Responses of Some Solanaceae to Attack by the Gall Mite *Eriophyes cladophthirus*

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ABSTRACT

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A list of host plants was developed for *Eriophyes cladophthirus* by experimentally introducing this mite onto various plant species. *E. cladophthirus* develops only on Solanaceae but is a relatively nonspecific gall former. It provokes the formation of galls on very different genera, such as *Solanum, Petunia,* and *Nicandra.* All the Solanaceae tested sometimes resisted attack by *E. cladophthirus.*

Plant mites cause serious damage to crops, either directly by their feeding or by transmitting virus diseases when they feed (5,8,9,11,12,14,15). Some mites, especially eriophyids, induce galls on plants (2,5–7,16,17). The mite *Eriophyes cladophthirus* Nal. provokes gall formation, with characteristic witches' broom and virescence, in *Solanum dulcamara* (2,16–18), the only known plant host for this parasite.

This study was done to determine the host range of *E. cladophthirus* and to determine whether it harms solanaceous plants of economic or ornamental importance.

MATERIALS AND METHODS

E. cladophthirus (20–50 mites) were taken from virescent fragments of *S. dulcamara* and deposited on the tips of healthy young plants (three or four leaf stage) of the following Solanaceae: *Capsicum annuum, Lycium chinense, Nicandra physaloides, Nicotiana glutinosa, N. tabacum, Petunia hybrida, Physalis alkekengi, S. atropurpureum, S. capsicastrum, S. dulcamara, S. luteum, S. lycopersicum, S. nigrum,* and *S. tuberosum.* Plants of other families also were tested: *Ajuga repens, Anagallis arvensis, Campanula medium, Digitalis purpurea,* and *Trifolium repens.*

Survival times and rates of reproduction of mites on each plant species were established by daily examinations of experimentally infested plants. The experiments were performed in a laboratory at 18–26 C, with 16 hr of light (20,000 lux).

RESULTS

The nonsolanaceous plants did not show any morphologic changes in either vegetative or floral structures. The survival time of the mites was always short, less than 3 days.

Symptoms developed in all of the solanaceous species 5–10 days after artificial infestation with the mites. Symptoms on the leaves, stems, and flowers of each host plant were noted as soon as they appeared. Some insignificant variations in the intensity of the symptoms on different plants of the same species might be explained by the variation in the number of mites that were placed on the young plants.

Symptoms that characterize the gall, induced on *S. dulcamara,* are shown in Fig. 1. After infestation, young plants showed brooming (bud proliferation accompanied by stunted leaves and internode shortening), occasional stem fasciation, and, later, different degrees of floral abnormality (virescence, phyllody, and sterility). The mites induced abnormal pilosity of all parts of the plant during its vegetative and floral development. The parasites bred actively and developed large populations on the young leaves and in the buds, where they provoked differentiation of nutritive tissue on which they fed by punctures, leaving cone-shaped traces in the punctured cells (18).

After becoming infested, tomato plants showed the various stages of gall formation with abnormal vegetative development (Fig. 2B,C) and profoundly disturbed flowering (Fig. 2E), which seriously reduced the production of fruit. The same happened for *S. capsicastrum, S. luteum, Nicandra physaloides,* and *Petunia hybrida.* In the case of *P. hybrida,* the virescences were particularly spectacular (Fig. 2G); considerable reduction and greening of the corolla destroyed the ornamental value. On this species, enations formed frequently on the leaf blades, a foliar symptom that also occurred on tomato and *Nicandra physaloides* but not on *S. dulcamara.*

E. cladophthirus provoked similar but much milder symptoms on *C. annuum* (Fig. 2I), *N. glutinosa* (Fig. 2K), *S. luteum,* and *S. tuberosum.* In these cases, it is difficult to know whether a cecidogenic effect occurred or the malformations resulted simply from a mechanical action of the punctures made by the mite as it fed.

