Effect of Apple Cultivar on *Venturia inaequalis* Ascospore Emission in California

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ABSTRACT

MOLLER, W. J. 1980. Effect of apple cultivar on *Venturia inaequalis* ascospore emission in California. Plant Disease 64:930-931.

Six apple cultivars growing in the interior region of central California were compared for spring ascospore productivity from infected leaves after an unexpected epidemic in 1978 when leaves and fruits became severely infected. There were distinct differences between cultivars in ascospore productivity, although overall levels were less than those reported from New York State, where an identical sampling procedure has been used for many years. Ascospore emission in this location in 1979 lasted only 4–5 wk; it began in late dormancy and was virtually complete before any of the cultivars reached full bloom.

Apple scab (*Venturia inaequalis* (Cke.) Wint.) is uncommon in apple (*Malus domestica* Borkh.) orchards in the interior of California (7), and no studies of the primary ascospore emission period have been reported from this region.

After the 1975–1977 drought (and consequent low disease incidence), many apple growers in the state applied inadequate control measures during the wet spring of 1978. One recently established, large (668 ha [1,650 acres]), overhead-sprinkled apple planting on the east side of the San Joaquin Valley in central California had many cultivars with natural infection of more than 75% of fruit and leaves by May 1978. The inoculum carryover at leaf-fall was substantial. This orchard also has a 13.4-ha (33 acre) block of 43 apple cultivars, all of which were naturally infected with scab disease during the 1978 season (J. M. Ogawa and M. Szkolnik, *unpublished data*). This epidemic provided a unique opportunity to compare spring ascospore productivity from a range of apple cultivars, something that seems to have been little studied. Such information is of significance in pest management programs in which infected leaves from the previous season are used as an indicator of primary inoculum potential the next spring.

MATERIALS AND METHODS

Leaf collection. The cultivars Golden Delicious, Granny Smith, Ruby, Summerred, Spur Rome, and Winesap, all growing in close proximity in the varietal block and all heavily infected with scab, were used in the study. On 26 October 1978 during early leaf-fall, 200

uniformly diseased leaves per cultivar were hand picked from the trees. Leaves that formed latest in the season were selected, since these are considered to contribute most of the ascospores (3). The leaves were then spread on bare soil in a thin layer beneath nylon mesh in the sampled tree rows, where they remained until the following late winter.

Sampling for ascospore productivity. Weekly leaf sampling for ascospore productivity commenced on 19 February 1979, when all cultivars were still dormant. Twenty leaves per cultivar were removed each week from beneath the nylon mesh, where they had been stored over the winter, and were placed in a permeable container to allow drying while in transit by mail to Davis. Two to three days after collection each week, a final selection of 12 most heavily infected leaves was made for ascospore discharge tests in the laboratory, following Szkolnik's technique (6). Since *V. inaequalis* perithecia were rarely abundant, leaf selection was based on lesion development during the previous season.

The 12 leaves of each cultivar were cut into segments about 1.27 cm^2, then immersed in distilled water for 5 min before all of the segments (lower side exposed) were placed on the inside of each lid of three clean petri plates. Free water was blotted off, then the plate lids were immediately placed over their corresponding half, which contained enough distilled water to cover the bottom of the plate. The bottom of each plate had been marked in quarters to facilitate counting any ascospores discharged into the water during 1 hr. Ascospores of 10 random fields in each quarter plate were counted under low power magnification (× 100) each week until the numbers markedly decreased and any discharged ascospores appeared distorted.

Measurement of infection periods. Temperature and leaf wetness were measured in the orchard with a standard 7-day recording hygrothermograph and a deWit 7-day recording leaf wetness meter (M. deWit, Hengelo, Holland) at 1.5 m above ground.

RESULTS

Counts for each cultivar were summarized as ascospores discharged per low power field in 1 hr (average of 3 × 4 × 10 = 120 fields). There were distinct differences between cultivars in ascospore productivity, although all curves followed the same trend (Fig. 1).

