Testing of the Bokashi/EM concept for the control of Pythium root rot in hyacinthus.

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Summary

The Bokashi/EM concept has been tested for its disease suppressive properties against Pythium root rot of hyacinths at Applied Plant Research, section flowerbulbs, Lisse, the Netherlands for Agriton, Noordwolde. Different concentrations and combinations of the Bokashi compost with Effective Microorganisms were tested in a field experiment. To follow the root development and root rot during the season the bulbs were harvested at three different moments.
Adding of Bokashi 4000 kg/ha to hyacinth resulted in the highest bulb en root weight, and also in the highest suppression of infection by Pythium. Adding EM to Bokashi compost had no extra effect on control of root rot. By using Bokashi compost a delay of Pythium root rot was established. At the end all roots of the bulbs were infected by Pythium.

1 Material & Methods

In a field experiment with hyacinths, two concentrations of Bokashi compost, mixed with clay minerals and sea shells, were tested. The concentrations of Bokashi were 4000 kg/ha and 8000 kg/ha. In a number of treatments, Effective Micro-organisms (EM) were added to the bulbs by pouring an EM suspension on the soil above the bulbs several times during the season.
Bulbs were planted in soil that was naturally infested by Pythium.
To test the effect of Bokashi/EM on the root development and root infection, bulbs were also planted in non-infested soil.
The experiment was carried out with the susceptible cultivar Pink Pearl.
With tulips (cultivar Sevilla) only the control treatment and the treatment with Bokashi compost were carried out to test the effect on the root development.

Treatments:

Hyacinth		Pythium
1. Control		-
2. Control		+
3. Bokashi (4000 kg/ha)	+EM	-
4. Bokashi (4000 kg/ha)	+EM	+
5. Bokashi (8000 kg/ha)	+EM	-
6. Bokashi (8000 kg/ha)	+EM	+
7. Bokashi (4000 kg/ha) - EM		+
8. Bokashi (8000 kg/ha) – EM		+
Tulip		
9. Control		-
10. Bokashi (4000 kg/ha)		-

The bulbs were planted in October 2003.
Bulbs were planted in 60 cm long, 10 cm wide PVC pipes. By using these PVC pipes, roots can be harvested without damage.
For each treatment 15 PVC pipes were planted with 4 hyacinth bulbs or 3 tulip bulbs on each PVC pipe. At three different moments during winter and spring of 2004, bulbs were harvested to follow root development and root rot. At each moment the bulbs of 5 PVC pipes were harvested, and soil was washed from the roots. The weight of the roots of the hyacinths and the amount of Pythium root rot was determined (disease index 0-5 where 0 is healthy and 5 is heavily infected). At the third moment, also the bulbweights were determined. Between October 2003 and April 2004 the EM were added three times to the bulbs.
The root systems of the tulips were judged on appearance and the rootweight was determined.
The condition of the crop on the field was also assessed.
A statistical analysis is carried out on disease index, root weight and bulb weight (ANOVA, $P \leq 0.05$ or a two way t-test, $P. \leq 0.05$).

2 Results

2.1 Hyacinth

The amount of damage of the hyacinth roots by Pythium root rot was determined and the average disease-index number of four bulbs per PVC pipe was noted.
Figure 1 shows the average disease index per PVC pipe for all three moments of harvesting. Per time point a statistical analysis has been done (ANOVA, P<0.05)