In *L. chinense, N. tabacum,* and *Physalis alkekengi,* certain leaf symptoms appeared, without anomalies of the stems or flowers. After invasion by the mites, *S. atropurpureum* developed small warts that became necrotic spots (Fig. 2L). After fleeting malformation, generally of the leaves, the four plant species resumed normal development within several days. This suggests that the mites produce only a minor traumatizing effect related to their feeding, which rules out any cecidogenic effect on these plant species.

Symptoms on the various Solanaceae after infestation by *E. cladophthirus* are summarized in Table 1. Depending on the host plant, the survival times of the mites (7 days to 3 mo), their rates of reproduction, and the intensity of symptoms they provoked varied greatly. The three factors were closely correlated. If the plant allowed mites to develop well, the symptoms were serious, long lasting, and reminiscent of those on the gall on the normal host plant. In all the Solanaceae spp. tested, fewer plants showed symptoms than were infested, which clearly demonstrates resistance to the attack of *E. cladophthirus.*

DISCUSSION

The observations made during this study indicate the general problem of the degree of specificity of host-parasite relationships, a problem that has been studied in cecidology only in galls induced by nematodes (1,4,13) and by cecidomyids (3,10). Although certain cecidozoans (worms, insects, and mites) develop only on one host species, many provoke gall formation on various species of a single botanical genus.

Experimental infestation with *E. cladophthirus* made it possible to establish that these mites survive and develop only on Solanaceae and that they are relatively nonspecific, since they provoke the formation of characteristic galls on species as different as *Solanum, Nicandra,* and *Petunia.*

Among the plants of economic or ornamental importance, those most affected by infestation with *E. cladophthirus* are tomatoes, peppers, and petunias.

Jeppson et al (5) gave two examples of eriophyids that also have a relatively wide range of host plants: *Abacarus hystrix*

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Table 1. Reaction of various solanaceous plants to infestation with *Eriophyes cladophthirus*

Host plants	Mites		Leaves						Stems			Flower virescence	Plants		
	Survival	Reproduction rate[a]	Abnormal form	Rolled edge	Abnormal pilosity	Wartlike structures	Enations	Necrotic spots	Internode shortening	Axillary bud growth	Fasciation		Infested (no.)	With symptoms (no.)	Without symptoms (no.)
Solanum															
S. atropurpureum	10 days	0	–[b]	–	–	+++	–	+++	–	–	–	–	33	27	6
S. capsicastrum	2 mo	H	+++	+++	+++	+	+	–	++	++	+	+	58	48	10
S. dulcamara[c]	6 mo	H	+++	+++	+++	–	–	–	+++	+++	+	+++	228	77	151
S. luteum	2 mo	H	+++	++	+++	++	+	–	+++	+++	+	++	28	20	8
S. lycopersicum	3 mo	H	+++	++	++	++	++	–	++	+++	+++	++	25	22	3
S. nigrum	11 days	L	+	+	+	+	–	–	+	+	+	+	52	11	41
S. tuberosum	1 mo	L	+	+	+	+	–	–	+	+	–	–	16	5	11
Capsicum annuum	15 days	L	+	–	–	++	+	–	+	++	+++	++	17	13	4
Lycium chinense	7 days	0	+	–	–	+	–	–	–	–	–	–	17	2	15
Nicandra physaloides	3 mo	H	++	++	–	++	++	–	+++	+++	+++	+	46	25	21
Nicotiana															
N. glutinosa	12 days	L	+	+	+	++	–	–	+	+	–	+	62	14	48
N. tabacum	10 days	0	–	–	–	+	–	–	–	–	–	–	22	2	20
Petunia hybrida	2 mo	H	++	++	+	++	+++	–	++	++	–	++	5	4	1
Physalis alkekengi	7 days	0	+	+	+	+	–	–	–	–	–	–	6	1	5

[a] H = high, L = low, 0 = absent.
[b] – = No visible symptoms.
[c] [illegible]

