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T. H. King
University of Minnesota

Stephen C.Y. Liu
University of Minnesota

R. L. Skiles
University of Minnesota

is again different in that the multiple-male groups did not maintain a normal balance and hence dropped out.

Another point may be mentioned. Multiple-male groups have been recorded for very few swarming insects. The paucity of records on this factor of intraspecific interference may be due to the difficulty in observing such incidences rather than suggesting that the factor is uncommon among swarming insects.

In summary, these observations show that a significant proportion of the male midges was involved in unsuccessful mating due to interference by other males, and also suggest that the male approached the females entering the swarm almost instantaneously.

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BOTANY

Occurrence and severity of the viruses of strawberry in Minnesota

T. H. KING, STEPHEN C. Y. LIU and R. L. SKILES[1]

University of Minnesota, St. Paul

SUMMARY: Approximately 900 plants of commercially grown strawberries of 45 varieties and experimental seedling selections were collected from various parts of the state of Minnesota and indexed for the presence of viruses. Their presence in these plants was demonstrated by the appearance of symptoms in the indicator plant, *Fragaria vesca* L., after they were inarch-grafted. 93% of the plants indexed were virus-infected. Based on symptoms, the viruses have been classified into 14 symptom-types. It was found that mottle and mild yellow-edge were the two dominant viruses, whereas crinkle and vein chlorosis were of rare occurrence. There was no indication that certain symptom-types are associated with particular commercial varieties of strawberries or experimental seedling selections.

INTRODUCTION: Plakidas (6) first reported diseases of strawberries of a virus nature in the United States in 1926. Harris (3) reported the occurrence of a virus disease in England in 1933. Since then many reports on strawberry viruses have been made which have dealt principally with new diseases, methods of transmission and control measures. A comprehensive review of the literature has been made by Plakidas (7).

Investigations on the prevalence of strawberry viruses in commercial varieties grown in 11 eastern states was made by Demaree and Marcus (1). They found all the commercial varieties affected and that nearly all the plants of each variety were contaminated with certain viruses regardless of the states in which the strawberries were grown in the United States. This paper reports the prevalence of viruses in strawberries grown in Minnesota (1951–57).

MATERIALS AND METHODS: In Minnesota commercially grown strawberry varieties which were to be studied were collected by members of the staff or sent to the experiment station by nurseries and growers from 19 counties in Minnesota. In addition, clonal plants were also collected of potential new varieties from the University Fruit Farm of the Minnesota Experiment Station at Excelsior, Minnesota. Approximately 900 plants from 45 varieties and experimental seedling selections (Tables 1 and 2) were collected and indexed to *Fragaria vesca* L., an East Malling clone of the indicator species. When one or more stolons had developed on an indicator plant to the stage where the terminal bud was geniculate, it was grafted to a plant of a selected commercial variety. The inarch-grafting of stolon-to-petiole or stolon-to-stolon was used in all the studies (4, 5). The petiole selected for grafting was the youngest which could be handled with reasonable facility and generally was about the same diameter as the stolon of *F. vesca* (indicator plant).

Symptoms resulting from virus infection in the indicator plants usually began to appear within 4 to 8 weeks after grafting depending on the season of the year. The success of the grafts were determined by severing the grafted petiole or stolon from the test plant 10 to 17 days after the grafts have been made (2).

The development of symptoms in the indicator such as epinasty, chlorosis, stunting and crinkle were recorded and grouped together into classes according to a system developed by Skiles (10) (Table 3).

[1] Paper No. 4860, Minnesota Agricultural Experiment Station, St. Paul, Minnesota.

TABLE 1. The prevalence of viruses in commercially grown varieties of strawberries in Minnesota.[a]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total[b]
Armore				2											2
Arrowhead	2	12	4	11			4		4		2				39
Beaver	2	14	2	10			2								30
Brunes Marvel				4											4
Burgundy		1		4			1					1			7
Catskill				2											2
Dunlap	3	9	5	25	8	2	1					2			55
Evermore		8		10											18
Gem		3	10	4	2										19
Jumbo				2											2
Kellogg Marvel		2		2											4
Minnesota	6	12													18
Montana Progressive						2	2								4
Premier	6	28	2	65	9	2	3		3		4				122
Redrich	2	4	2	18				6	3			1			36
Robinson	2	31	4	21	1				3	4	4	1			71
Sawyer				2											2
Sparkle				4											4
Streamliner			4	2	4	4	6								20
Temple				2	2				9						13
Thomas		2		4											6
Wayzata			1				2			4					7
TOTAL	23	126	34	194	26	10	21	6	22	8	10	5	0	0	485

[a] Based on inarch grafting between plants of commercial varieties and *F. vesca.*
[b] Results of studies made in Minnesota from 1951-1957.

