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Tan spot – the most harmful wheat leaf disease in Latvia

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Summary

Tan spot (*Pyrenophora tritici-repentis*) is one of the most important wheat diseases in Latvia. Significant spreading of this disease was observed from 1998. Field experiments were carried out at the Research and Training Farm „Peterlauki" of the Latvia University of Agriculture, during 1998-2003. Development of diseases was observed on 14 winter wheat varieties, dynamics of development was investigated on 'Donskaja polukarlikovaja' and 'Stava'. Assessments of the disease severity were carried out on the upper three leaves each week from the start of stem elongation to full ripening. Tan spot was observed at the stage of stem elongation in 2003, and only after flowering in 1999. Increase of the disease severity was slow until stage of milk ripeness, and only in late stages of wheat development sharp increase of the disease was observed. Total rate of infection (through the session of vegetation) was very slow (0,01-0,19), but during ripening rate achieved 0,5-0,6. The main reason of so unequal development of the disease seems changes in amount of infection sources. Other possible reason of rapid increase of the disease development is the relationship between leaf age and susceptibility to the disease. Further research is necessary for better understanding of tan spot life cycle.

Key words: *Drechslera tritici repentis*, epidemiology, AUDAC, rate of infection

INTRODUCTION

Tan spot, caused by *Pyrenophora tritici repentis* (Died.) Drechs., anamorph *Drechslera tritici-repentis* is one of the most important wheat diseases in the world, especially in the regions of intensive wheat growing, also in Latvia from 1998 until present (Wolf et al., 1998; Bankina, 2002). Epidemiology of the disease, disease cycle and favourable conditions for development of this pathogen has been investigated all over the world, nevertheless we have not model of warning and forecast for tan spot.

The rate of tan spot progression depends upon host, temporal and environmental components. Strong association between availability of moisture and infection

of tan spot was established. Association with other weather parameters was less evident (Wolf et al., 1998).

Changes in the epidemic of the disease are reflected by alterations in the disease progress curve. The most important parameters are rate of infection, shape of the curve and area under the disease progress curve (Campbell and Madden, 1990).

Detailed study of the disease cycle and distribution of diseases and dynamics of development of wheat tan spot, caused by *Pyrenophora tritici repentis*, promotes a better understanding of how the disease develops and spreads, which may improve control strategy.

MATERIALS AND METHODS

Field experiments were carried out at the Research and Training Farm „Peterlauki" of the Latvia University of Agriculture in central part of Latvia, during 1998-2003 as described previously (Bankina, 2002).

All agronomic requirements were noticed in the trials. Seed dressing, herbicides and high doses of nitrogen were used in all trials.

Development of the disease was investigated in untreated plots (25-28 m^2 with four replicates) in the trials applying fungicides in different times and dosages.

Development of the diseases was observed on 14 winter wheat varieties from 1998 to 2000. Dynamics of tan spot development was investigated from 1999 on early variety 'Donskaja polukarlikovaja' and from 2000 on late variety 'Stava'.

Assessments were carried out on the upper three leaves each week from the start of stem elongation to full ripening.

Meteorological conditions were measured by automatic meteorological stations in „Peterlauki".

Values of AUDAC and rate of infection were calculated for characterisation of tan spot development peculiarities (Campbell and Madden, 1990).

Development model of tan spot was charasterized as logistic. Rate of infection was calculated according to equation $r= 1/(t_2-t_1) * [\ln(x_2/(1-x_2) - \ln(x_1/(1-x_1)]$, suggested by G. Hugges, J. Yuen, A. Djurle (personal communication). In this equation t means numbers of days of the first and following assessment, x_1 and x_2 severity of the disease.

RESULTS

Severity of tan spot fluctuated between varieties and years (Bankina, 2002). It is important task to understand reasons for so large difference of tan spot severity. Significant influence of year was demonstrated by statistical methods of investigations (Fig.1). Difference between varieties is substantial (coefficient of variance is 27.6), but the influence of year is considerably more important (coefficient of variance is 71.6).

