AGROCLIMATICAL ANALYSIS OF PLUM POX VIRUS SPREAD IN SLOVAKIA

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Summary. – In this report, the plum pox virus (PPV) spread from the point of view of agroclimatical conditions on the territory of Slovakia is analysed. The worst condition for the PPV spread was found in a warm macroregion. The air temperature sum in this macroregion during vegetative period ranged from 2400 to 3100°C. The worst condition for the PPV spread was found in dry subregions of the macroregion. These were defined by differences between potential evapotranspiration and rainfall sums which ranged from 50 to 150 mm during summer months (from June to August). The decrease in air temperature sums and the increase of moisture in the environment as well as the severity of winter period was found to support the occurrence and spread of PPV.

Key words: plum pox virus; spread; climatical conditions

Introduction

The occurrence and disastrous spread of PPV in Slovakia are basic causes of permanent decrease of stone fruits yields as well as fruit quality. The occurrence and wide spread of PPV are influenced by many factors.The most important are: the resistance of stone fruits to manifestation of ill effects of PPV, virus strains and their requirements towards environment, ecological conditions from the point of view of PPV vectors, and meteorological and climatical conditions of environment with special reference to energy and water regimes. The impact of harmful effects of PPV on plum yield has been evaluated in Slovakia by Blatný (1952), Králiková (1962), Ackerman (1989), and Baumgartnerová (1991).

In this report, the PPV spread is evaluated from the point of view of agroclimatical conditions in Slovakia by use of a graphic method.

Materials and Methods

The used method is considered very effective because optimal conditions and consequently the ecology and development of plum pox according to sites of PPV occurrence can be defined. The evaluation is based on the data on PPV spread area published by Baumgartnerová (1991) and agroclimatical conditions in Slovak Republic (Kurpelová *et al.,* 1975).

For this purpose, the territory of Slovakia was divided into 85 squares. High mountain regions (above 700 m altitude) were excluded from this analysis. The number of PPV occurrence sites (localities) found in each square was defined as the occurrence intensity I and evaluated as follows: numbers of sites (0 – 1), (2 – 4), (5 – 6) and ≥7 corresponded to I values of 0, 1, 2 and 3, respectively. Each square was characterized by temperature, moisture and winter parameters. The temperature index was defined as the air temperature sum in days with mean air temperature T ≥10°C (TS 10). The moisture index was defined as the difference between the potential evapotranspiration (E_0) and rainfall (R) values during summer months from June to August ($K_{VI-VIII}$). The winter index was defined as the average absolute minimal air temperature in winter (T_{min}). The occurrence probability (P) was calculated according to the formula

$$P = \frac{n_v}{n} \cdot 100$$

in which n_v = the areas of PPV occurrence and n = all areas.

Results and Discussion

The evaluation of PPV spread in Slovakia is given in Table 1 and Fig. 1. The results show that the PPV occurrence

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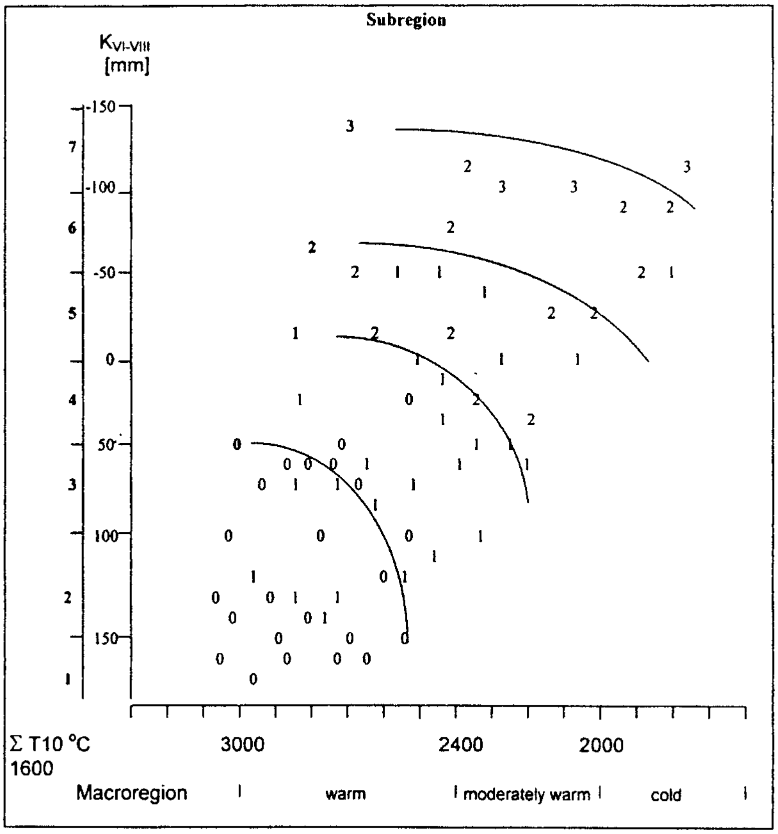