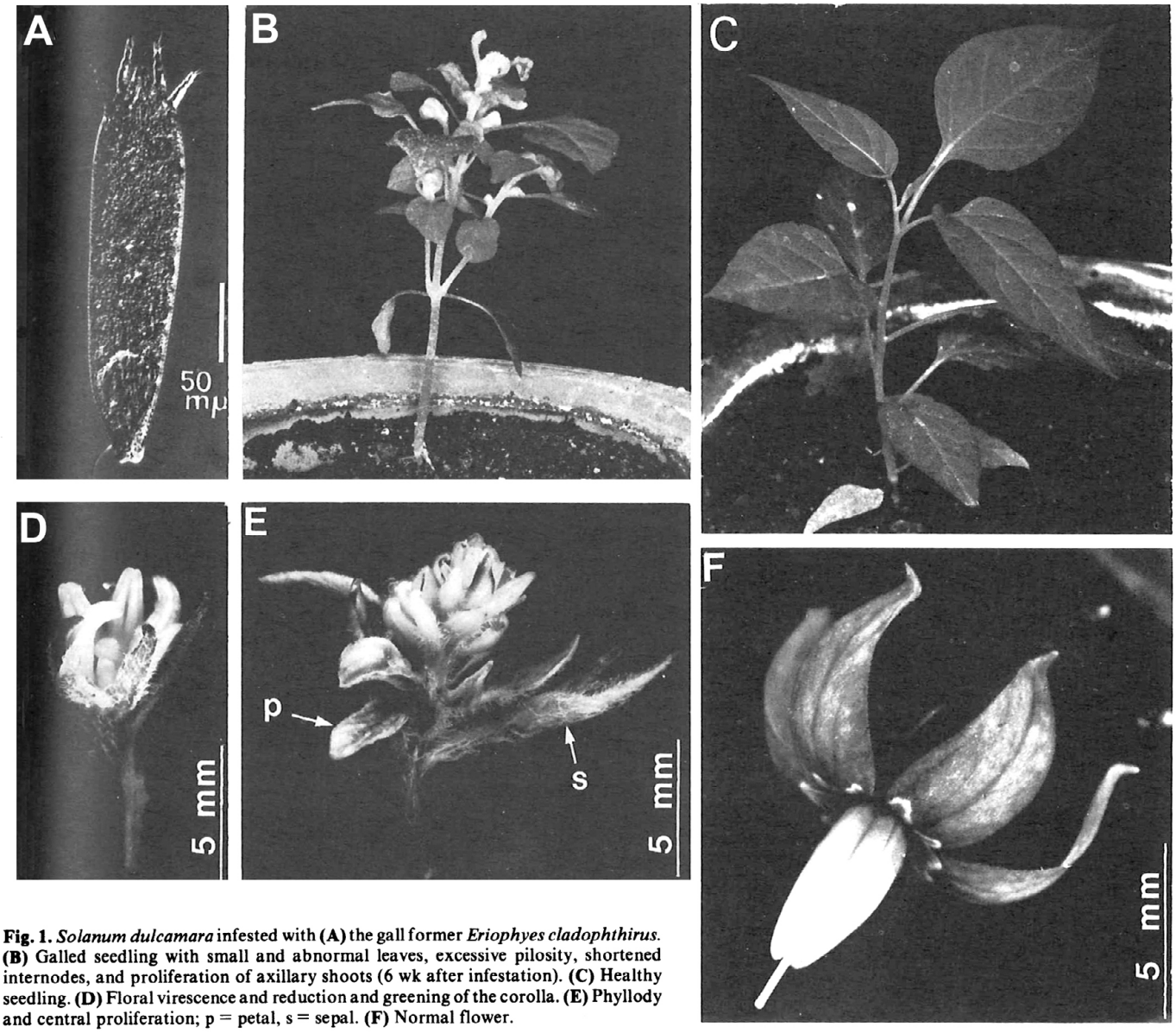