TABLE 2. The prevalence and classes of viruses occurring in Minnesota experimental seedling selections (1954-1957)[a]

Seedling selection	Virus Classes														No. of Virus-free plants	Total no of plants indexed
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
1283			1	10											1	12
1361	1	4		7								1				13
1363				8					1		1					10
1393				4										1	1	6
1395		1	2	11											1	15
1400				5												5
1404	5		2	14												21
1504	2			9												11
1636	1		1	8							2	1			3	16
1643	3	4	1	16			1			1	1		2		5	34
1650	1	4	1	11								2				19
1666				14											3	17
1668				8											1	9
1711	3	2	2	13											4	24
1715				14							1				2	17
1728	1			9											1	11
1731	2	2	4	20					1		1				8	38
1778				5											1	6
1788	1	2		8											4	15
1811				2												2
1839	2			8												10
1844				2											1	3
1864	2			13											2	17
TOTAL	24	19	14	219	0	0	1	0	2	1	6	4	2	1	38	331

[a] The experimental seedlings are potentially new strawberry varieties being developed by the Horticulture Department, University of Minnesota for use by growers. In most cases they are not distributed around the state of Minnesota and have only been grown at the University of Minnesota Fruit Farm located near Excelsior, Minnesota.

TABLE 3. Basic symptoms or symptom-combinations produced in *F. vesca* when grafted to commercial varieties or strawberries grown in Minnesota.[a]

Minnesota virus class number	Symptoms
1	Epinasty
2	Epinasty and mild chlorosis
3	Epinasty and chlorosis
4	Epinasty, chlorosis and dwarfing
5	Epinasty and chlorotic spotting
6	Chlorotic spotting or streaking
7	Epinasty, chlorosis, and necrotic spotting
8	Ring spot, epinasty and mild chlorosis
9	Chlorotic spotting, dwarfing and chlorosis
10	Dwarfing and chlorosis
11	Crinkle
12	Veinal necrosis and chlorosis
13	Witches' broom
14	Leaf curl

[a] Classes 1-10 were recognized by Skiles (10); whereas the additional classes 11-14 or combinations of symptoms have been recognized in this study.

RESULTS: The results presented in Tables 1 and 2 indicate that in commercially grown strawberries in Minnesota as well as in certain experimental seedling selections viruses or virus complexes occur in nearly every plant. All the viruses were masked in the commercial varieties and their presence was demonstrated by the development of symptoms in the indicator plants. In the commercial varieties and seedling selections, 93% of the plants indexed were virus-infected. Epinasty, chlorosis and stunting were the most prevalent symptoms that developed in the indicator host.

It was observed that seasonal environmental changes had an effect on the symptom development. As a rule the yellows-types (chlorosis) develop best during the summer and are less severe when transmitted to the indicator host during the winter, whereas many of the crinkle or mosaic type viruses complexes caused the most severe reactions in the indicator plants during the winter months. Moreover, in some plants the yellows-type reaction seemed to become less severe 4 to 6 weeks after the initial appearance of the symptoms, resulting in only a mild discoloration and abnormality of the leaves and petioles.

It was found that mottle and mild yellow-edge as described by Prentice (8, 9) were the two dominant viruses in Minnesota strawberries, whereas crinkle and vein chlorosis were of rare occurrence (Figures 1 and 2).

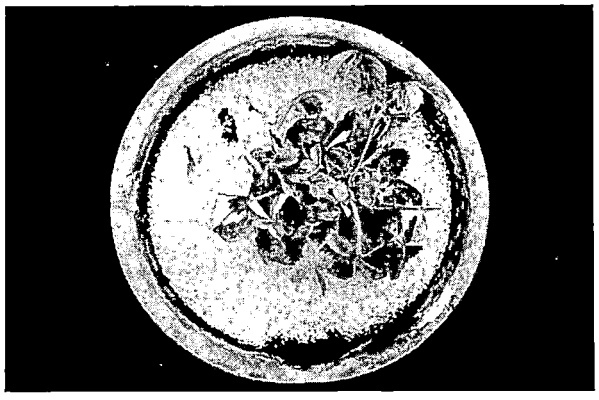

FIGURE 1: Yellows virus of strawberry in the indicator plant, *F. vesca*. Yellows consists of epinasty, leaf distortion, stunting and chlorosis.

