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RESEARCH ON APPLE AND PEAR SCAB IN THE NETHERLANDS FROM 1938 UNTIL 1961[1]

Onderzoek over schurft van appel en peer in Nederland van 1938 tot 1961

BY

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In the Netherlands until 1938 the timing of the first applications of chemical sprays against apple and pear scab was determined by reference to the stages of fruit bud development, as a correlation was supposed to exist between tree-development and fungus-development. In America KEITT & JONES (1926) were the first to abandon this view; they stated that in the spring anti-scab sprays should be timed according to the development of the fungus.

RESEARCH FROM 1938 UNTIL 1950

In the Netherlands an investigation on the timing of spray applications in spring was started in 1938, at the instigation of Prof. Dr. H. M. QUANJER. This investigation which lasted until 1950 might be regarded as the *first stage* of Dutch research on apple and pear scab. The development of perithecia and ascospores and the discharge of ascospores has been closely studied each year since 1938 (VAN DE POL, 1941; GERSONS et al., 1942; KNOPPIEN & VLASVELD, 1947; VLASVELD, 1951) with an interruption in 1945, due to the war. It became apparent from these observations that a correlation did not always exist between the development of apple and pear fruit buds and the development of the fungus.

In some years ascospores may be liberated before susceptible tissues are present; in this case the first protective sprays should be applied as soon as such parts appear. Occasionally susceptible areas are present before the perithecia are ready to eject ascospores and in such cases, provided no wood scab is present, the first spray might be applied according to the development of the perithecia. It should be stated, however, that in the Netherlands in most years the ripening of ascospores coincides with the emergence of susceptible tissues from the fruit buds of early apple and pear varieties.

The investigations carried out between 1938 and 1950 showed that in timing the first spray application both the development of the fruit buds and the development of the ascospores should be considered. KNOPPIEN & VLASVELD (1947) pointed out that a prognosis of ascospore emissions is impeded owing to the lack of a reliable long-term weather-forecast, in this case rainfall-forecast. However, between 1938 and 1948 a method was developed (afterwards described by MEIJNEKE, 1957), making it possible to issue a pre-warning. Since 1948, a radio warning service for apple and pear scab has been in operation and pre-warnings have been issued, worded as follows: (a) "the ascospores are

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almost mature"; (b) "ascospores are expected to be released following rain". As soon as the first discharge of ascospores occurs it is also reported in a broadcast.

In the early years of the existence of the radio warning service fruitgrowers were advised to carry out the first protective spray application between the two warnings (a) and (b), or at the latest as soon as possible after warning (b).

RESEARCH FROM 1951 TO 1961 INCLUSIVE

SPROSTON's (1949) work on post-infection applications of chemical sprays and the publication in 1951 of MILLS' scab forecasting table (MILLS & LAPLANTE, 1951) led to the *second stage* of research on apple and pear scab in the Netherlands, which lasted until the end of 1960. In this period several aspects of the problem were tackled and a good co-ordination of the work was ensured by the "Committee for Scab Research", established by the Inspector of Horticultural Research on February 22nd, 1952, and consisting of those taking part in the investigation. A brief survey of the various aspects of the investigation during this second stage is given below.

Investigation into the validity of MILLS' data on the relation between temperature and length of the wetting period of the trees on the one hand and the occurrence of scab infection on the other

In the years 1951 until 1954 KEYER & DIJKSTERHUIS (1952, 1953a, 1955) established the validity of the data by SPROSTON (1949) and MILLS (MILLS & LAPLANTE, 1951) on the relation between the weather and scab-infection. Their tests related to a limited number of natural infection periods. ROOSJE (1955a, 1959a) performed semi-laboratory experiments, in which small potted apple-trees were inoculated. His results partly agreed with MILLS' data (MILLS & LAPLANTE, 1951), but he also found some points of difference. According to ROOSJE (1955a) the minimum wetting period required by the leaves for infection by conidia was certainly not shorter than the wetting period needed for infection by ascospores; according to MILLS (MILLS & LAPLANTE, 1951), however, conidia required only two thirds of the time needed by ascospores for infection. Moreover ROOSJE (1959a) found that germinating conidia could survive a dry period of 4–15½ hours occurring between two wet periods each of which was of insufficient duration to cause infection. MILLS & LAPLANTE (1951), however, regarded a dry period of 3 to 4 hours as being the maximum that could be tolerated. Later (1954) they revised their opinion and stated that wetting periods may still be added together if the intervening dry period is no longer than "half a day or more". Although vague this latter description more closely approximates to the results of the Dutch investigators. Based on Dutch research the instructions for the detection of infection periods in cases of intermittent wetting were altered twice (ROOSJE, 1958, 1959c) for practical purposes. In the Netherlands since 1959 the view has been taken that periods should be added together if the intervening dry period has been eight hours or less, which view did not fail so far.

