

ON THE CONTROL OF CUCUMBER SCAB

(*Cladosporium cucumerinum* ELL. & ARTH.).

By

ANNIKKI LINNASALMI.

*Department of Plant Pathology, Agricultural Experiment Station,
Tikkurila, Finland.*

Received December 15, 1947.

According to the reports annually received by the Department of Plant Pathology at the Agricultural Experiment Station as well as on the basis of the observations made by the officials of the Department on the garden plantings all over the country *Cladosporium cucumerinum* ELL. & ARTH., the cause of the cucumber scab, is the most common and injurious pathogenic fungus met in field cultivations of cucumber in Finland. Particularly in years when the weather keeps rainy in late summer at the time of ripening of the cucumber crop the disease spreads rapidly causing great damage on the cultivations. In worst cases both the leaves and the fruit are contaminated, in milder cases the leaves may be healthy and only the fruit more or less spotty. — In greenhouse cultures, too, the disease occurs in Finland.

For the control of the disease use of copper-containing substances as well as sulphur and lime sulphur in the form of dust or spray is recommended in the handbooks of plant protection of different countries.

Actual experimental research work on this respect has so far been very little done. FRANK (2) who mentions that gardeners in Germany at the end of last century tested spraying with copper lime against cucumber scab in greenhouse cultures with fully negative results, found that the spores of *Cladosporium cucumerinum* retain their germinating ability in spite of 2 hours treatment with 2 per cent copper lime mixture. With reference to this result WOLLENWEBER (6) states that Bordeaux sprayings are of no use in the control of cucumber scab. ERIKSSON (1) reports on an incident in Sweden where the copper lime sprayings were started immediately after the first symptoms of the disease on the cucumbers but nevertheless, satisfactory results were not obtained. Studies made in Holland revealed that formalin,

and Uspulun (MUYZENBERG, 5) Aretan, Bulbosan, mercuric chloride, sulphur, and salicylanilide (HERINGA-WESTERHOF, 3) prevent germination of the fungus on agar medium. Sprayings with solutions containing mercury and with Shirlan, a salicylanilide-preparation, have been recommended against cucumber scab, and in the plant-bed culture experiments conducted by HERINGA-WESTERHOF (3), Bulbosan dust gave fairly good results in control of the disease.

Experiments on fungicides for controlling of cucumber scab.

On the Plant Disease Department of the Agricultural Experiment Station in Tikkurila fungicide experiments were conducted for controlling of the cucumber scab in field plantings in 1936 and later in 1945—47. Besides, in 1946—47 experiments were arranged in the local Plant Cultivation Experiment Station of North-Häme in Pälkäne.

The experiments in 1936 where the effect of 1 % Bordeaux mixture was examined gave promising results. The percentage of the healthy crop in the sprayed plots was 61.3 and in the unsprayed 16.8 (calculated after the appearance of the first symptoms). In the experiments of 1945 where Venturia copper lime preparation (Kasvinsuojelu Oy., Finland) was used as 1 % solution the results were less favourable. Healthy crop was obtained 55.8 % of the sprayed plots and 40.5 % of the unsprayed ones (HÅRDH, 4). The results of the experiments in 1946—47 are given in Table 1, excluding the experiments in North-Häme in 1947, for the reason, that no disease occurred that year in the experiment field there.

In the experiments of 1946—47 the following chemicals were used:

Copper lime mixture: in 1946 Vihannes-Kuparikalkki-preparation (Kasvinsuojelu Oy., Finland), in 1947 cupric sulphate and hydrated lime as 2 % solution.

Perenox: (Plant Protection Ltd., England), containing cuprous oxide, as 1 % solution.

Soltosan: (Bayer Products Ltd., England), containing copper oxychloride, as 1 % solution.

F. D.-spray: (E. I. du Pont de Nemours & Company, U. S. A.), containing tetramethyl thiuramdisulphide, in 1946 as 0.6 % and in 1947 as 2.0 % solution.

Fermate: (E. I. du Pont de Nemours & Company, U. S. A.), containing ferric dimethyldithiocarbamate, as 0.2 % solution.

Potassium sulphide: as 0.3 % solution.

Venturicide: (Lunevale Products Ltd., England), containing mercuric chloride, as 0.2 % solution.

Spergon: (U. S. Rubber Co., U. S. A.), containing tetrachloro-para-benzoquinone, as 0.4 % solution.

Sulphur powder: as dust.

In potassium sulphide solution 0.5 % wheat meal paste was used as fixative, and *Spridex* preparation (Casco, Sweden) in all other sprays of 1947 experiments except in copper lime mixture.

Table 1. Results of the experiments for control of cucumber scab in 1946—47.

