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SUPERFICIAL NECROSIS CAUSED BY VIRUS (PTNRD)

Submitted by France, the Netherlands and the United Kingdom

Note by the secretariat: This paper outlines the occurrence and biology of the virus PVY^{NTN} and examines possible constraints in applying potential quality measures within the context of the UNECE standard.

PVY^{NTN}, the present status.

A strain of potato virus Y (PVY^{NTN}) may cause necrotic symptoms on potato tubers. These symptoms make tubers unattractive for sale in the pre-pack market. On tubers for processing, peeling losses may be increased significantly because additional peel has to be removed to achieve an acceptable product and this is impractical in an industrial process. However, as the symptoms are superficial, diseased tubers can be seen and removed at sorting to make a crop acceptable for its end use. There will be a practical and economic limit to the amount of tubers which can be discarded. Effective measures to keep this virus at low levels in potato crops are therefore required. This paper outlines the occurrence and biology of this virus and examines possible constraints in applying potential quality measures within the context of the UNECE standard.

Introduction: potato virus Y (PVY)

Potato virus Y belongs to the largest plant virus family, *Potyviridae*. All strains are transmitted non-persistently by aphids. The 3 most common strains infecting potatoes are differentiated according to their reaction on potato and tobacco.

PVY^O (ordinary or common strain), known since 1931, is found wherever potatoes are grown. Isolates of this strain cause mild to severe mosaic, leaf drop, and leaf and stem necrosis in susceptible cultivars.

PVY^C (stipple streak strain), produces hypersensitive reactions or a systemic mosaic in potato and PVY^O-like symptoms in tobacco.

PVY^N (**tobacco veinal necrosis**), appeared during the 1950s in European and South American countries. Infection by this strain may be symptomless or produce mosaic symptoms, both mild and severe. In tobacco, the virus produces severe veinal necrosis and leaf death. The strain is now present worldwide. It was responsible for severe potato crop epidemics in the 1950s and 1970s in many countries in Europe. Recent outbreaks have been reported in North America and, since 1984, the importance of PVY^N has been increasing again in Europe.

These three strain groups are heterogeneous with several variants of each being recorded.

A relatively new strain, PVY^{NW} (W stands for Wilga), has been reported, amongst others by researchers in France and Poland. The virus is a recombinant of PVY^N and PVY^O, and infects plants without producing disease symptoms on the growing plant.

PVY^{NTN}

A new sub-group of the PVY^N virus (PVY^{NTN}), which produces superficial necrotic ring spots on infected tubers, was described first in the 1980's. These symptoms led to it being called potato tuber necrotic ring spot disease (**PTNRD**). The tuber symptoms develop during storage and may render the crop unfit for marketing. The development of tuber necrosis is very dependent on warm temperatures in the latter stages of growth in the field and in the store.

Cultivars react differently to infection. Symptoms in the growing plant vary from very mild to severe mosaic and in the tuber from strong tuber necrosis to none. There is, often, a poor relationship between the development of symptoms on the growing plant and on the tubers of a cultivar. Consequently, the correlation between the level of virus disease in the growing crop and the incidence of necrotic symptoms on tubers is frequently weak. This difference between symptom expression on plant and tuber caused by cultivar may be exacerbated by environmental conditions. Moreover, isolates of PVY^{NTN} appear to differ in their ability to cause PTNRD.

There seems to be no or little relationship between cultivar resistance to PVY^N and PVY^{NTN}, so cultivars which are (relatively) resistant to PVY^N may be susceptible to PVY^{NTN}.

Distribution of PVY^{NTN}

The disease was first reported in Hungary in 1980 and, over the past 10 years, it has been recorded in most European countries, and is very likely present in North America, although not officially recognised. Severe damage was reported in Slovenia (late 80's and early 90s), where susceptible varieties were grown, and Italy (1997). Although the virus is known to occur in the EU, it has never been recorded on tubers submitted for the EU Seed Potato Comparative Trials.

The virus can be considered a potential threat and the relatively warm summer of 2003 in many Western-European countries may reveal the extent of its progress.

Control and Diagnostics

In seed certification schemes, tolerances are applied largely according to symptom expression and not the virus causing the symptom. Thus NTN is covered by the current tolerances for mosaic virus in the growing crop, with the same constraints regarding virus expression on different cultivars as with other PVY strains. Although the virus has been recorded in most countries, its incidence does not appear to have increased significantly since the first findings which might suggest that the present growing crop measures, including virus tolerances, are effective in controlling this virus.