Improvement of methods for determination of infection periods throughout the country

POST (1955) established, that the average temperatures measured at the synoptic stations of the Royal Netherlands Meteorological Institute (K.N.M.I.) and at those of special orchard stations during wetting periods usually agree to such an extent, that they lead to the same conclusions with respect to a possible infection period. The reports on rainfall, as given by the synoptic stations, also proved to afford a reasonably reliable indication for the determination of wetting periods. However, most of the synoptic stations are not situated in fruit growing areas but near sea and airports, and therefore observations in special orchard stations are preferred.

Later POST (1959b) ascertained that the data on the length of wet periods and the average temperatures during these periods, as collected in an orchard station, were in most cases applicable to an area within a 15 miles' radius of the station. As a part of the warning service these orchard stations were later called observation-posts.

For easier determination of the length of wetting periods, the development of a rain recorder was taken up. Easy operation was an important point with respect to a rain recorder. In 1955 the "Committee for Scab Research" recommended a so-called pluvioscope for practical purposes. This instrument was developed by the K.N.M.I. (POST, 1955). The pluvioscope had the following drawbacks: 1. only the period of actual rainfall is registered, and so no information is obtained about the end of the wetting period, 2. the instrument operates on a daily rotation. On account of these objections another type of instrument was developed by the K.N.M.I., based on a design of SCHNELLE (1959). After the experimental year 1959, this led to the "DE WIT leaf wetness recorder" (POST, 1959a), manufactured by a Dutch firm at the instigation of the "Committee for Scab Research". The DE WIT leaf wetness recorder replaced the pluvioscope, because the first instrument provides information about a wetting period, which is more or less comparable with the duration of leaf wetness. Moreover, the DE WIT leaf wetness recorder operates on a weekly rotation.

Investigation on the curative properties of organic fungicides

With the term curative is meant in this publication "post-infection, in the first days of the incubation period". In the Netherlands KEYER & DIJKSTERHUIS (1952) were the first to prove in field trials in 1951, that apple scab could be controlled just as well by curative spray-applications with organo-mercury compounds, as by protective sprays. Later many field experiments on the curative action of organo-mercury compounds and other organic fungicides were carried out by various research-workers in the Netherlands (KEYER & DIJKSTERHUIS, 1953b; BESEMER & MEIJNEKE, 1953; JONGEJAN & MULDER, 1953; HUS, 1953; BESEMER et al., 1955; BESEMER, 1960), while ROOSJE (1955a, 1959b) also obtained data on the curative action of fungicides in semi-laboratory experiments. The results proved that in the Netherlands the curative action of organo-mercury compounds against scab in commercial orchards lasts for periods of 72 to 96 hours. However, owing to their phytotoxic properties the use of this type of fungicide is restricted to the period before blossoming for all pear varieties and some apple varieties.

Most of the fungicides tested (captan, dinitrophenyl thiocyanate, ferbam, mesulfan, thiram, Tuzet, ziram) either proved to have no curative action, or their curative action was insufficient for general practical purposes. With respect tot curative action two fungicides, cepyram (cetylpyridiniumdimethyldithiocarbamate) and dodine (n-dodecylguanidine acetate), proved to be intermediate between the group of organo-mercury compounds and the fungicides listed above. Because of phytotoxicity only dodine is suitable for practical application on a limited scale in the Netherlands. There is still need for a non-phytotoxic fungicide with a good curative action, which may be applied during the whole season or the greater part of it.

Besides the curative action also the protectant action of many fungicides has been investigated, especially by the Plant Protection Service, as part of their testing of fungicides. ROOSJE (1955a, p. 148–149) and MEIJNEKE (1960, p. 757) have drawn attention to the difficulties encountered in testing protectant fungicides against apple and pear scab. There is no indisputable evidence as to differences in protectant action, and for that reason publication of the general consensus of opinion as regards the protectant action of various fungicides, based on research, has not been included.

Application of the results of the investigation

During the second stage of the investigation, as described above, it became apparent that protective spray-applications should remain the basis of apple and pear scab control. A *deliberate scheme* of curative spray-applications presents some practical difficulties (ROOSJE, 1955b). The curative method should be looked upon as a welcome supplement, but with the fungicides at present available this method should only be used in the relatively short period before blossoming, because there would be a risk of phytotoxicity (organo-mercury compounds, dodine) when used later.

