The Libyan Journal of Agriculture: volume 3, 1974

Movement of Exocortis Virus in Citrus Plants

ABD EL-SHAFY A. FUDL-ALLAH[1]

ABSTRACT

The exocortis virus failed to move up or down across any girdle within nine months after inoculation. Any amount of bark bridging permitted the exocortis virus to cross. Plants inoculated with the inner bark portions showed symptoms two months after inoculation while plants inoculated with the outer bark portions showed symptoms, if any, ten months after inoculation. Results indicate that exocortis virus moves through the bark and is mainly phloem limited.

INTRODUCTION

Few studies have been reported on the distribution and movement of viruses affecting citrus plants (5,7,8,9). Salibe (11) reported that exocortis virus moved from the inoculating bud into a Rangpur lime, *Citrus limonia* Osbeck, seedling in 5 to 13 days, but it required 20 days to pass from the inoculating bud and move 30 cm downward through a Valencia shoot into the Rangpur lime rootstock.

The objective of the present study was to determine if exocortis virus would pass a zone from which a bark ring had been removed.

MATERIALS AND METHODS

I. Field Experiment

Five symptomless 3-year-old trees of Rangpur lime on trifoliate orange, *Poncirus trifoliata* Raf., rootstocks were selected from field plantings. Indexing showed that they were free from known citrus virus including the exocortis virus (4). Four of the trees were used in girdling experiment and one was left ungirdled as a control. Twelve branches were chosen on each test tree and on each a bark ring was removed to expose the woody cylinder. Bark of three different widthes were removed from each tree. Bark bands 1/4 inch wide were removed from four branches; four branches had bands 1/8 inch wide exposed; and the remaining four branches had bands 1/16 inch wide exposed.

[1] *Abd El-Shafy A. Fudl-Allah, Department of Plant Production, Faculty of Agriculture, University of Tripoli, Tripoli, Libyan Arab Republic. Research was done at the Department of Plant Pathology, University of California, Riverside, CA, U.S.A.*

Arizona 861 'Etrog' citron, *Citrus medica* L., plants with a severe strain of exocortis virus served as inoculum source. In two trees infected citron buds were grafted into each branch above the exposed bands while in the other two trees inocula were grafted below the girdles.

The exposed areas were checked 4 times weekly to remove callus and scrape the exposed woody cylinder with a knife to prevent development of any bridge of bark across the exposed zone.

Nine months after inoculation, plants in the field were indexed to determine whether or not the exocortis virus had crossed the exposed band. Bark patches, each with an area of 1 cm^2, taken from above or below the girdled zone and within one inch from the center of the girdle, were used as inocula. Each bark patch was grafted to a healthy 3-month citron on rough lemon, *Citrus jambhiri* Lushington, budling. Tops were pruned to favor growth of the test buds and each plant was pruned to a single citron shoot. Citron shoots were observed daily to detect any external symptoms of exocortis disease (4).

II. Greenhouse Experiments

Experiment No. 1 A technique similar to that used in the field was carried out in the greenhouse. Rough lemon seedlings 3-month-old were substituted for Rangpur lime trees. Seedlings with incomplete rings of bark removed were also used. With these trees the exocortis virus-infected buds were grafted below or above the exposed band. Each treatment was replicated fifteen times. Plants were kept at 25–30 C.

Plants were indexed nine months later by the bark patch technique previously described.

Experiment No. 2 Inocula, as bark patches 1 × 1 cm, were obtained from citron plants infected with a severe strain of exocortis virus. Each patch was divided into two halves using clean and sterile (9) razor blades under a stereoscope. One half contained the epidermis and most of the cortex and the other half contained phloem and a little portion of the cortex. Each half of every bark patch was grafted to a healthy 3-month citron on rough lemon budling. Tops were pruned to favor growth of the test buds and every plant was pruned to a single citron shoot. Each treatment was replicated ten times. Plants were kept at 25–30 C.