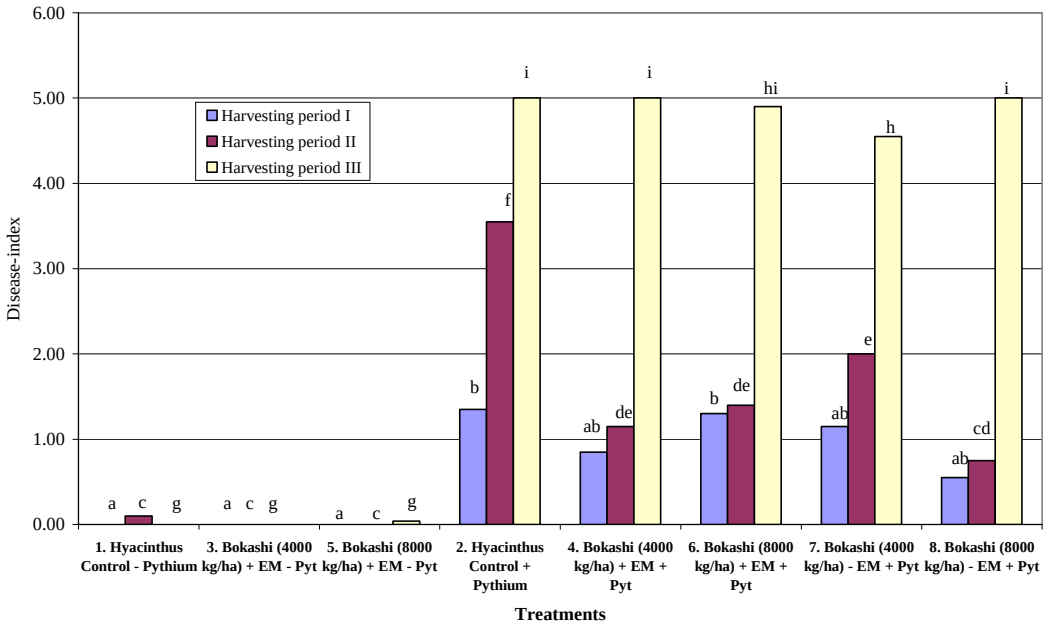

Figure 1. Average disease-index of four hyacinth bulbs. A disease index is assessed to the roots of the bulb, from 0 til 5. 0=0% infected, 1= 1-20% infection of the roots; 2= 21-40% infection; 3= 41-60% infection; 4= 61-80% infection and 5=81-100% infection. For each harvest time, a statistical analysis is carried out (ANOVA, P< 0.05). Characters in the figure indicate statistical significant differences between results. Bars with similar characters are not significantly different.

The average root weight of 4 hyacinth bulbs and 3 tulip bulbs of all three harvest times is shown in figure 2.