As with the other PVY strains, the virus is transmitted non-persistently by aphids. This means that, unlike with PLRV, insecticides have no direct effect on its control. A high infection pressure results from high aphid numbers and a high incidence of infected plants in a potato crop or in adjacent potato crops or volunteer potatoes. The use of non-certified seed (farm saved seed) especially is a risk.

Monoclonal antibodies are available to identify PVY^N. However, PVY^{NTN} cannot be distinguished from PVY^N strain by present biological and serological methods. Moreover, there is no agreement between virologists on how to decide whether a virus isolate is NTN or not. Some consider that an isolate is NTN if infection produces tuber necrosis on a susceptible variety in the field. Research is being done to develop a specific RT-PCR¹ method for this virus strain group but none has been validated sufficiently for practical use.

¹ (immunocapture) Reverse Transcription-Polymerase Chain Reaction

Current position in other certification schemes

In its certification scheme for seed potatoes, EPPO has included a 0.5% tolerance for surface necrosis (mainly PTNRD) as part of an overall 1% tolerance for visual necrosis in pre-basic class seed potatoes. France applies a 0.1% tolerance for PTNRD and has suggested this as a tolerance for the UNECE Standard.

Options for the Regulation of PTNRD

Growing crop

The most effective way to control PVY^{NTN} is probably by applying a low overall growing crop tolerance for PVY in certification schemes, especially in basic seed grades. This has to be linked with measures to reduce other infection sources (e.g. farm saved seed). As indicated above, the current tolerances for mosaic diseases seem to be sufficient to effect control of NTN so it does not seem necessary to introduce specific measures for this virus in the growing crop at the moment, particularly as the symptoms of PVY^{NTN} infection in the plant are indistinguishable from other PVY strains.

Tubers

Combined tolerance for surface necrosis

Infection of tubers by Potato Mop Top Virus (PMTV) and Tobacco Rattle Virus (TRV) may also produce symptoms similar to those of PTNRD. As with other aphid transmitted viruses, all tubers infected by PVY^{NTN} will produce infected plants which may or may not show symptoms on the plant, depending on the variety: isolate reaction. However, in contrast to PVY^{NTN}, only a relatively low proportion of PMTV/TRV affected tubers will produce infected plants in the succeeding crop. This significant difference in transmission between PVY^{NTN} and PMTV and TRV makes it inappropriate to introduce a tolerance for all tubers affected by visual necrosis.

Specific tolerance for PTNRD

The introduction of a specific tolerance for PTNRD could be an effective tool in controlling the incidence of the virus in the succeeding crop for cultivars, which react by producing tuber symptoms when infected by this strain but will be ineffective for those cultivars that do not produce tuber symptoms when infected by the virus. A constraint on the effectiveness of tolerance in a certification scheme would be the ease with which PTNRD could be distinguished from other necrotic ring symptoms. If a very strict tolerance was applied, i.e. 1 affected tuber in a sample, growers may challenge the diagnosis. Inspectors would require a fast and accurate identification of the virus causing the necrosis in order to reach a decision as to whether a consignment was certifiable.

The adoption of a specific tolerance for PTNRD would, therefore, require a rapid and accurate confirmatory diagnostic test for PVY that could be used by the inspectors at the time of inspection. Often in trading seed potatoes internationally, there is limited time between the inspection and export in which to conduct a confirmatory test for the virus. The adoption of a specific tolerance for PTNRD would be difficult unless we are sure that the symptoms are clearly different from those caused by other viruses or that a rapid test could be done on suspect tuber material by an inspector using a diagnostic kit similar to that developed by Central Science Laboratory (CSL) for testing leaf material.

A PTNRD-affected seed tuber will produce an infected plant and presumably affected daughter tubers since the initial presence of the disease on the seed indicates a compatible cultivar/virus strain reaction. For classes of seed potatoes intended for consumption or processing, the minimum tolerance for such seed potatoes could be set at a level which would give a usable end product, particularly as the growers of these crops would be unlikely to remove affected growing plants, i.e. rogue. A possible tolerance for Certified I and II class seed potatoes could be 1.5%. For classes intended for further seed production, tolerances for PTNRD could be aligned with the growing crop tolerances for virus. Stricter tolerance should be unnecessary as the growers of such seed would rogue their crops and thus reduce the level of NTN within the crop. The percentage of tubers affected by PNTRD by weight could, therefore, be 0% for Pre-basic TC, 0.1% for Pre-basic, 0.4 %for Basic I and 0.8% for Basic II. Implementation of these proposals would require resolution of the constraints set out above.