Since the scab warning service in the Netherlands was started in 1948, its organisation has been continually adapted as new conclusions were reached in the investigation. Since 1960 this service has been composed of a national centre (Plant Protection Service), a network of 19 primary observation-posts and 57 secondary observation-posts. These observation-posts determine scab infection periods, and on the strength of their observations a warning is broadcast (MEIJNEKE, 1963). The warnings have their greatest value before blossoming, because then the fruitgrower may still cure an infection by choosing the correct fungicide.

Since the application of research results and the extension-work in this field, apple and pear scab have ceased to be a problem in the Netherlands. Research on apple and pear scab is now confined to the following points: 1. a comparison of instruments for recording wet periods, 2. determining corrections for the "DE WIT wetness recorder", 3. testing the effect of new fungicides and 4. examining the possibilities of mixing chemicals for scab control with those for the control of apple mildew.

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SAMENVATTING

Het onderzoek over schurft bij appel en peer, dat in Nederland van 1938 tot 1950 werd uitgevoerd, was voornamelijk gericht op de ontwikkeling van de peritheciën van de ziekteverwekkers en de uitstoting van ascosporen door de peritheciën. In deze eerste fase van het onderzoek bleek, dat voor het bepalen van het tijdstip van de eerste bespuiting zowel de ontwikkeling van de gemengde knoppen van appel en peer als de ontwikkeling van peritheciën dient te worden gevolgd.

In de tweede fase van het onderzoek, van 1951 tot 1961, werd de geldigheid van de zogenaamde gegevens van MILLS over het verband tussen de temperatuur en de bevochtigingsduur van de bomen enerzijds en het optreden van schurftinfectie anderzijds onderzocht. Voorts werd het vaststellen van infectieperioden door het gehele land geperfectioneerd. Voor het bepalen van de bevochtigingsduur van bladeren werd aanvankelijk een pluvioscoop, later de „DE WIT-bladnatschrijver" geïntroduceerd.

Zowel in semi-laboratoriumproeven als in veldproeven werden de curatieve eigenschappen van organische fungiciden bepaald, terwijl uit veldproeven eveneens een oordeel over de preventieve werking van verscheidene fungiciden werd gevormd. Aan curatieve bespuitingen met organische kwikpreparaten of dodine wordt in het algemeen slechts een plaats toegekend als aanvulling op de preventieve methode van schurftbestrijding in de periode vóór de bloei.

Mede ten gevolge van de toepassing van de resultaten van het onderzoek vormt de bestrijding van schurft bij appel en peer in Nederland thans geen probleem meer.

REFERENCES

BESEMER, A. F. H., – 1960. Het schurftonderzoek in Nederland van 1955 t/m 1958 III. Veldervaringen met de curatieve werking van enige bestrijdingsmiddelen tegen schurft bij appel en peer. Meded. Dir. Tuinb. 23: 178–191.

BESEMER, A. F. H., H. P. DIJKSTERHUIS, E. J. KEYER, G. S. ROOSJE & W. P. N. VLASVELD, – 1955. Het schurftonderzoek in 1953 en 1954, veldproeven. Meded. Dir. Tuinb. 18: 297–315.

BESEMER, A. F. H. & C. A. R. MEIJNEKE, – 1953. Het schurftonderzoek in 1952 III. Proefnemingen in 1952. Proeven door de Plantenziektenkundige Dienst. Meded. Dir. Tuinb. 16: 200–204.

GERSONS, L., B. K. BARTELDS, W. G. VAN DE KROFT, J. D. GERRITSEN, B. BOSMA, D. KERS & H. M. QUANJER, – 1942. Onderzoek naar de beste tijdstippen der voorjaarsbespuitingen tegen appel- en pereschurft II. Tijdschr. Pl.Ziekt. 84: 33–60.

HUS, P., – 1953. Het schurftonderzoek in 1952 III. Proefnemingen in 1952, landelijke schurftproeven. Meded. Dir. Tuinb. 16: 207–213.

JONGEJAN, P. J. H. & D. MULDER, – 1953. Het schurftonderzoek in 1952 III. Proefnemingen in 1952, het onderzoek in Zeeland. Meded. Dir. Tuinb. 16: 204–207.

KEYER, E. J. & H. P. DIJKSTERHUIS, – 1952. Schurftwaarnemingen 1951 in de provincie Groningen. Fruitteelt 42: 114–117.