FIGURE 2. Crinkle virus of strawberry in the indicator plant, *F. vesca*. Crinkle consists of mottle pattern in the leaf, leaf distortion and vein necrosis.

The results indicate that specific viruses or virus complexes were not associated with any specific commercial variety or seedling selection but are more or less randomly distributed throughout the state of Minnesota in the numerous strawberry varieties. From the complexity of the symptoms that developed in *F. vesca*, it seems probable that there are numerous strains of the strawberry viruses occurring in various combinations that are responsible for the symptoms that developed in *F. vesca*. In the 22 varieties tested, virus free plants were found in only the following: Brilliant, Catskill, Dunlap, Evermore, Gem, Premier (Howard 17), Redrich, Robinson and Wayzata.

The development of resistant varieties and the elimination of viruses from commercial plantings by isolating virus-free stock, and increasing, distributing, and maintaining a source of this stock by a certification plan, appears to be the most practical and feasible method of control.

The development of resistant varieties, after more is known about the strawberry virus complex and its effect on the degeneration of strawberries, is an important goal for the future.

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BOTANY

The Effect of O-Phenylphenol on the Growth of Some Fungi Occurring in Wood[1]

WILLIAM MERRILL and D. W. FRENCH
University of Minnesota, St. Paul

INTRODUCTION: It is often difficult or impossible to obtain cultures of wood rotting fungi from pieces of decayed wood placed on agar media, because other fungi present in the wood grow out rapidly and hide or suppress the fungus or fungi responsible for the decay. *Trichoderma viride* Pers. occurs very commonly in decayed wood, grows rapidly on agar media suitable for the isolation of wood-rotting fungi, and makes the isolation of wood decay fungi difficult. Russell (2) reported that O-phenylphenol added to the culture medium at the rate of 0.06 grams per liter would inhibit the growth of Trichoderma but permit wood rotting fungi to grow, although it did inhibit *Merulius lacrymans* (Wulf.) Fr., a fungus that causes brown rot. Denyer (1) tested 20 species of fungi and found that a medium containing O-phenylphenol had little or no inhibitory effect on fungi that cause white rot and on some of those that cause brown rot, but did inhibit some fungi that cause brown cubical rot.

Isolations by the authors from decayed wood from buildings, using a medium containing O-phenylphenol, and involving white and brown rots, often failed to yield any wood rotting fungi. For this reason it seemed desirable to determine the effect of O-phenylphenol in the medium upon the growth of some of the common fungi known to cause either white rot or brown rot.

MATERIALS AND METHODS: A medium of the following composition was prepared:

malt extract	30 g
peptone	5 g
agar	25 g
O-phenylphenol	0.06 g
water	1 liter

The medium was autoclaved, cooled to 50° C., the O-phenylphenol added, the medium poured into petri dishes and allowed to solidify. Pieces of inoculum approximately 5 mm. square from cultures grown 2 weeks on malt agar were transferred to the dishes, the dishes stored 14 days in diffuse light at 25° C., and notes were taken.

RESULTS: The fungi which grew on the medium containing O-phenylphenol are listed in Table 1; some of these grew more slowly on this medium than on the comparable medium not containing O-phenylphenol. Those fungi which did not grow on this medium are listed in Table 2. Those which grew very slowly on the medium or which grew only on the block of inoculum are listed in Table 3.

DISCUSSION: The O-phenylphenol completely inhibited (Table 2) or greatly suppressed (Table 3) the growth of about as many species of fungi that cause white rot as those that cause brown rot. None of the Ascomycetes or Fungi Imperfecti tested grew on this medium; both *Daldinia concentrica* (Bolt.) Ces. and de Not. and *Chaetomium globosum* Kunze are common Ascomycetes which can cause white rot of wood. The following fungi produced a red halo, as shown in Figure 1, in the agar around the inoculum block or around the growing colony: *Asterostroma cervicolor* (Berk. and Curt.) Massee, one isolate of *Coniophora puteana* (Schum. ex Fr.) Karst., *Coprinus comatus* Fr., *Fomes applanatus* (Pers. ex Wallr.) Gill., *Lenzites saepiaria* (Wulf. ex Fr.) Fr., *Panus rudis* Fr., *Polyporus compactus* Overh., and *Poria subacida* (Peck) Sacc.

CONCLUSION: Ortho-phenylphenol inhibited the growth of both white rotting and brown rotting fungi, and would seem to have limited value as an ingredient of an agar medium used for the isolation of many common fungi that cause decay of wood.

[1] Paper No. 4829, Scientific Journal Series, Minnesota Agricultural Experiment Station, St. Paul, Minnesota.