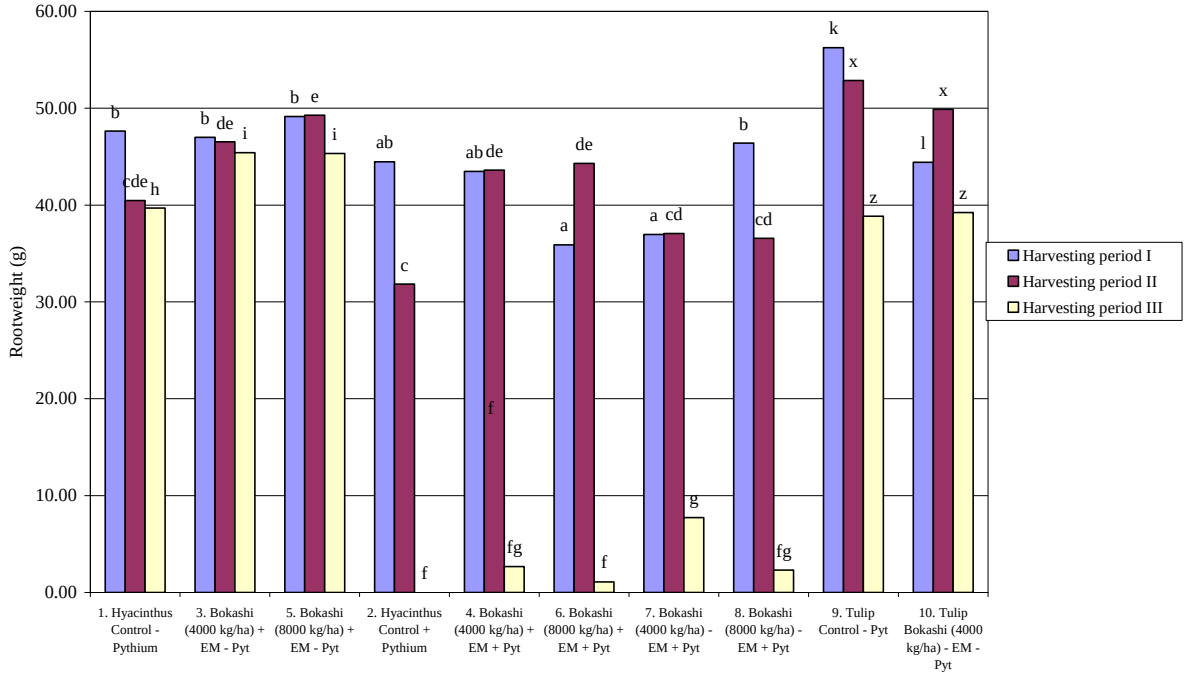

Figure 2. Average root weight of four hyacinth bulbs and three tulip bulbs. For eacht harvest time, a statistical analysis is carried out (for hyacinth ANOVA, P< 0.05; for tulip t-test 2 ways P<0.05). Characters in the figure indicate statistical significant differences between treatments. Bars with similar letters are not significantly different.

At the first harvesting period, there was hardly any root rot in the Pythium control treatment (Figure 1, treatment 2). At this moment, there is no visible significant effect of the treatments with Bokashi, with or without addition of EM. This is the same for the root weight. The root weight of the treatments with Bokashi/EM was not significantly higher than of the Pythium control treatment.

At the second harvesting period, no Pythium infection occurred in control treatment 1 and in treatments 3 en 5. This was to be expected, since the soil was not infested by Pythium.
In roots of treatment 2 there was a rather severe root infection by Pythium (Figure 1). In all treatments with Bokashi and EM added, or Bokashi without EM, Pythium infection was significantly lower as compared to control treatment 2. The treatment with the lowest disease-index is treatment 8 (8000 kg/ha Bokashi without EM). Treatment 8 however did not have the highest root weight (Figure 2). At the second harvesting period treatments 4 (Bokashi 4000 kg/ha+EM) and 6 (Bokashi 8000 kg/ha+EM) showed a small, but not significant increase of root weight compared to treatments 7 and 8, where no EM were added. There is also a small increase of root weight in the treatments 3 (Bokashi 4000 kg/ha+EM) and 5 (Bokashi 8000 kg/ha +EM) compared to the control treatment without Pythium (treatment 1).

At the third harvesting period there was no Pythium infection in the treatments 1, 3 and 5 and a very severe root rot infection in the treatments 2, 4, 6, 7 and 8 (Figure 1). In the treatments 3 and 5 the root weight was significantly higher as compared to the control treatment without Pythium (figure 2). In the treatments with Pythium-infested soil, there was only a significant

disease suppressive effect in treatment 7 (Bokashi 4000 kg/ha-EM).

At harvesting period 3 the weight of four hyacinth bulbs or three tulip bulbs was determined (Figure 3). The bulb weights in the treatments with Bokashi in soil that was not infested by Pythium (treatments 3 and 5) were similar to that of the control treatment without Pythium. Bulb weights in treatments 4, 6, 7 and 8 were significantly higher as compared to the Pythium control treatment.
At the visual assessment of the condition of the crop on the field, the leaves of treatments 2 and 6 were deceased first. All the other treatments remained green until the last harvesting period.

