

Short communication

Neth. J. Pl. Path. 76 (1970) 293–295

The effect of chitin amendment on actinomycetes in soil and on the infection of potato tubers by *Streptomyces scabies*

H. VRUGGINK

Instituut voor Plantenziektenkundig onderzoek (IPO), Wageningen

Accepted 1 April 1970

In recent *in vitro* experiments on actinomycete populations from different agricultural soils, streptomycetes were found which were very antagonistic to *Streptomyces scabies* (Thaxt.) Waksman and Henrici, the causal organism of common scab. For example, in a pot experiment with pathogen and different antagonists in sterilized soil, one decreased the surface area of scabbed tubers from 48 to 8 %. Testing antagonistic activity in non-sterilized soil, by adding organisms, is complicated because of the balanced microflora already present, but this difficulty can be overcome by adding chitin in the form of ground shrimp 'shells' which the actinomycetes can use as a source of nutrient (Veldkamp 1955, Mitchell and Alexander 1962).

The experiment described here was done with six liter pots containing so-called 'Ramspolsand', a sandy soil in which tubers often become severely scabbed. The soil was treated in four ways:

1. Chitin was added at a rate of 15 g/kg soil
2. Mycelium of the strong antagonist mentioned above added from 20 bottles of ten day-old shake culture, each containing 50 ml nutrient
3. Chitin and antagonist added to soil
4. Unamended soil (control).

Per treatment two pots were used. Potatoes of the scab-susceptible variety '*Bintje*' were grown in the pots for four months and at harvest the percentage scab on tubers from the control and the soil amended with antagonist was about 22 %. Tubers from soil amended with chitin and chitin with antagonist were covered with scab for about 4 %. When planted with potatoes for a second time, 21 % scab was recorded on tubers from untreated soil and 9.5 % from soil amended with chitin.

To investigate the effect of chitin amendment on the actinomycete population, dilution plates were made from treated and untreated soil, six and ten months after the chitin was added. From each sample about 200 actinomycete colonies were taken at random and identified according to the code of Cross and Maciver (1966). The symbol M3 was added to this code to indicate *Streptomyces spp.* which gave a positive melanin reaction on peptone-iron agar, but a negative one on tyrosine agar. (see Table 1).

The results (Table 1) indicate, that compared with untreated, the chitin amended soil had a greater total actinomycete population, 24 times as great at six months and

Table 1. Frequency of different actinomycetes from soil with and without chitin, sampled after six and ten months.

Code of the species	Chitin				Untreated			
	after 6 months		after 10 months		after 6 months		after 10 months	
	number	%	number	%	number	%	number	%
M2, S2, A1, C6, G1, (U1, 3, 4, 6, 7,)	121	69.1	120	61.2	2	1.1	7	3.6
M2, S2, A1, C6, G1, (U2, 4, 5, 6, 7,)	2	1.1						
M2, S2, A1, C6, G1, (U1, 4, 5, 6, 7,)			2	1.0	4	2.3	1	0.5
M2, S1, A1, C1, G1, (U1, 2, 3, 6, 7, 8)							6	3.1
M2, S1, A1, C5, G2, (U2, 4, 6, 8)			3	1.5			4	2.1
M2, S1, A1, C4, G3, (U1, 2, 3, 4, 5, 6, 7, 8)							4	2.1
M2, S1, A3, C6, G1, (U1, 2, 4, 6)					2	1.1		
M2, S1, A3, C5, G1, (U1, 2, 3, 4, 5, 6, 8)	1	0.6						
M2, S1, A3, C5, G3, (U1, 2, 3, 4, 5, 6, 7, 8)							1	0.5
M2, S1, A4, C5, G3, (U1, 2, 3, 4, 5, 6, 7, 8)	3	1.7	1	0.5			1	0.5
M2, S2, A4, C5, G1, (U1, 2, 3, 4, 6)	30	17.1	42	21.4	10	5.6	26	13.9
M2, S1, A4, C2, G1, (U1, 2, 4, 6, 7, 8)	1	0.6			2	1.1		
M2, S4, A4, C5, G1, (U1, 2, 3, 5, 6, 7, 8)			3	1.5			4	2.1
M2, S4, A4, C5, G1, (U1, 2, 3, 4, 5, 6, 7, 8)							1	0.5
M3, S1, A1, C2, G1, (U2, 4, 6, 7, 8)							1	0.5
M3, S1, A1, C5, G2, (U1,8)							1	0.5
M1, S1, A1, C5, G3, (U1, 2, 3, 4, 5, 6, 7, 8)							1	0.5
M1, S1, A3, C1, G1, (U1, 2, 3, 4, 5, 6, 7, 8)							3	1.5
M1, S2, A4, C6, G1, (U1, 2, 3, 4, 5, 6, 7, 8)							2	1.0
<i>S. griseinus</i> : M2, S1, A1, C2, G1, (U1, 2, 4, 6, 8)	6	3.4	2	1.0			1	0.5
<i>S. scabies</i> : M1, S1, A4, C5, G1 (U1, 2, 3, 4, 5, 6, 7, 8)	11	6.3	23	11.7	140	79.1	97	50.0
<i>Nocardia</i> sp.							1	0.5
<i>Micromonospora</i> sp.					19	9.6	31	16.0
Total number of isolates	175	100	196	100	177	100	193	100
Number of Actinomycetes per gram of dry soil	840 × 10 ⁵		755 × 10 ⁵		35 × 10 ⁵		25 × 10 ⁵	

