Onion seedlings versus onion sets in organic onion production

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**Implications**

The results of field experiments and on-farm trials comparing onion seedlings and onion sets indicate that the onions produced from seedlings are healthier than those produced from sets. Yield losses caused by *Fusarium* rot could potentially be reduced by using onion seedlings instead of sets. However, further research is needed to develop appropriate and economical cultivation techniques for producing onions from seedlings, to obtain high yield and high quality crop.

**Background and objectives**

Fusarium basal rot of onions causes severe losses in Finnish organic and conventional onion production (Avikainen et al. 2013, Kuivainen et al. 2015, Kivijärvi et al. 2016). Our recent studies showed that some lots of onion sets imported to Finland were highly contaminated by several *Fusarium* species (Haapalainen et al. 2016). The *Fusarium* problem is more severe in organic than in conventional onion production, because chemical fungicide treatment of onion sets against *Fusarium* is not permitted in organic production. In contrast, the lots of onion seeds examined in this and earlier studies have been almost free of pathogenic fungi. Therefore, producing onions from seedlings grown in the greenhouse could be a solution to reduce onion crop losses caused by *Fusarium* species, both in the field and during storage.

The objective of this study is to find onion varieties that are suitable for seedling cultivation and high-yielding in our relatively cool and short growing season. In addition, the yield quantity, quality and long-term storage durability of onions produced from either seedlings or sets are compared. Rot incidence and composition of pathogen populations in diseased onions is monitored during the growing season and long-term storage. The field experiments and on-farm trials will be carried out in 2016–2018.

**Key results and discussion**

In 2016, the yield of and disease development in onion crops produced from seedlings of six different cultivars were studied. Cultivars Hybing, Hybound, Hylander and Hytech represented yellow onion and Red Baron and Retano red onions. The average yield was quite low for all of the varieties. Hytech produced the highest marketable yield (dried and graded), 3.018 kg/m2, and the second best was Hybing, 2.690 kg/m2. The lowest yields were obtained from the red cultivars Red Baron and Retano, 2.234 and 1.847 kg/m2, respectively. During the growing season and at harvest the proportion of diseased onions was very low, from 0 to 0.7%, in all cultivars. The disease incidence slightly increased during the drying process, but remained within 0.5 to 1.1% range. *Fusarium oxysporum* and *F. proliferatum* were only detected in low frequencies in cultivars Hylander, Hytech and Red Baron.

The dried onions were stored at room temperature (18 °C) for three months. Considering the high storage temperature, the storage durability was excellent for all the cultivars: in the end the proportion of marketable onions was still over 90%. Also, despite disease favorable storage conditions, the disease progress was slow. The proportion of diseased onions was less than 5% in all cultivars. In this study cv. Hytech seemed to be more susceptible to *Fusarium* infections than the other cultivars, while Hybing was most susceptible to grey mold, *Botrytis cinerea*.

In 2016, four on-farm trials were carried out at organic farms in Eastern Finland to compare the yield of and disease development in onions produced from either seedlings or sets in actual farm conditions. The average dried and marketable yield produced from seedlings was very low and varied from 0.778 kg/m2 to 1.923 kg/m2,depending on the farm and the cultivar. There are many possible reasons for the low yield, like sparse planting density, short growing time, planting too deep or too close to the surface, weeds, and downy mildew (*Peronospora destructor*). However, only few rotten onions were found during the growing period.

The yield produced from onion sets was also low, but higher than that gained from seedlings. The average dried and marketable yield from sets varied between 1.430 to 2.888 kg/m2,depending on the variety and the farm. Red Baron gave the lowest yield, due to serious weed problems. On one of the other farms, very severe yield loss for cultivar Setton was caused by an early and severe downy mildew epidemic. During the growth period, rotten onions were found slightly more in the crop produced from onion sets compared to the seedlings.

At harvest time, the proportion of diseased onions was 10% on average in the crop produced from onion sets, and only 5% in the crop produced from seedlings. During the drying process and long term-storage the difference in the disease incidence between the onions produced from sets and seedlings increased. In March, the proportion of diseased onions in the onion set yield was over 40%, while in the seedling yield only 15% of onions were diseased. In most cases the main causal agent of rot was *F. oxysporum.* Towards the end of the storage period the incidence of grey mold increased and the incidence of *Fusarium* species declined.

There was considerable variation in the composition of the pathogen populations in diseased onions between different farms. The most common species in all the farms was *F. oxysporum*. There were clearly more rots caused by *Fusarium* species as well as grey mold in the onions produced from sets than in the crop produced from seedlings. The results indicate that yield losses caused by *Fusarium* can be reduced by producing onions from seedlings. However, as these results are only from one year, more research is required before any recommendations for onion production can be given.

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