in Bonn did not influence the conductivity remarkably, the mineral version from Darmstadt could be seperated clearly from the others.

## **Conclusions**

In the described trials the influence of biodynamic preparations and also of different kinds and intensities of fertilization on potatoes were investigated. It was observed that:

- an increase of fertilizer enlarged the total yield, the average tuber weight, the total carbohydrate content, the weight loss in store and the tendency to self-digestion,
- the higher intensity of fertilization also reduced the tissue strength, the content of dry matter and the share of saccharose.
- In comparison to biodynamic and organic fertilizer the mineral fertilizer reduced the content of dry matter and increased the total yield, the average tuber weight, the self-digestion, conductivity and the tendency to build germs.
- Biodynamic preparations influenced the number of flowers and the content of carbohydrates without a clear tendency, reduced the relation between leaf-surface and -dimensions and raised the tissue strength.

After all it is still not quite clear, under which circumstances the preparates are effective and why they sometimes show contrary effects.

A lot more parameters are still waiting to be analyzed, for example some more contents like ascorbic acid, nitrate and minerals. In addition to that sensoric investigations are carried out in cooperation with the „Federal Research Institute for Nutrition“ in Karlsruhe. With these results and those of the following years we expect conclusive indications to possibilities of improving quality of potatoes by means of fertilization and treatment with biodynamic preparations.

### **Acknowledgements**

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### **References**

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The print out of this paper includes additionally eleven figures.