Treatment	1946				1947	
	Tikkurila Test variety: Spångberg's white		Pälkäne Test variety: cucumber of Murom		Tikkurila Test variety: cucumber of Murom	
	Yield after appearance of disease kg/m ²	Healthy %	Yield after appearance of disease kg/m ²	Healthy %	Yield after appearance of disease kg/m ²	Healthy %
Untreated	3.457	64.8	2.098	56.9	2.168	80.3
Copper lime	3.118	75.4	2.350	73.2	1.413	84.0
Perenox	—	—	—	—	1.809	74.3
Soltosan	—	—	—	—	1.909	77.3
F D.-spray	2.778	64.5	—	—	1.823	77.5
Fermate	—	—	—	—	2.052	73.6
Potassium sulphide	3.190	67.8	1.840	52.3	—	—
Sulphur dust	2.728	71.5	1.978	58.8	—	—
Venturicide	—	—	—	—	1.602	83.6
Spergon	—	—	—	—	2.147	82.9

The experiments were carried out in sandy soil, the size of the plot in Tikkurila was 3 square meters, in Pälkäne 5 square meters, number of replicates 4. The cucumber varieties tested were Cucumber of Murom (Russian origin) and Spångberg's white (Swedish origin). Sprayings were applied in 1946 3 times at 10 days' intervals, in Tikkurila during the period 9. VIII—31. VIII, in Pälkäne 30. VII—9. VIII, in 1947 4 times at 8 days' intervals during 11. VIII—3. IX. Both spray and dust were abundantly applied so that the foliage became completely wet or dusty from above and below as well as the vines with the fruit. The treatments were started a little before or just at the appearance of the disease.

In regard to the weather conditions prevailing during the experiments it should be mentioned that the amount of rain in August when the main cucumber crop ripened was in 1946 36.3 mm. in Tikkurila and 72.9 mm. in Pälkäne, the number of rainy days being respectively 11 and 15. The August in 1947 was exceptionally dry, in Tikkurila the amount of rain was only 3.5 mm., rainy days 4. No distinct correlation can be noted between the raininess and the abundance of scab although the results seem to indicate that the rain favours the appearance of the disease. The effectiveness of the control seems neither to be affected by the moisture of the climate.

Of the copper-containing substances tested the *copper lime* spray had a somewhat positive effect. The increase in the healthy crop was in 1946 about 30 % in Pälkäne, whereas in Tikkurila the increase was about 15 % in 1946 and only about 5 % in 1947. *Perenox* and *Soltosan*, which were used in higher concentrations than recommended by the manufacturer, proved to be ineffective. The host plant did not fully stand the concentration applied: in *Perenox*-plots yellowing occurred at first in the margin of leaves, later on the whole leaf blade, in *Soltosan*-plots the yellowing restricted to the margin of leaves within a breadth of 1 ½—2 cm. It may

be mentioned, that in the 1947 experiments the copper lime sprayings also caused similar injury to leaf margin, but to a less extent.

In the experiment with *sulphur dust* the increase in healthy crop was about 10 % in Tikkurila, whereas in Pälkäne the dust was practically ineffective. The treatment caused loss of chlorophyll and death of tissues all over the leaf blade soon after the first application. *F. D.-spray* was in 1946 tested in higher concentration than recommended by the manufacturer, but because it in this way did not at all prevent the occurrence of cucumber scab, it was in 1947 applied in about 3 times higher concentration. The host plant stood without injury even this concentration, but nevertheless the disease was unaffected by the sprays. The sulphur-containing sprays, *potassium sulphide* and *Fermate* appeared to be completely ineffective neither did *Venturicide* and *Spergon* have any scab-controlling effect. *Spergon* caused rather insignificant brown necrotic spots on the leaves.

On the basis of the above experiments it can be concluded that of the fungicides tested only the copper lime sprays and the sulphur dusts had a slight scab-preventing effect. The main difficulty in attaining an effective control of scab by fungicides lies evidently therein that owing to the rapid development and growth of sprouts and in particular, fruit in cucumber plantings there are always met parts of plants which of necessity are left without the toxic protection of the spray or dust at the intervals of the treatments and therefore are exposed to contamination by *Cladosporium cucumerinum* spores from the environment. By more frequent treatments, for instance, every day or every other day satisfactory results could perhaps be obtained but in practical gardening application can hardly be repeated so often.

The above experiments were conducted under the guidance of the Director of the Plant Pathology Department of Agricultural Experiment Station, Prof. Dr. E. A. Jamalainen. The experiments in Pälkäne were in charge of Mr. P. Jalakanen, B. Agr. and in Tikkurila Miss Annikki Linnasalmi, B. Sc.

Summary.

1. The cucumber scab caused by *Cladosporium cucumerinum* ELL. & ARTH. is the most common and detrimental fungal disease occurring in the field plantings of cucumber in Finland.

