# Technical Papers

## An Unusual Type of Protection with the Carnation Mosaic Virus[1]

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The demonstrable presence of a virus in a plant is currently regarded as a prerequisite for the protection of that plant against subsequent infection by the same virus or one of its strains. Evidence is presented here that an unusual form of protection may occur with carnation mosaic virus in at least one host.

The virus used in these studies was isolated from a variety of carnation growing in a local greenhouse. Transmission of the virus was effected in all cases by dusting carborundum on the leaves and then rubbing with infective juice.

Brierley and Smith (*1*) have reported that *Dianthus barbatus* is a satisfactory indicator plant for carnation mosaic virus. The senior author has propagated two seedling clones of this species (Nos. 20 and 26) that reacted to inoculation with this virus by the development of primary local lesions only. On the other hand, in a third seedling clone (No. 21), only systemic mosaic symptoms developed after inoculation.

Indications of this type of protection were first observed in leaves that had been detached from two plants, A and B, of Clone 20. Plant A was healthy; Plant B bore local lesions only on those leaves that had been previously inoculated with the virus. Leaves of Plant A, and apparently healthy leaves of Plant B, were detached, inoculated, and then floated on water in Petri dishes. As shown in Table 1, abundant lesions developed on the leaves from Plant A, but no lesions, except one, developed on the leaves of Plant B. Protection in the latter leaves appeared to be virtually complete.

To obtain further evidence of this protection, leaves on 3 healthy plants of each of Clones 20 and 26 were inoculated with the carnation mosaic virus. At the same time, apparently normal leaves on 3 previously inoculated plants of each clone were treated in the same way. As shown in Table 2 there was a highly significant decrease in the number of lesions that developed on the leaves of previously inoculated plants of Clone 20, as compared with the number developing on the leaves of the corresponding healthy plants of the same clone. Similarly, almost complete protection occurred in the previously inoculated plants of Clone 26.

According to the generally accepted hypothesis, these protected plants of Clones 20 and 26 should be systemically infected, although they remained systemically symptomless. In an attempt to test this hypothesis, 7 plants were selected that had previously been inoculated; protection had been demonstrated in 5 of these and could be presumed operative in the other 2. Juice transfers were made from apparently healthy leaves of these plants to 22 healthy plants—12 of Clone 20, 6 of Clone 26, and 4 of the more susceptible Clone 21. No symptoms appeared on any of the plants thus inoculated—i.e., the virus was not recovered from the apparently healthy leaves of the 7 plants. On the other hand, juice transfers from primary local lesions on the same 7 plants to healthy plants of Clones 20 and 26 readily induced symptoms on them—i.e., the virus was recovered without difficulty from the local primary lesions.

As far as the authors are aware, the form of protection described here is unique. The hypothesis suggested, and perhaps generally accepted, to explain the phenomenon of protection in plants requires that "protection extends only to cells that are actually infected . . ." (*2*). According to this view, a requisite of protection is the presence of the virus in the protected cells. Since no virus was recovered from the

TABLE 1

PRODUCTION OF LESIONS BY CARNATION MOSAIC VIRUS ON LEAVES DETACHED FROM HEALTHY AND FROM PREVIOUSLY INOCULATED PLANTS OF *D. barbatus*, CLONE 20

| No. of lesions/leaf | |
|---|---|
| From previously inoculated plant | From healthy plant |
| 1 | 49 |
| 0 | 35 |
| 0 | 17 |
| 0 | 27 |
| 0 | 16 |
| 0 | 46 |
| 0 | 57 |
| 0 | 76 |

TABLE 2

PRODUCTION OF LESIONS BY CARNATION MOSAIC VIRUS ON LEAVES ON HEALTHY AND PREVIOUSLY INOCULATED PLANTS OF *D. barbatus*

| Test plants | | Mean number of lesions/leaf/plant | | | |
|---|---|---|---|---|---|
| | | Plant 1 | Plant 2 | Plant 3 | Mean |
| Clone 20 | Healthy | 25.4 | 14.2 | 28.0 | 22.5 |
| " " | Previously inoculated | 4.5 | 2.4 | 7.6 | 4.8 |
| Clone 26 | Healthy | 28.8 | 26.5 | 31.3 | 28.9 |
| " " | Previously inoculated | 0 | 0.8 | 0.8 | 0.5 |

For differences, $P < .001$ ("$t$" test)

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protected leaves, there is in the experiments described above no evidence that such a condition obtains.