KEYER, E. J. & H. P. DIJKSTERHUIS, – 1953a. Het schurftonderzoek in 1952 II. Waarnemingen over de levenswijze van de schurftzwam te Zeerijp (Groningen) 1952. Meded. Dir. Tuinb. 16: 186–193.

KEYER, E. J. & H. P. DIJKSTERHUIS, – 1953b. Het schurftonderzoek in 1952 II. Proefnemingen in 1952, proeven te Zeerijp (Groningen). Meded. Dir. Tuinb. 16: 193–200.

KEYER, E. J. & H. P. DIJKSTERHUIS, – 1955. Waarnemingen over de levenswijze van de schurftzwam in 1953 en 1954 te Zeerijp (Groningen). Meded. Dir. Tuinb. 18: 137–139.

KEITT, G. W. & L. K. JONES, – 1926. Studies of the epidemiology and control of apple scab. Res. Bull. Un. Wisc. agr. Exp. Sta. 73: 1–104.

KNOPPIEN, P. & W. P. N. VLASVELD, – 1947. Vier jaren voortgezet onderzoek over de schurft van appel en peer. Tijdschr. Pl.Ziekt. 53: 145–180.

MEIJNEKE, C. A. R., – 1957. The radio warning service for apple and pear scab in the Netherlands. Neth. J. agr. Sc. 5: 263–270.
MEIJNEKE, C. A. R., – 1960. Het schurftonderzoek in Nederland van 1955 t/m 1958 V. Slotbeschouwingen en samenvatting. Meded. Dir. Tuinb. 23: 755–764.
MEIJNEKE, C. A. R., – 1963. The radio warning service for apple and pear scab in the Netherlands, 1961. Neth. J. Plant Path. 69: 138–144.
MILLS, W. D. & A. A. LAPLANTE, – 1951. Diseases and insects in the orchard. Cornell Ext. Bull. 711: 21–27.
MILLS, W. D. & A. A. LAPLANTE, – 1954. Diseases and insects in the orchard. Corn. Ext. Bull. 711: 20–28. [Revised edition].
POL, P. H. VAN DE, – 1941. Onderzoek naar het beste tijdstip der voorjaarsbespuiting tegen appel- en pereschurft I. Tijdschr. Pl.Ziekt. 47: 197–230.
POST, J. J., – 1955. De meteorologische zijde van het schurftonderzoek. Meded. Dir. Tuinb. 18: 130–137.
POST, J. J., – 1959a. Het schurftonderzoek in Nederland van 1955 t/m 1958. Het instrumentarium voor het bepalen van infectieperioden. Meded. Dir. Tuinb. 22: 365–371.
POST, J. J., – 1959b. Het schurftonderzoek in Nederland van 1955 t/m 1958. De representativiteit der waarschuwingsberichten. Meded. Dir. Tuinb. 22: 371–374.
ROOSJE, G. S., – 1955a. Laboratoriumonderzoek over de biologie en de bestrijding van Venturia inaequalis (Cke) Wint. Meded. Dir. Tuinb. 18: 139–151.
ROOSJE, G. S., – 1955b. Treatment of apple and pear scab in Holland. Plant Prot. Overs. Rev. 4: 128–135.
ROOSJE, G. S., – 1958. Het belang van de kennis van schurftinfecties bij de schurftbestrijding. Fruitteelt 48: 182–183.
ROOSJE, G. S., – 1959a. Het schurftonderzoek in Nederland van 1955 t/m 1958 II. Laboratoriumonderzoek van infecties door ascosporen en conidiën. Meded. Dir. Tuinb. 22: 441–447.
ROOSJE, G. S., – 1959b. Het schurftonderzoek in Nederland van 1959 t/m 1958 II. Een schakel tussen laboratorium- en veldproeven bij de toetsing van fungiciden tegen appelschurft. Meded. Dir. Tuinb. 22: 448–453.
ROOSJE, G. S., – 1959c. Vaststelling van infectieperioden van schurft. Fruitteelt 49: 297.
SCHNELLE, F., – 1959. Meteorologische Hilfsmittel beim Schorfwarndienst. Verhandl. IV Int. Pflanzensch.-Kongr., Hamburg 1: 205–208.
SPROSTON, T., – 1949. Vermont apple scab and control, 1947–1948. Bull. agr. Exp. Sta., Un. Vermont, 550.
VLASVELD, W. P. N., – 1951. Het schurftonderzoek in de jaren 1947 en 1948 en de waarnemingen in 1949. Tijdschr. Pl.Ziekt. 57: 15–32.