Fig. 1
Agroclimatical diagram of PPV occurrence intensity on the territory of Slovakia

increases with the temperature decrease, rise in moisture and winter intensity.The air temperature significantly influences the intensity of PPV manifestation and consequently the harmful effects of PPV too (Baumgartnerová, 1991). An increased temperature reduces virus reproduction in plants and consequently reduces negative impacts of PPV infection on stone fruits yields. This relation is connected with the area spread of the disease.

As it is evident from the results shown in Table 1, the lowest occurrence of PPV was registered in a warm macroregion (TS10 = 3100 – 2400°C). The I values of 0 and 1 were found in 23 and 9 squares, respectively, while higher values were not registered.

Higher I values were found for the moderately warm (TS10 = 2400 – 2000°C) and cold (TS10 = 2000 – 1600°C) macroregions.

The PPV occurrence probability (*P*) was about 28% in the warm macroregion, 94% in the moderately warm macroregion, and 100% in the cold macroregion.

The water regime of environment can be connected with the resistance to negative effects of the disease as well as with the occurrence and reproductive cycles of biological vectors of PPV (mainly aphids).

The rise in moisture of environment also increased the PPV occurrence probability (*P*) from 29% in the very dry region ($K_{VI-VIII} \geq$ 150 mm), where the water deficit level exceeded 150 mm, up to 100% in the predominantly wet region ($K_{VI-VIII} \geq$ -100 mm), where the rainfall exceeded potential evapotranspiration by more then 100 mm.

Low temperatures during winter can negatively influence the PPV resistance of stone fruit trees in spring and summer parts of their vegetative period. On the other hand, these temperature can positively influence the development of the disease and its harmful effects on plants.

The winter severity did not influence the occurrence and spread of PPV in proportion to the factors mentioned above.The lowest PPV occurrence probability (*P* = 24%) was found in the zone of relatively moderate winter (T_{min} = -18 – -20°C). An increase of *P* up to 100% was observed in the coldest zone. The agroclimatical diagram of the intensity of PPV occurrence in Slovakia (Fig. 1) illustrates a zonal character of the disease spread.

Table 1. Intensity (I) and probability (P) of PPV occurrence in various agroclimatical geographical entities of Slovakia

	I					P (%)
Agroclimatical macroregions according to TS10 (°C)	0	1	2	3	Mean	
1.Warm (TS10 = 3100-2400 °C)	23	9	0	0	0.25	28
2. Moderately warm (TS10 = 2400-2000 °C)	2	18	9	2	1 66	94
3. Cold (TS10 = 2000-1600 °C)	0	1	4	1	2.00	100
Agroclimatical subregions according to $K_{VI-VIII}$ [mm]						
1. Very dry ($K_{VI-VIII} \geq 150$ mm)	12	5	0	0	0.29	29
2. Relatively dry ($K_{VI-VIII}$ = 150 – 100 mm)	8	5	0	0	0.38	38
3. Moderately dry ($K_{VI-VIII}$ = 100 – 50 mm)	4	8	2	0	0.92	71
4. Moderately wet ($K_{VI-VIII}$ = 50 – 0 mm)	1	6	5	0	1.33	92
5. Relatively wet ($K_{VI-VIII}$ = 0 – -50 mm)	0	1	1	0	1 00	100
6. Wet ($K_{VI-VIII}$ = -50 – -100 mm)	0	2	5	2	2.00	100
7. Very wet ($K_{VI-VIII} \leq -100$ mm)	0	1	0	1	2.00	100
Agroclimatical zones according to T_{min} (°C)						
1. Predominantly moderate winter ($T_{min} \geq -18$ °C)	6	4	0	0	0.40	40
2. Relatively moderate winter (T_{min} = -18 – -20°C)	16	5	0	0	0.20	24
3. Moderately cold winter (T_{min} = -20 – -22°C)	1	9	3	0	1.20	92
4. Predominantly cold winter (T_{min} = -22 – -24°C)	2	8	10	2	1.50	91
5. Cold winter ($T_{min} \leq -24$°C)	0	1	0	1	2.00	100

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