In order to fulfil the requirements of the accepted hypothesis, it is necessary to postulate that sufficient virus is present to afford protection to the apparently healthy leaves, but insufficient for transmission by the technique employed. The probability of such a condition occurring is minimized by the finding of other workers (*3*) that the dilution end point of this virus lies beyond $10^{-5}$. However, from the known data, it is difficult at the present stage of the investigation to suggest any plausible alternative explanation for the phenomena described.

### References


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## An Interspecific Cross Involving the Lima Bean *Phaseolus lunatus* L.[1]


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The presentation of this brief account of preliminary success in the crossing of the Lima bean *Phaseolus lunatus* L. with the native wild thicket bean *P. polystachyus* (L.) B. S. P. may provide bean breeders with an incentive to investigate further the possible contributions of this native source of germ plasm to any Lima-bean breeding program.

The cross *P. polystachyus* ♀ × *P. lunatus* ♂ was attempted an estimated 50 times with no success, but an estimated 100 attempts to effect the reciprocal cross resulted in the production of seven $F_1$ plants for which there is objective evidence that these are bona fide hybrids, although none of the plants has yet matured to the point of flower and seed production.

All the hybrids expressed completely or nearly completely the hypogaeal germination habit of the staminate, *P. polystachyus* parent. In two out of the seven a tendency toward the epigaeal habit of the pistillate parent was expressed by the slight elevation of the cotyledons to a level barely above the surface of the soil. With deeper planting this might even have escaped observation. In a Lima control the cotyledons were elevated to a height of 3 in. (Fig. 1).

One of the hybrids has as its pistillate parent a Lima selection resembling the commercial variety Fordhook. The Lima parent of the other six $F_1$ hybrids is itself an $F_1$ hybrid from a cross between a Fordhook-type selection and line M-270 from O. W. Norvell. M-270 is a small-seeded, colored-flowered, short-day, wild, viny type with a strong perennial tendency.

[1] Florida Agricultural Experiment Station Journal Series, No. 55.

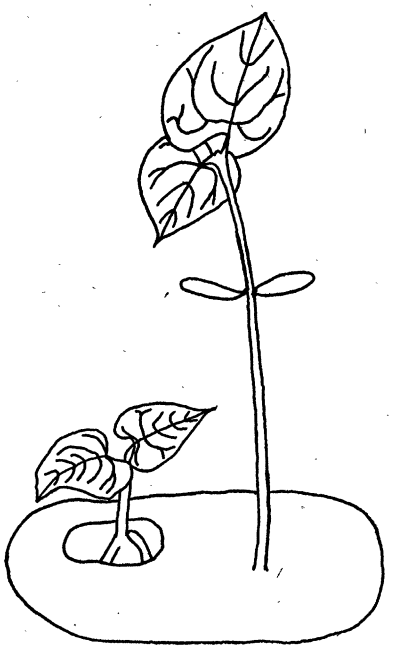

FIG. 1. Emergence behavior of *P. lunatus* × *P. polystachyus* $F_1$ hybrid (left) compared to that of *P. lunatus*. Soil removed to show hypogaeal position of the cotyledons of the hybrid. (Line drawings traced from a photographic negative.)

The principal objective of the *P. lunatus* × *P. polystachyus* cross has been to incorporate into the former species the hypogaeal germination habit of the latter in an attempt to solve the emergence problem in Limas, where a high mortality among seedlings is likely to result from the breaking of the hypocotyl ("neck-breaking") as it elongates in an often unsuccessful effort to push the extremely large Lima cotyledons through an encrusted or impacted soil. In *P. polystachyus* and several other bean species elongation of the stem of the plant involves only the development of the epicotyl and the plumule, and the cotyledons remain at planting depth because of the absence of elongation of the hypocotyl.

Apart from consideration of this one obviously valuable germination character is the possibility that a native species, such as *P. polystachyus,* having a comparatively wide geographic distribution, may possess yet unrecognized resistances to diseases and pests and may also possess physiological attributes of survival value. According to Small (*1*), *P. polystachyus* ranges from Florida as far north as Minnesota, Ontario, and Maine and as far west as Texas and Nebraska, so it seems apparent that the perennial rootstock at least has some degree of cold-hardiness even though the plant usually occurs in protected locations.

In view of the consideration that *P. polystachyus* may be a valuable source of germ plasm to bean breeders, that the realization that such a cross is possible may be of interest to taxonomists, and that