Tabel 1. Frequentie van verschillende actinomyceten in grondmonsters met en zonder chitine, genomen na zes en tien maanden.

30 times as great at ten months. They also show that some actinomycetes like *Micro-monospora* disappeared, others like *S. scabies* were isolated less frequently and yet others, for example Isolate 1 (Table 1) and *S. griseinus* (a grisein-producing form of *S. griseus*), occurred more frequently. The latter was also found earlier after amendment of chitin to clay soil (Vruggink 1969). The total number of propagules/g dry soil of *S. scabies* is greater in the chitin amended soil, respectively for the six and ten months samples 55×10^5 and 88×10^5 in amended and 28×10^5 and 12×10^5 in untreated soil, (whether as pathogenic or non-pathogenic forms is not known). Isolate 1 (Table 1) also increased in number after adding chitin, respectively 58×10^6 and 46×10^6 in treated and 4×10^4 and 9×10^4 in untreated for the two sampling dates. As this isolate is weakly antagonistic to *S. scabies* this may explain the small amount of infection on potato tubers from chitin amended soil despite an increase in the soil population of *S. scabies*.

Samenvatting

Het effect van chitine op het aantal actinomyceten in de grond en op de aantasting van aardappelknollen door Streptomyces scabies.

In gesteriliseerde grond bleek toevoeging van een *Streptomyces*-soort, in vivo antagonistisch voor *Streptomyces scabies* (Thaxter) Waksman and Henrici, een sterke onderdrukking van de schurft- aantasting te veroorzaken. Werd deze antagonist tezamen met chitine aan ongesteryliseerde grond toegevoegd dan verminderde de schurftaantasting, en wel alleen tengevolge van de toegevoegde chitine. Er bleek een aanzienlijke verhoging van het totale aantal actinomyceten te zijn opgetreden. Eveneens had er een verschuiving in de actinomyceten-flora plaatsgevonden. De eerste isolatie in tabel 1 gaf een opbloei te zien na toevoeging van chitine, hetgeen een verklaring zou kunnen zijn voor de verminderde schurftaantasting.

References

- Cross, T. & Maciver, A. M., 1966. An alternative approach for the identification of *Streptomyces* species: a working system. Soc. appl. Bact. Techn. Ser. 1: 103-110.
- Mitchell, R. & Alexander, M., 1962. Microbiological processes associated with the use of chitin for biological control. Proc. Soil. Sci. Soc. Am. 26: 556-558.
- Veldkamp, H., 1955. A study of the aerobic decomposition of chitin by micro-organisms. Meded. LandbHogesch. Wageningen 55: 127-175.
- Vruggink, H., 1969. Jversl. Inst. plziektenk. Onderz. 1968: 50.