RESULTS AND DISCUSSION

Exocortis virus did not appear to cross any girdle since no symptoms developed on the citron shoots of indicator plants grafted with bark obtained across a girdle from the inoculum. Exposed bands of 1/4, 1/8, or 1/16 inch wide were equally effective as barriers to both downward and upward movement of exocortis virus. Citron shoots inoculated with bark patches obtained from any area of ungirdled Rangpur lime tree showed exocortis symptoms (Field experiment).

Exocortis virus failed to cross the complete girdled plants regardless of whether the inoculum was grafted above or below the girdle. Exocortis virus moved upward and downward in incompletely girdled trees in rate similar to controls. The results with exocortis virus are similar to those of Bennett (1,2,3) with the curl virus of raspberries. Curl virus of raspberries can be confined to the inoculated shoot for an indefinite period by the simple process of 'ringing', whereas the virus moved through unringed shoots into the roots and to newly developing shoots. He also found that in tobacco tree, *Nicotiana glauca* Graham, plants ringed to break phloem-continuity, the mosaic virus failed to pass in periods up to 250 days. Also Nour-Eldin and El-Banna (9) reported that tristeza virus failed to cross a zone from which a ring of bark was removed.

Citron shoots showed exocortis disease symptoms two months after inoculation whenever inoculated with bark pieces that contained phloem tissue while plants grafted with bark pieces that contained most of the cortex and epidermis showed symptoms about 9 months or more after inoculation. This indicates that exocortis virus might be present mainly in phloem tissue.

The results showed that exocortis virus would not cross completely girdled zones but that a relatively small amount of bark bridging was sufficient to permit the passage of the exocortis virus. These results indicate that the exocortis virus appears to move only through the bark within the phloem, rays, or in the cortical tissue. The inconsistent results from some kinds of mechanical inoculation and the rather high and consistent rate of infection with inoculation via a contaminated knife (6), and with cut stems in the case of petunia, *Petunia* spp., (12) also suggests that exocortis virus is mainly phloem limited.

LITERATURE CITED

1. Bennett, C. W. 1927. Virus diseases of raspberries. Mich. Agr. Exp. Sta. Tech. Bull. 80.
2. Bennett, C. W. 1937. Correlation between movement of the curly top virus and translocation of food in tobacco and sugar beet. J. Agr. Res. 54:479–502.
3. Bennett, C. W. 1939. Movement of the virus of tobacco mosaic. Phytopathology 29:1–2.
4. Calavan, E. C., E. F. Frolich, J. B. Carpenter, C. N. Roistacher, and D. W. Christiansen. 1964. Rapid indexing for exocortis of citrus. Phytopathology 54:1359–1362.
5. Costa, A. S., T. J. Grant, and S. Moreira. 1949. Investigacoes sobre a tristeza dos citrus. Bragantia 9:59–80.
6. Garnsey, S. M. and J. W. Jones. 1967. Mechanical transmission of exocortis virus with contaminated budding tools. Plant Dis. Reptr. 51:410–413.
7. Knorr, L. C. 1956. Suscepts, indicators, and filters of tristeza in Argentina and in Florida. Phytopathology 46:557–560.
8. McClean, A. P. D. 1961. Transmission of tristeza virus to *Aeglopsis chevalieri* and *Afraegle paniculata*. S. African J. Agr. Sci. 4:83–94.
9. Nour-Eldin, F. and M. T. El-Banna. 1965. Distribution and movement of psorosis and tristeza viruses in citrus plants, p. 272–275. *In* W. C. Price (ed.), Proc. 3rd Conf. Intern. Organization Citrus Virol. Univ. Florida Press, Gainesville.
10. Roistacher, C. N., E. C. Calavan, and R. L. Blue. 1969. Citrus exocortis virus — chemical inactivation on tools, tolerance to heat and separation of isolates. Plant Dis. Reptr. 53:333–336.
11. Salibe, A. A. 1965. Distribution and movement of exocortis virus in citrus trees, p. 276–279. *In* W. C. Price (ed.), Proc. 3rd Conf. Intern. Organization Citrus Virol. Univ. Florida Press, Gainesville.
12. Weathers, L. G. 1965. Petunia, an herbaceous host of exocortis virus of citrus. Phytopathology 55:1081.