2. The fungicides tested did not give satisfactory results in the control of scab. Copper lime sprays and sulphur dusts had a slightly preventing effect on scab. *F. D.-spray*, *Fermate*, *potassium sulphide*, *Perenox*, *Soltosan*, *Spergon*, and *Venturicide* were completely ineffective.

REFERENCES.

- (1) ERIKSSON, J. 1915 — Die Einbürgerung neuer zerstörender Gurken-Krankheiten in Schweden. Zentr. Bl. Bakt. II, 44, p. 116—125.
- (2) FRANK, B. 1893 — Ueber ein parasitisches Cladosporium auf Gurken. Zeitschr. Pflanzenkrankh. 3, p. 30—31.
- (3) HERINGA-WESTERHOF, A. C. 1946 — Het vruchtvuur in de komkommers veroorzaakt door *Cladosporium cucumerinum* ELLIS et ARTHUR en zijn bestrijding. Tijdschr. Plantenziekten 52, p. 138—149.
- (4) HÄRDH, H. 1946 — Kurkun laikkutaudista ja sen torjunnasta. Puutarha 2, p. 56—57.
- (5) MUYZENBERG, E. W. B. v.d. 1932 — Onderzoek over Cladosporium cucumerinum ELLIS & ARTHUR (de veroorzaker van het vruchtvuur van de komkommer). Tijdschr. Plantenziekten 38, p. 81—118. Ref. Biol. Abstr. 7, I, p. 777.
- (6) WOLLENWEBER, H. W. 1932 — Hyphomycetes, in Sorauer, P.: Handbuch der Pflanzenkrankheiten 3, II. Teil, p. 577—819, Berlin.

SELOSTUS.

KURKUN LAIKKUTAUDIN (*Cladosporium cucumerinum* ELL. & ARTH.) TORJUNNASTA.

ANNIKKI LINNASALMI.

Maatalouskoelaitos, kasvitautiosasto, Tikkurila.

Maatalouskoelaitoksen kasvitautiosastolle vuosittain saapuvien ilmoitusten ja osaston virkailijoiden puutarhaviljelyksillä ympäri maan tekemien havaintojen mukaan on *Cladosporium cucumerinum* ELL. & ARTH., k u r k u n l a i k k u t a u d i n aiheuttaja, yleisin ja vahingollisin Suomessa avomaan kurkkuviljelyksissä esiintyvä tuhosieni. Pahimmissa tapauksissa ovat sekä lehdet että hedelmät sienen saastuttamat, lievemmissä tapauksissa saattavat lehdet olla terveitä ja ainoastaan hedelmät enemmän tai vähemmän laikullisia. — Myös kasvihuoneviljelyksissä on tautia todettu meillä esiintyvän.

Kurkun laikkutaudin torjumiseksi suositellaan ei maiden kasvinsuojelukäsikirjoissa kupari- tai rikin aineiden sekä rikin ja rikkikalkin käyttöä pölytteinä tai ruiskutteina. Varsinaista kokeellista tutkimustyötä on tässä suhteessa tehty verraten vähän (1, 2, 3, 5, 6).

Maatalouskoelaitoksen kasvitautiosastolla Tikkurilassa on ruiskutus- ja pölytyskokeita kurkun laikkutaudin torjumiseksi avomaaviljelyksissä suoritettu v. 1936 ja myöhemmin vv. 1945—47. Vv. 1946—47 oli kokeita osaston toimesta järjestetty myös Pohjois-Hämeen kasvinviljelyskoeasemalle Pälkäneellä.

V. 1936 kokeissa antoivat kuparikalkkiseosruiskutukset lupaavia tuloksia, v. 1945 eivät tulokset olleet yhtä suotuisia (4). Vv. 1946—47 koetulokset selviävät taulukosta I, s. 126. Niiden nojalla voidaan todeta, että kokeiltavina olleista fungisideista ainoastaan kuparikalkkiseosruiskutuksilla ja rikki-pölytyksellä oli lievä laikkutautia ehkäisevä vaikutus. F.D.-ruiskute, Fermate-, kaliumsulfidi-, Perenox-, Soltosan-, Spergon- ja Venturicide-ruiskutukset olivat tehottomia.

Päävaikeus tehokkaan torjunnan aikaansaamiseksi fungisideilla kurkun laikkutautia vastaan on ilmeisesti siinä, että kurkkuviljelmällä veisojen ja erittäinkin hedelmien nopean kehityksen ja kasvun takia on aina kasvinosia, jotka käsittelyjen väliaikoina joutuvat olemaan ilman ruiskutteen tai pölytteen myrkkysuojaa ja näinollen ovat alttiina ympäristön *Cladosporium cucumerinum*-itiöiden saastu-
tukselle.