

# VIROLOGY

## Main Causes of Potato Spindle Tuber Viroid Distribution in Seed Potato in Russia in 1990s

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### ABSTRACT

Intensive application of the technologies for the virus-free potato production, which did not protect from viroid infection, was the reason of drastic outbreak of potato spindle tuber viroid disease that took place in Russia in 1990's.

*Key words:* potato diseases, viroids, spindle tuber disease.

Можаяева К.А., Гирсова Н.В., Кастальева Т.Б. Распространение вириода веретеновидности клубней картофеля в 90-х годах XX в. в России.

Интенсивное использование в России технологий получения безвирусного картофеля, не защищающих от вириодной инфекции, привело к широкому распространению вириодной болезни веретеновидности клубней картофеля в 90-х годах.

### INTRODUCTION

Potato spindle tuber viroid (PSTVd) is the smallest autonomously replicating disease-causing agent. It consists of the low molecular weight single-stranded circular RNA of 356–360 nucleotides and causes disease in higher plants only. It retains the infectivity after incubation at high temperature (more than 100°C). PSTVd forming a part of total low molecular RNA was shown to save its infective properties in solution frozen and stored at –20°C for more than twenty years and in dried plant tissues for more than ten years (Girsova et al., 2002).

PSTVd is highly contagious. It is transmitted through mechanical contact, sap inoculation, infected tools and farm machinery. Viroid is also transmitted through pollen

and true seeds. PSTVd causes stunting, upright growth, and some leaf distortion in the foliage of potato and reduces size and number of tubers (Fig. 1). Reduction in leaf size and a slate (gray) color are also observed. Tubers are elongated or deformed, they may become very spindly and small and show growth cracks (Fig. 2). Yield reduction depends on the PSTVd strain, growing conditions, and type of cultivar. The danger of the disease caused by PSTVd forced West European countries to consider this pathogen as a quarantine object (EPPO, 1992).

As much as 40–90% reduction in yield of tuber production caused by PSTVd was observed in field experiments using artificial inoculation (Mozhaeva et al., 1998).

### METHODS

Bioassay on indicator hosts *Lycopersicon esculentum* (var. Rutgers) and *Scopolia sinensis*, electrophoresis in polyacrilamide gel (PAGE) and molecular hybridization on nitrocellulose filters were used for

the routine detection of PSTVd (Mozhaeva et al., 1989). Fraction of low molecular nucleic acid enriched with viroid RNA was used in electrophoresis and bioassay (Kastalyeva & Mozhaeva, 1988).



TABLE 2

## Diagnostics of PSTVd in potato between 1997–1999\*

Regions	<i>In vitro</i> potato plants			Tubers**		
	Plants tested (No.)	Plants infected (No.)	Plants infected (%)	Tubers tested (No.)	Tubers infected (No.)	Tubers infected (%)
Moskovskaja province: Pustchino 1997	8	4	50	22	12	55
Pustchino 1999	50	2	4	30	3	10
Korenevo (RSRIP)	20	10	50	36	17	47
Kaluzhskaja province: Belousovskoe	13	2	15	—	—	—

\* — Results published by Baranov and Dynnik in 2000

\*\* — Seedlings were analyzed

The main cause of such a situation was a wide application of meristemic-tip culture technology to produce virusfree potato in the former USSR since 1972. The technology did not provide for a possibility of PSTVd infection. As a result, plants were never tested for PSTVd presence before they were used for virus eliminating. Another reason was favorable conditions for pathogen replication and transmission (thermo-therapy, high temperature in greenhouses, non-satisfaction of phytosanitation etc.). Moreover, hydroponics was widely employed for virusfree potato growing that promoted PSTVd spreading through the nutrient solution (Mozhaeva et al., 1996).

Distribution of non-tested potato seeds resulted in a large-scale distribution of PSTVd all over Russia. High

degree of *in vitro* potato plant and seed infectivity posed a threat to seed growing and breeding of potato. To solve the problem, the following steps are being realized for the PSTVd control in Russia presently (Drygin, et al., 2000; Baranov & Dynnik, 2000):

1) the procedure of identification of PSTVd is included to the scheme for production of virus-free potatoes by meristem-tip culture;

2) regional laboratories for certification of seed potato are being founded;

3) virus/viroid-free samples of potato are being produced for the Russian germplasm bank;

4) the clone selection together with the meristem-tip culture is recommended for the production of healthy seed tubers.

## CONCLUSIONS

Underestimation of the danger of PSTVd spreading, as well as the absence of control for the PSTVd presence in the plant material that was used as a parental in breeding and me-

ristem tips preparation led to spread of the disease in Russia. Urgent strong measures were recently applied to prevent further expansion of PSTVd and to save the potato germplasm.

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