STUDIES ON SOME POTYVIRUSES WITH SPECIAL REFERENCE TO THOSE INFECTING LEGUMES IN AUSTRALIA

by

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SUMMARY

Some legume-infecting potyviruses including bean yellow mosaic virus (BYMV), pea mosaic virus (PMV), a PMV variant isolated from sweet pea and referred to as sweet pea mosaic virus (SPMV), lettuce mosaic virus (LMV), bean common mosaic virus (BCMV), passionfruit woodiness virus (PWV) and peanut mottle virus (PMoV) were studied and compared with potato virus Y (PVY) and sugarcane mosaic virus (SCMV) which do not usually infect legume species. Purification of these viruses by the methods described in the literature were considered unsatisfactory because of high losses of virus and inadequate removal of contaminating materials. However, by modifying these methods satisfactory purification of 12 potyvirus isolates was achieved. These methods were used to routinely purify nine of these isolates in sufficient quantities and purity, and without significant aggregation and fragmentation of the virus particles, for serological, physical and chemical studies.

Purified BYMV, PMV, SPMV, LMV, BCMV, PWV, PVY and SCMV were used to prepare high titered antisera free of detectable amounts of antibodies to host antigens. The antisera were used to study serological relationship of the viruses by immunodiffusion tests. Antisera to PMoV and soybean mosaic virus (SBMV) which were obtained from other sources were also used. BYMV, PMV and SPMV were shown to be antigenically very closely related and should be considered as strains of a single virus. LMV was also shown to be relatively closely related to these viruses. Distant serological relationships were demonstrated between BYMV and BCMV, BCMV

and PWV, and PWV and PVY. Anti-SBMV serum reacted with BYMV, PMV, SPMV, LMV and PWV antigens. These results suggest that there is a continuous range of interrelationships among the potyviruses. Coat protein preparations from potyviruses were found to be poorly immunogenic, and hence attempts to compare relationships of these viruses using such antigens were frustrated.

Host ranges and symptomatology of the potyviruses studied indicate that the viruses can be readily differentiated. Cytological studies using electron microscopy indicate that these potyviruses can be divided into two subgroups depending on the type of inclusions they induce; one with relaxed pinwheels and large laminated aggregates which were observed in cells infected by BYMV, PMV, SPMV and LMV, and the other with tight and curved pinwheels induced by BCMV, PWV, PMoV, PVY and SCMV. In cells infected by the latter viruses no laminated aggregates were observed.

Mean particle length of PMV was 790 nm, that of SPMV was 840 nm and that of the other viruses studied was between 735 and 750 nm. However, changes could be induced in the particle morphology by Mg^{++} and Ca^{++} and by EDTA. The particle length of BYMV, PMV, SPMV and LMV was found to be independent of the host from which they were extracted and the age of the infection.

Sedimentation rates and buoyant densities of BYMV, PMV, SPMV and LMV were indistinguishable. Protein and RNA of the potyviruses studied was dissociated with LiCl. Data from polyacrylamide gel electrophoretic and amino acid analyses indicate that the protein subunits of the potyviruses have a molecular weight of about 33,000 daltons with 285-292

amino acid residues. However, the viral coat proteins were prone to partial degradation which raises problems in the interpretation of amino acid composition and serological data. RNA isolated from purified PMV was infectious, had an S value of approximately 38 and a calculated molecular weight of about 3.2×10^6 daltons. Nucleic acid isolated from PWV was identified as single stranded RNA.

Results presented in this thesis are used as a basis for suggesting future approaches in classifying potyviruses. Particle morphology is useful to distinguish potyviruses from viruses of other groups, but small differences in mean lengths appear to be of no significance for sub-grouping the potyviruses. Physical and chemical properties of the potyviruses appear to lack sufficient variation to be useful in subdividing these viruses within the group. Amino acid composition, serological studies and examination of cell inclusions induced by virus infection may be useful approaches for dividing the potyviruses into subgroups. It would appear that host reactions may be useful as a basis for differentiating and distinguishing potyviruses into strains.