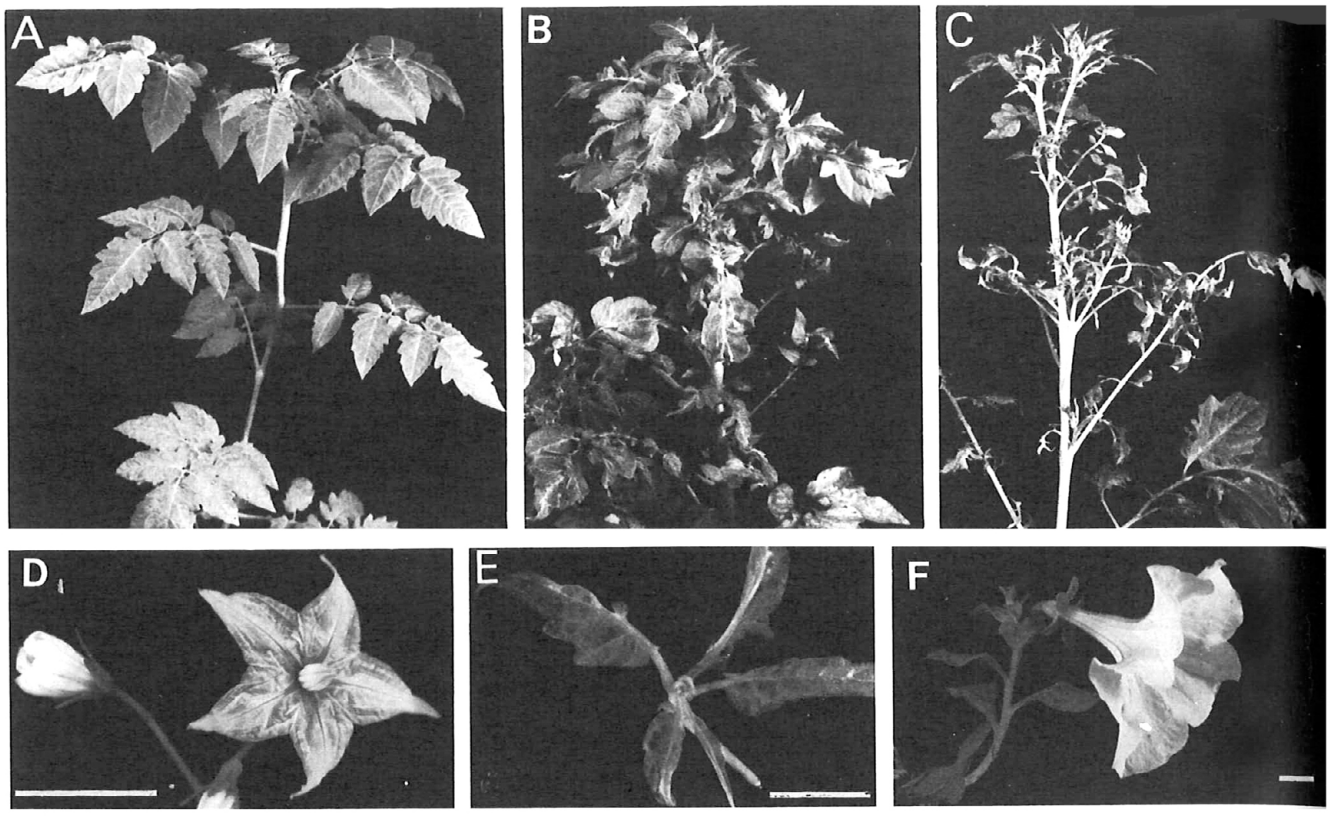