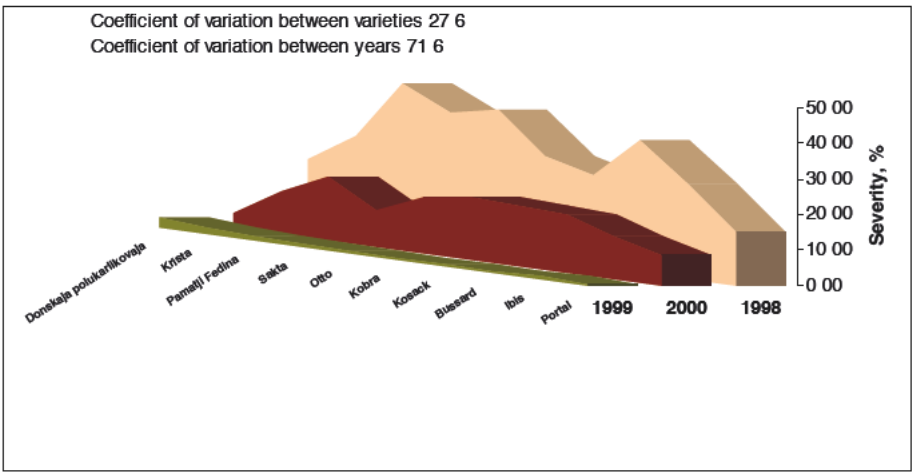

Fig. 1. Tan spot development depending on varieties and year

Time of tan spot first symptoms appearance depends on year and varieties under agroecological conditions of Latvia (Fig. 2). Tan spot was observed at the stage of stem elongation (DC 32-34) in 2003, and only after flowering (DC 65-69) in 1999. It is very difficult to explain so large differences, because relationships between conditions of whether and time of first symptoms was not noted. For example, spring was cool and dry in 2003, however tan spot appeared very early. Amount of infection sources should be the most important reason for diverse time of the disease development beginning. Ascospores and conidia borne on infested plant residues were noted as primary inoculum (Wright, Sutton, 1990). The relative contribution of ascospores and conidia to the primary inoculum dosage needs further study under conditions of Latvia.

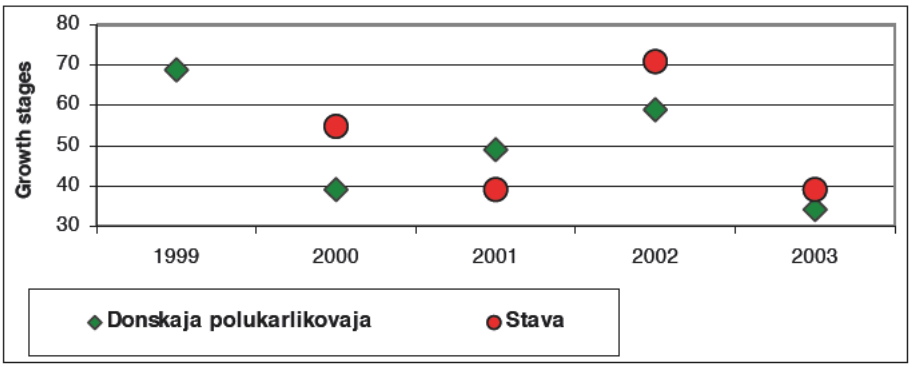

Fig. 2. Appearance of first symptoms of tan spot under agroecological conditions of Latvia

First symptoms of the disease were observed on early varieties primarily, but AUDAC of the disease was considerably higher for late varieties (Fig. 3).

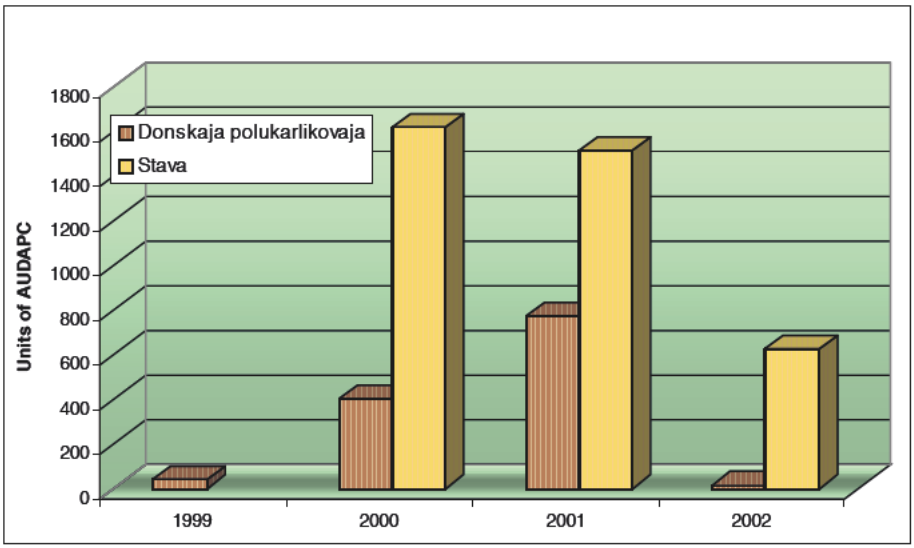

Fig. 3. AUDAC depending on varieties and years

Differences and peculiarities of the disease epidemic between varieties and years are reflected by the disease progress curves. Increase of the disease severity was slow until stage of milk ripeness, and only in late stages of wheat development sharp increase of the disease was observed (Fig. 4.).

