

Letters to the Editor.

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Composite Nature of Certain Potato Viruses of the Mosaic Group.

IN 1928 some experiments on the transmission of a potato mosaic virus to tobacco revealed the curious fact that needle and aphid (*Myzus persicae*) inoculation respectively, from the same mosaic-affected potato plant, produced in tobacco symptoms characteristic of the method of infection.¹ The disease produced by the needle has since been shown to be a complex, the constituent viruses of which, for the sake of clarity, will be referred to as *x* and *y*, where *x* represents the virus which forms in tobacco double concentric rings with a central spot, hereinafter referred to as 'ring-spot', and *y* represents the aphid-borne virus, the symptoms of which take the form of a darkening of the green colour of the tissues along the veins.

This phenomenon has formed the basis of further studies carried on since that time, and the following facts which have been elucidated seem worthy of record. By the development of a technique of virus isolation from a complex within the living plant, much evidence has been accumulated that certain potato viruses of the mosaic group are not single entities but are composite in character. This is true of the following, among others—a mosaic from Arran Victory potato, a crinkle from Myatt's Ashleaf, a streak carried without symptoms by Up-to-date, and a streak also carried by Di Vernon. All these diseases have been separated into their constituent viruses by means of the technique which will now be briefly outlined.

The methods of virus isolation used in these studies fall into three groups, and separation was effected in the following ways:

(1) By utilising a selective relationship which exists between the aphid vector *Myzus persicae* and the tobacco plant.

(2) By the use of what may be called 'filter' plants. A comparative study of the host range of the single virus (*y*), isolated by means of the insect and of the virus complex (*x* + *y*), revealed the fact that there were several plants which were susceptible to the ring-spot virus (*x*) but were resistant to the aphid-transmitted virus (*y*). This fact suggested the possibility of using certain of these plants as filters, and experiment has shown that passage of the whole complex (*x* + *y*) through such plants removes the aphid-carried virus (*y*). That the virus *y* is actually removed by this process is shown by the analysis and synthesis of the complex frequently carried out, and by the fact that the aphid cannot pick up the virus *y* from a ring-spot resulting from passage of the complex through one of these filter plants.

It should perhaps be pointed out that successful filtration by means of these plants is dependent upon the needle-scratch method of infection; grafting transmits the whole complex. Examples of plants susceptible to the virus *y* isolated by means of the aphid are *Hyoscyamus* sp., tomato, and *Solanum nigrum*; and of the 'filter' plants resistant to this virus, *Datura stramonium* and *Solanum dulcamara* among others. All are susceptible to the ring-spot virus *x*.

(3) By taking advantage of the unequal rates of movement of the constituent viruses within the plant host: (a) At the moment of development of primary

symptoms in the young plant inoculated with the virus complex. (b) In the ageing plant.

By means of this technique it has been possible to analyse in the tobacco plant the virus complexes into their constituent viruses and then to synthesise them. Thus, needle inoculation to tobacco from a streak-carrying Up-to-date potato produced a virulent disease characterised by gross lesions and severe necrosis of the veins with no sign of rings, while aphid transmission from the same plant produced in tobacco the disease *y*, with the characteristic darkening of the green colour of the tissues along the veins. On passage of the necrotic complex through one of the filter plants referred to, back to tobacco again, the disease took on a ring-spot form with numbers of clearly defined double concentric rings, each with a central spot; there was no general necrosis. The primary symptoms of this disease take the form of double rings upon the inoculated leaf. Now, to a number of tobacco plants showing this ring-spot was added the virus *y*, which had been isolated from the complex by means of the aphid. After the usual incubation period the primary symptoms peculiar to the aphid-transmitted virus (*y*) appeared; following rapidly upon this, the rings lost their regular outline, became filled up and degenerated into irregular necrotic lesions, while a severe necrosis of the veins developed. In a short time the symptom picture was identical in every respect with that of the necrotic disease before the separation had been effected. Further passage through the filter plants again produced the ring-spot disease, while the addition to this of the aphid-carried virus (*y*) once more restored the virulent necrotic picture.

While the majority of the diseases studied are shown by these methods to contain two constituent viruses, there is evidence of a third constituent occurring, notably in a streak and a crinkle. There are also certain cases where only one virus can be isolated, at all events by the present technique, and here it is reasonable to suppose that the disease is a single entity.

As regards the question of the non-transmission by the aphid, of the ring-spot disease produced in tobacco by needle inoculation with these potato viruses, the obvious explanation is that the aphid is the selective agent and picks up one constituent only of the complex. There is, however, some evidence which suggests that this is not the correct explanation, but that the tobacco plant itself plays a part as the selective factor. It is hoped to settle this question during the coming season.

Finally, to avoid confusion, it is necessary to state that the ring-spot diseases referred to here are quite distinct from one or more ring-spot diseases which affect the tobacco plant in Nature.² There appears to be no record of the experimental ring-spots and necrotic diseases, here dealt with, affecting tobacco in Nature, a fact probably connected with the selective relationship existing between aphid vector and tobacco plant.

It is of interest to record that Valteau and Johnson, in a paper recently received,³ have also suggested the possibility that *Datura stramonium*, one of the 'filter' plants used in these studies, is resistant to a disease in tobacco called 'veinbanding' by Valteau. This veinbanding occurs naturally in the tobacco fields of Kentucky and is presumably identical with the aphid-borne virus (*y*) originating in potatoes.

It is evident that future work upon these potato virus diseases must take cognisance of their composite nature.

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¹ *Ann. Appl. Biol.*, 16, Nos. 1, 3.

² Smith, *Ann. Appl. Biol.*, 18, No. 1; Wingard, *Jour. Agric. Res.*, 37, No. 3.

³ *Kentucky Agric. Exp. Stat. Bull.*, 309.