Fig. 1. *Solanum dulcamara* infested with **(A)** the gall former *Eriophyes cladophthirus*. **(B)** Galled seedling with small and abnormal leaves, excessive pilosity, shortened internodes, and proliferation of axillary shoots (6 wk after infestation). **(C)** Healthy seedling. **(D)** Floral virescence and reduction and greening of the corolla. **(E)** Phyllody and central proliferation; p = petal, s = sepal. **(F)** Normal flower.



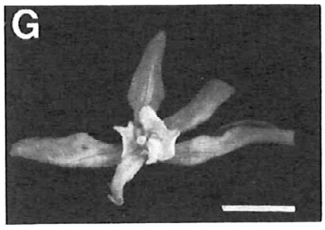
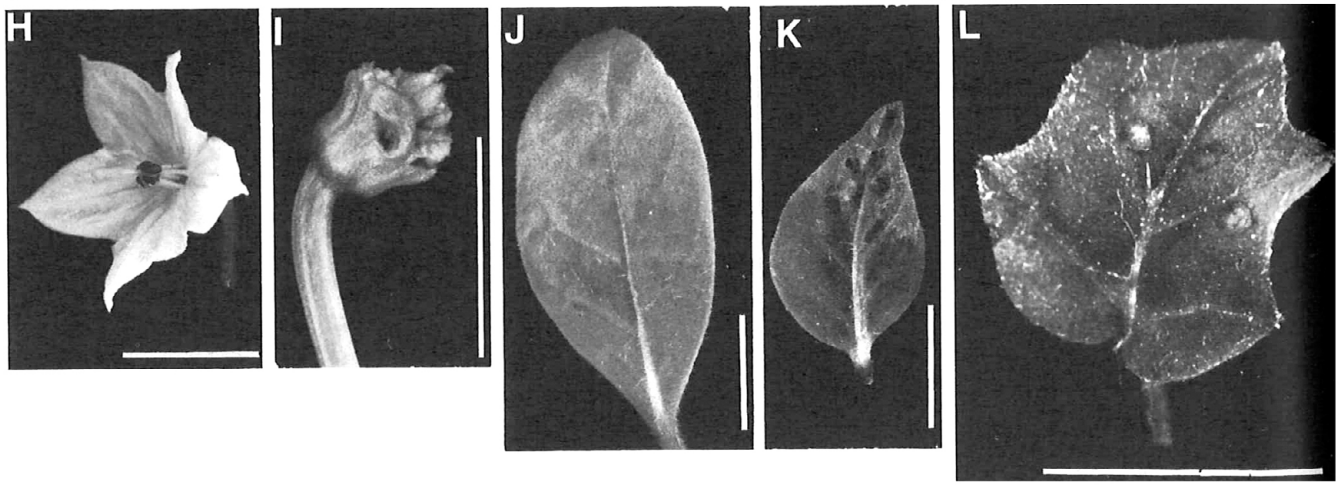


Fig. 2. Symptoms induced by *Eriophyes cladophthirus*. **(A–E)** *Solanum lycopersicum*: **(A)** Healthy plant. **(B and C)** Plants with witches' broom and leaf abnormalities (2 mo after infestation). **(D)** Normal flower. **(E)** Prominent virescence with enlargement and phyllody of sepals, sterility of the flower. **(F)** Normal *Petunia hybrida* and **(G)** virescence, enlargement of sepals, and reduction and greening of corolla (6 wk after infestation). **(H)** Normal *Capsicum annuum* and **(I)** virescent flower with fasciated peduncle, enlargement of calyx, and proliferation of small green floral pieces (2 mo after infestation). **(J)** Normal leaf and **(K)** distorted leaf of *Nicotiana glutinosa* (1 mo after infestation). **(L)** Necrotic spots on leaf of *Solanum atropurpureum* (15 days after infestation). (Scale bars represent 1 cm.)



Nal. develops on many Gramineae (*Bromus, Festuca, Poa,* etc.), and *Eriophyes tulipae* K. develops even on plants of different families (Gramineae and Liliaceae). Nevertheless, in these two instances, it seems difficult to determine whether the anomalies in the plant's development result solely from the effect of the mites' feeding or from the combined effects of feeding and viral infection, since these mites are both virus vectors (ryegrass mosaic virus for *A. hystrix* and wheat streak mosaic virus for *E. tulipae*). In the Solanaceae, the hypothesis that *E. cladophthirus* could also be the vector of a pathogenic agent (such as a virus) can be completely ruled out, since we previously showed (19) that plants of *S. dulcamara* bearing galls are permanently cured by treatment with an acaricide and resume normal growth.

Individuals of each species of host plant studied resisted attack by *E. cladophthirus*. We are now studying this resistance phenomenon in *S. dulcamara*.

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