Earliest ascospore discharge in this year began just ahead of the silver-tip stage of the earliest cultivars, and peak discharge occurred during the same week but at various cultivar growth stages, ranging from green tip in Spur Rome to early bloom in the Summerred cultivar. In this season, the overall ascospore discharge period lasted for little more than a month and was completed before most cultivars reached full bloom. Three scab infection periods as predicted by Mills' table (4) occurred on 16–17 and 27–28 March and 17 April 1979; two of these periods were during the time of ascospore emission. Two protective fungicide applications of dodine (Cyprex 65W) during these critical times (8–15 and 19–26 March) to the entire 1,650 acres kept scab infection of fruit levels to < 2% in most cultivars in 1979, in contrast to the uncontrolled epidemic of 1978.

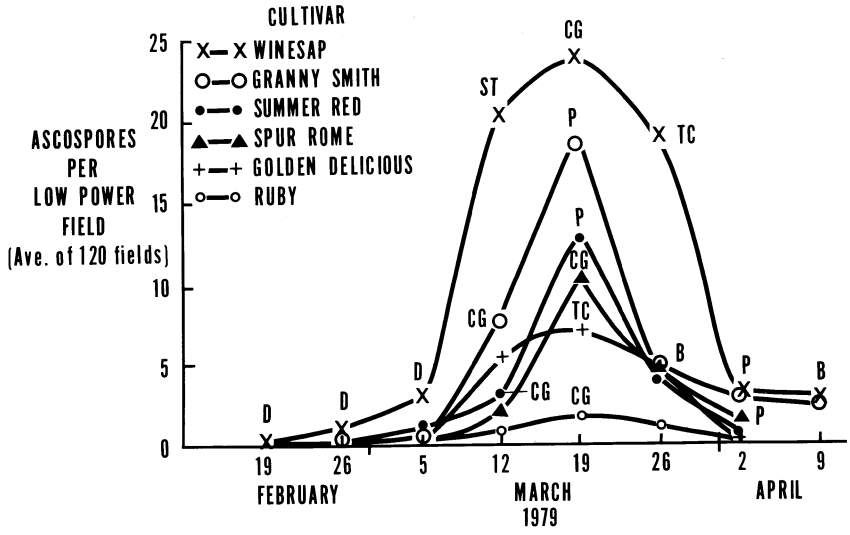

Fig. 1. Relative weekly ascospore productivity of six apple cultivars in the San Joaquin Valley of California during the spring of 1979. Fruit bud states: D = dormant; ST = silver tip; CG = 1 cm green; TC = tight cluster; P = pink; B = bloom.

DISCUSSION

Because of the frequency of rains during early apple growth stages in the central valley of California, epidemics of the magnitude seen in 1978 are uncommon; thus the opportunity to compare the effects of cultivar on ascospore productivity is unlikely to be repeated soon. Data accrued from this single location and year, when climatic parameters were not significantly different from normal, indicate that overall levels of ascospore productivity were well below the long-term data reported for New York State using this same technique (2,6). Nevertheless, they still provided a definite pattern on which spray schedules could be based. Of interest is the fact that the major output of ascospores occurred during a primary scab period of about 4–5 wk, compared with 11–12 wk or longer in other apple regions (1,3,5).

Cultivars differed substantially in overall inoculum productivity, with the Ruby cultivar producing only 4.7% of the total ascospore potential shown by Winesap for the same period. The significance of this in relation to disease control is not clear. The data suggest, however, that even under identical epidemiological conditions, heavily infected leaves of certain cultivars have less potential for ascospore output, which may be important where infected leaf samples are collected in the autumn for use in pest management prediction programs.

ACKNOWLEDGMENTS

I am grateful to Mitchell R. King for technical assistance. Thanks are due also to J. M. Ogawa and M. Szkolnik for consultation and for reviewing the manuscript.

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