Reaction of strawberry cultivars to clover phyllody (green petal) agent transmitted by Aphrodes bicincta[1]

L.N. Chiykowski[2] *and D.L. Craig*[3]

Considerable variation was found in the reaction of 9 strawberry ***(Fragaria chiloensis)*** cultivars to the clover phyllody (green petal) agent transmitted by the leafhopper ***Aphrodes bicincta*** under greenhouse conditions. Cultivars Sparkle, Redcoat, and Redchief showed relatively high susceptibility while the Kentville, Nova Scotia, selection K64-462 and the cultivar Vibrant appeared to be relatively resistant. The cultivar Redcoat was more susceptible under controlled conditions than in the field suggesting that disease incidence in the field is dependent on cultiavr preference by the vector as well as on cultivar susceptibility to the causal agent.

Can. Plant Dis. Surv. 55: 66-68. 1975

Neuf cultivars de fraisiers ***Fragaria chiloensis*** ont reagi de façon fort variee a l'agent de la phyllodie du fraisier transmis en serre par la cicadelle ***Aphrodes bicincta.*** Les cultivars Sparkle, Redcoat et Redchief s'y sont révélés assez sensibles alors que les cultivars K64-462 (selectionne a Kentville en Nouvelle-Ecosse) et Vibrant ont semble y être relativement resistants. Le cultivar Redcoat était plus sensible au virus en ambiance contrôlée que dans les champs, ce qui laisse sous-entendre que l'apparition de la maladie dans les champs depend de la preference de vecteur en matière de cultivar ainsi que de la sensibilite du cultivar a l'agent causal.

The clover phyllody agent (CPA) is a mycoplasma-like microorganism (6,7) which causes the clover phyllody and strawberry green petal diseases (1). Observations by Collins and Morgan (4) on the nature and distribution of strawberry green petal disease in New Brunswick led them to conclude that the vector migrated into the strawberry plots primarily from adjoining meadow areas since the greatest infection occurred in the periphery of the plantation. They also suggested the possibility of cultivar resistance to the disease although most commercial cultivars examined in the field were susceptible. Several reports have indicated that cultivars may differ in susceptibility to green petal but all have been based on observations made in field plots in which plants had been exposed to natural infection (2,4,5,8,9). Since no information is available on leafhopper vector populations in the various cultivars, it is not possible to determine to what extent the observed differences in green petal infection are due to actual cultivar susceptibility to the causal agent, to the attractiveness of the cultivar to the insect vectors, or to a combination of both.

The present study was undertaken to determine the reaction of several strawberry cultivars exposed to the clover phyllody agent (CPA) transmitted by the leafhopper ***Aphrodes bicincta*** (Schrank) under controlled conditions.

Materials and methods

The CPA isolate (isolate O) used in the first series of tests was obtained in 1962 from infected strawberry ***(Fragaria chiloensis*** (L.) Duchesne) from Nova Scotia and was subsequently maintained in aster (***Callistephus chinensis*** Nees) and Ladino clover ***(Trifolium repens*** L.). In 1972 a second isolate (isolate P) was obtained from infected strawberry from Prince Edward Island and was maintained in Ladino clover. Source insects for inoculating plants were obtained by caging ***A. bicincta*** nymphs, reared from diapausing eggs (3), on infected clover for 3 weeks and then maintaining them on healthy clover for an additional 3 weeks. Under such conditions, approximately 70% of the leafhoppers became inoculative.

The reaction of the various cultivars to CPA was determined by confining a small group of source insects (3 to 8 per group) on each test plant for 7 days. Each group of insects was then transferred to Ladino clover for 5 days to confirm their inoculativity. Inoculated test plants were held in a greenhouse (21°-26°C) for ***8*** weeks for symptom development. Plants that had not developed symptoms by this time were given a cold treatment (4°-6°C) in an unlighted room for 6 weeks and again returned to the greenhouse. Such treatment stimulates the production of new foliage and flowers in which the disease is often readily expressed.

Nine cultivars were exposed to CPA isolate O in the first series of tests (Table 1) and 8 cultivars were used in a second series of tests in which the two CPA isolates were compared (Table 2). The number of plants of each cultivar used in the tests varied from 1 to 4 depending on the availability of plants and insects. However, whithin each test, the same number of plants was used for each cultivar. Similarly, the number of insects used per plant varied (3 to ***8)*** but within each test all plants received the same number.

[1] ***Contribution no. 859, Chemistry and Biology Research Institute, Agriculture Canada, Ottawa, Ontario K1A 0C6***

[2] ***Chemistry and Biology Research Institute.***

[3] ***Research Station, Agriculture Canada, Kentville, Nova Scotia B4N 1J5***

Table 1. Reaction of strawberry cultivars to clover phyllody agent (isolate O) transmitted by the leafhopper ***Aphrodes bicincta***

	Green petal transmission to:			
	Strawberry		Clover*	
Cultivar	Infected/tested	%	Infected/tested	%
Sparkle	8/22	36	21/22	95
Redcoat	6/22	27	21/22	95
Veestar	6/22	27	19/21	90
Redchief	5/22	23	22/22	100
K65-436**	5/22	23	17/22	77
Bounty	5/22	23	19/22	86
Midway	3/22	14	19/22	86
Vibrant	2/22	9	18/21	86
K64-462**	1/22	5	19/22	86
TOTAL	41/197	21	175/196	89

* Following confinement for 7 days on strawberry, each group of leafhoppers was transferred to Ladino clover for 5 days to test their inoculativity.