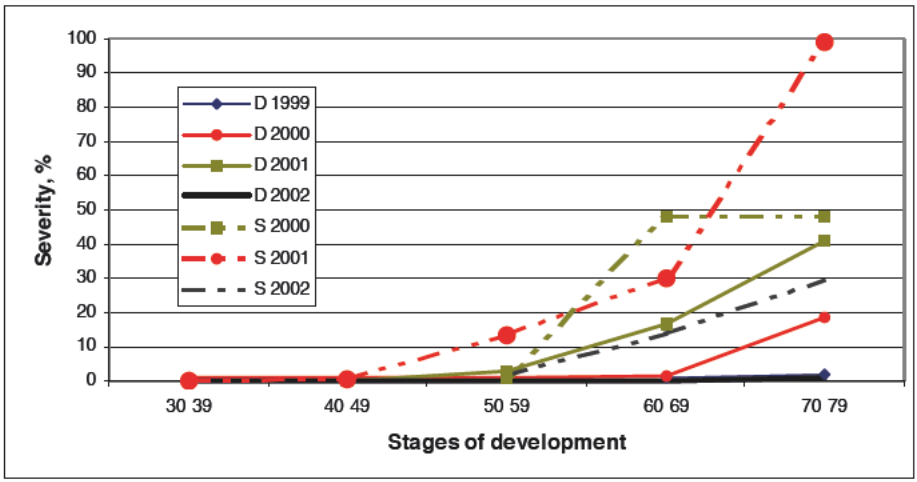

Fig. 4. Development of tan spot depending on varieties and year
(D Donskaja polukarlikovaja, S Stava)

Rate of infection was very slow (near zero) until stage of milk ripeness (Tab.1), only in some cases it increased at the time of flowering. Total rate of infection (through the session of vegetation) was very slowly (0,01-0,19), but in time of ripening it achieved 0,5-0,6 in 2002.

Tab. 1. Rate of tan spot severity development (% of severity per day)

Development stages	Donskaja polukarlikovaja				Stava		
	1999	2000	2001	2002	2000	2001	2002
Heading-flowering	0,1	0,1	0,13	0,1	0,18	0,08	0,1
Milk ripening	0,08	0,25	0,32	0,62	0,01	0,44	0,50
Total	0,03	0,07	0,01	0,04	0,10	0,19	0,07

DISCUSSION

Meteorological conditions are most important factor that influenced severity of tan spot. It is not possible to determine the level of variety resistance now, for resolve of this question is necessary to continue observations and determination of *Pyrenophora tritici-repentis* races in Latvia.

Slope of the disease progress curve showed that the disease has been characterised as a polycyclic disease with logistic model of disease growth. Tan spot epidemics were characterised by a simple interest phase initiated by ascospores, followed late in the crop season by a short compound-interest phase resulting from infection by conidia (Wright and Sutton, 1990). Usually infections on the upper leaf and head of wheat by conidia cause more yield losses than infection of seedlings. The relative contribution of ascospores and conidia to the development of tan spot under Latvia conditions needs further studies.

The rate of disease progress in the field may be punctuated than constant (Francl, 1998). The same results were obtained in Latvia, rate of infection increased only after flowering, but the role of different sources of inoculum is not clear. Ascospores were dispersed in the lower canopy, but rarely to the upper leaves (Wright and Sutton, 1990). Period of very slow increase of the disease severity (rate of infection nearly zero) supported this view. Although conidia may not normally form on lesions prior to leaf senescence, lesions of the disease on upper leaves commonly were found only after flowering.

The peculiarities of the disease development depending on changes in amount of infection sources, other possible reason of rapid increase of the disease development is the relationship between leaf age and susceptibility to the disease. Leaf age affects the disease severity, the oldest leaves being the most susceptibly (Cox and Hosford, 1987).

Relationships between different sources of infection, wheat development stages and yield losses are unclear, and further investigations are necessary for better understanding of tan spot development peculiarities.

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Brunatna plamistość – najbardziej szkodliwa choroba pszenicy na Łotwie

Streszczenie

W latach 1998-2003 na terenie stacji doświadczalnej „Peterlauki" Łotewskiej Akademii Rolniczej podjęto badania, których celem była charakterystyka brunatnej plamistości liści w uprawach pszenicy ozimej. Oceniano stopień porażenia odmian oraz dynamikę rozwoju epifitozy. W każdym sezonie obserwacje prowadzono w odstępach tygodniowych, od fazy strzelania w źdźbło do pełnej dojrzałości roślin z wyjątkiem lat 1999 i 2003 w których ocena była wykonana odpowiednio: tylko po kwitnieniu zbóż i w fazie strzelania w źdźbło. Jak stwierdzono, wzrost stopnia porażenia roślin był powolny aż do fazy dojrzałości mlecznej. W okresie tym wskaźnik porażenia roślin osiągał wartość 0,01-0,19. Bardziej dynamiczny rozwój choroby obserwowano dopiero w późniejszych fazach rozwojowych roślin a wskaźnik porażenia roślin wynosił 0,5-0,6.

Sugeruje się, że obserwowane różnice w dynamice przebiegu epifitozy brunatnej plamistości liści w trakcie sezonu wegetacyjnego są wynikiem zmieniającej się (wzrastającej) wraz z wiekiem roślin podatności na porażenie przez *P. tritici-repentis* oraz bardziej obfitym występowaniem inokulum patogena w miarę rozwoju epifitozy.