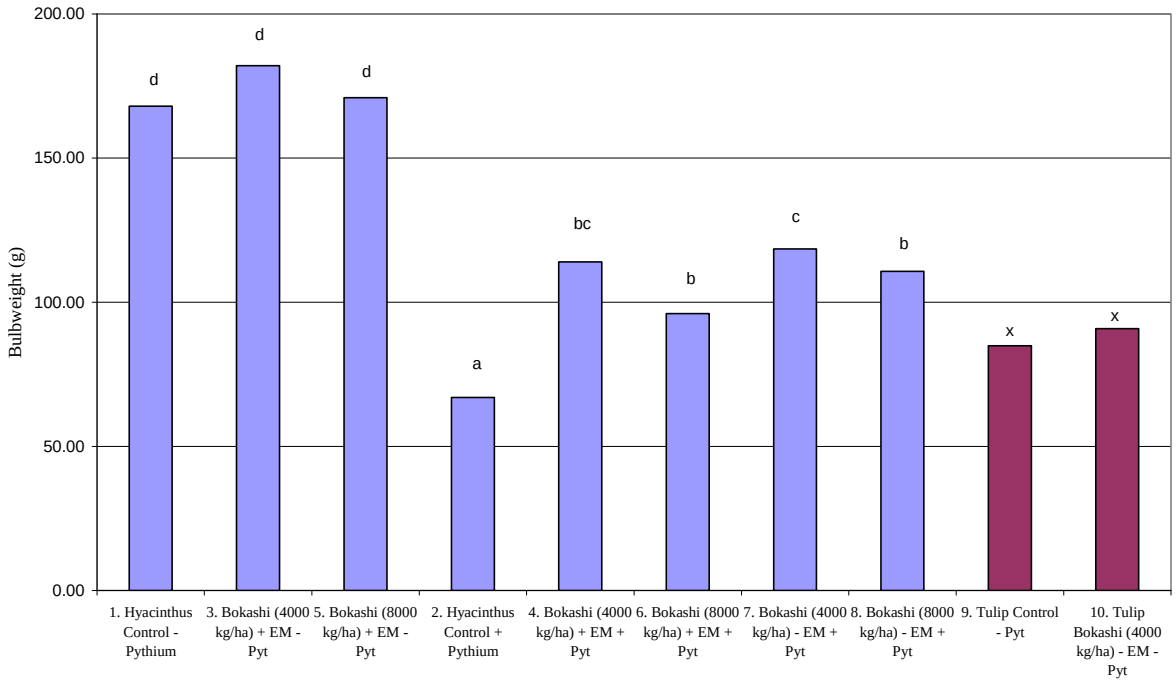

Figure 3. Average bulb weight of four hyacinth bulbs and three tulip bulbs. For eacht harvest time, a statistical analysis is carried out (for hyacinth ANOVA, P< 0.05; for tulip t-test 2 ways P<0.05). Characters in the graph indicate statistical significant differences between results. Bars with similar characters are not significantly different.

2.2 Tulip

At the first moment of harvest, there are significant differences in root weight between the control treatment and the treatment in which 4000 kg/ha Bokashi was added. The root weight in the control treatment was higher (Figure 2). At the second and third harvesting period there were no differences in root weight. Also, there was no difference in bulb weight between the two treatments (figure 3). In the field, there were no differences in crop condition.

3 Conclusions and recommendations

3.1 Conclusions

By using only Bokashi, in a concentration of 4000kg/ha, a delay of the Pythium root rot in springtime was established. Because of this delay in root rot the bulbs were able to produce more and longer roots resulting finally in a higher bulb weight as compared to the control treatment without the Bokashi compost. At the end of the season all roots of the bulbs were infected by Pythium.
Adding EM to the Bokashi compost had no extra effect on the root and bulb weight or on the control of the Pythium root rot. Doubling the amount of Bokashi compost from 4000kg/ha to 8000kg/ha did not enhance the disease suppressive effect.
There is no effect on bulb weight of the hyacinths and tulips when the Bokashi compost is added to non infested soil.
So, the increase in bulb weight in this experiment was caused by the suppressive effect of Bokashi compost that delays the Pythium root rot, and was not (only) caused by fertilization.

3.2 Recommendations for further research

To test the disease suppressive properties of Bokashi (in combination with EM) at larger scale, a field trial could be done. A field trial will give more information about the effect of the concepts under circumstances in practice.
Also in further research, the Bokashi/EM concept can be tested against other soil-borne pathogenic fungi that cause diseases in bulbs like Fusarium or Rhizoctonia.
In this experiment the effect of adding only EM to control Pythium root rot, was not tested. In further research, this could be done in an experiment using again PVC pipes, or in a bio assay.