** K65-436 - a Kentville selection derived from Acadia X Senga Sengana; K64-462 - derived from Redstar X Senga Sengana.

Table 2. Reaction of strawberry cultivars to two isolates of clover phyllody agent transmitted by the leafhopper ***Aphrodes bicincta***

	Isolate O		Isolate P	
Cultivar	Infected/tested	%	Infected/tested	%
Redchief	8/13	62	3/17	18
Sparkle	3/12	25	7/15	47
Midway	3/12	25	1/15	7
Redcoat	2/12	15	1/17	6
Vibrant	1/12	8	0/16	0
K64-462*	1/12	8	0/15	0
Bounty	1/13	8	3/15	20
Veestar	0/13	0	0/15	0
TOTAL	19/100	19	15/125	12

* K64-462 - a Kentville selection derived from Redstar X Senga Sengana.

Results and discussion

The percentage of strawberry plants that developed symptoms when inoculated with isolate O varied among cultivars and indicated differences in their susceptibility to CPA (Table 1). Sparkle, with 36% of the plants infected, was the most susceptible cultivar while the Kentville selection K64-462, with an infection of 5%, was the most resistant cultivar. The overall level of infection in strawberry (21%), however, was considerably lower than that obtained in clover (77-100%) plants on which the leafhoppers were placed following their confinement on strawberry. The high percentage infection in clover was indicative of the infectivity of the causal agent and of the effectiveness of the insects in transmitting CPA. The relatively low infectivity in strawberry suggested that some degree of resistance to green petal was present in all cultivars tested.

Isolate O had been maintained in clover and aster in the greenhouse for several years without passage through strawberry and this isolate may have undergone a change in its ability to infect strawberry. Therefore, a second series of tests was conducted to compare the reaction of cultivars to isolate O and to isolate P, newly isolated from infected strawberry.

In the second series of tests, the overall percentage of plants that became infected with isolate O (19%) was similar to that of the first test and was greater than that with isolate P (12%), indicating that the infectivity of isolate O toward strawberry had not been attenuated during maintenance in clover and aster (Table 2). Differences in susceptibility to the two isolates of CPA were observed with such cultivars as Redchief, Sparkle, and Bounty but more extensive testing is required to determine whether these differences are due to differential reaction or to experimental variation. A comparison of the performance of isolate O in the two tests indicates the variation that can occur with the same isolate used at different times. The overall percentage of plants infected by isolate O was about the same in both series of tests but the order of susceptibility of the cultivars was different.

Although considerable variation was observed between isolates and tests, certain trends are indicated. Cultivars Sparkle and Redchief consistently appeared high and K64-462 and Vibrant low in the order of susceptibility, and these results correspond to their reaction under field conditions (4). However, the susceptibility of Redcoat was higher than expected from its field performance (3,4) and may suggest that although it is readily susceptible to the causal agent, its attractiveness to insects under field conditions may be less than that of other cultivars, resulting in lower field infection.

Further studies are contemplated to investigate possible effects of plant and insect age on infection of strawberry with CPA in an attempt to explain the variation in cultivar susceptibility between tests.

Literature cited

1. Chiykowski. L.N. 1962. Clover phyllody and strawberry green petal diseases, caused by the same virus in Eastern Canada. Can. J. Bot. 40:1615-1617.
2. Chiykowski, L.N., S.R., Colpitts, L.J. Couiombe, R.W. Delbridge, C.O. Gourley, C.H. Lawrence, R.A. Murray, J. Santerre, and L.S. Thompson. 1973. Strawberry green petal disease in Quebec and the Maritime provinces, 1971-72. Can. Plant Dis. Surv. 53:63-66.
3. Chiykowski, L.N. *Aphrodes bicincta* as a vector of the clover phyllody agent. Ann. Entomol. Soc. Amer. 68:645-648.
4. Collins, W.B.. and G.T. Morgan. 1958. Green petal of strawberry in New Brunswick. Plant Dis. Rep. 42:339-341
5. Gourley, C.O., G.W. Bishop, and D.L. Craig. 1971. Susceptibility of some strawberry cultivars to green petal. Can. Plant Dis. Surv. 51:129-130.
6. Maillet, P.L., J. Gourret, et C. Hamon. 1968. Sur la presence de particules de type mycoplasme dans le liber de plantes atteintes de maladies du type 'jaunisse' (Aster Yellow, Phyllodie du Trefle, Stolbur de la Tomate) et sur la parente ultrastructurale de ces particules avec celles trouvees chez divers insectes homopteres. Compt. Rend. Acad. Sci. 266:2309-2311.
7. Sinha, R.C., and Y.C. Paliwal. 1969. Association, development and growth cycle of mycoplasma-like organisms in plants with clover phyllody. Virology 39:759-767.
8. Thompson. L.S.. and J.A. Cutcliffe. 1972. Incidence of green petal disease in some strawberry cultivars and selections in Prince Edward Island, 1970-71, Can. Plant Dis. Surv. 52:4-5.
9. Willis, C.B. and L.S. Thompson. 1966. Observations on strawberry green petal in Prince Edward Island. Can. Plant Dis. Surv. 46:137.