

POPULATION STRUCTURE OF LUPIN ANTHRACNOSE IN RUSSIA

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ABSTRACT

2003–2006 heavy lupin anthracnose epiphytotics happened in Russia, it had not occurred earlier. Compared anthracnose isolates tests have been done. These isolates infect lupin in main regions of its cultivation and have been collected 1996–98 and 2006–07. Two agent isolates with different colony growth speed, colour, relations to lupin and virulence have been selected. These isolates are more aggressive as a mixture for yellow, white and narrow-leaved lupins compared to their separately action.

KEY WORDS

lupin, anthracnose, isolates, biological peculiarities

INTRODUCTION

Anthracnose is known as one of the most dangerous and harmful disease all over the world. It's often epiphytotics result in decrease of lupin cultivated area in many countries (Evsikov *et al.* 2000; Yakusheva *et al.* 2001; Feiler, 1998; Sweetingham, 1997). In Russia during 2003–2006 heavy lupin anthracnose epiphytotics occurred both on yellow and white and narrow-leaved lupins. It did not occur earlier.

Study of phytopathogenic microorganism population structure particularly their biology is the base for estimation methods development of initial and breeding material for disease resistance, their occurrence and spreading level forecasts. Finding of resistance sources and development of continuous resistant varieties for particular region should be done taking into account structure of local pathogen populations and their variability speed.

In spite of actuality of anthracnose problem management for their new types occurrence and accumulation is not sufficient. The reason is in absence of stable varieties sortiment – differentiators and immune responses inside *Lupinus* L. genotypes. It makes difficult clear scale of fixed races. Australian scientists made compared study for vegetative compatibility of anthracnose agent strains received from different countries and on the base of PCR selected strain groups (VCG⁻¹, VCG⁻², COL⁻³) which infect lupin (Yang *et al.* 1998). Sweetingham (2003) analysed the Russian anthracnose isolates collected on lupin field to 2001 (we express our acknowledgement to M. Sweetingham). These isolates have been identified as VCG1/COL⁻¹.

The aim of our tests is to compare anthracnose agent populations collected in 1994–98 and 2006–07 in lupin growing regions in Russia, to study their development in terms of relations to cultivated lupin species.

MATERIALS AND METHODS

Anthracnose agent isolates were extracted to pure culture from infected yellow, white, narrow-leaved and perennial lupin stems, pods and seeds in different regions of Russia. Tests have been done on laboratory and field conditions according to Chochryakov (1974), Yakusheva *et al.* (2001). Morphological properties of culture were tested on PGA where the fungus grows well and produces spores. More than 140 isolates in 6 replications were analysed. Different lupin species and varieties were used to study pathogenic and virulent isolate properties at the seedling stage in the laboratory and on the stem formation stage in field. We used 30–45 plants of each variety in the tests.

RESULTS AND DISCUSSION

Compared study of anthracnose agent population structure has shown that isolate colonies collected from 1994–98 had pink or gray-pink colour. Anthracnose population collected from 2006–2007 had critically other colour in isolates. Among 59 isolates from that period only 4 had pink coloured colonies, 6 were dark coloured, the rest (49) demonstrated a mixture of the first and the second ones. The isolates have been divided into groups according to their colour: the first group of pink coloured isolates (GPI¹) and the second group of dark coloured isolates (GDI²).

GPI¹ colonies are round, have equal height and flat pale pink surface which is soft velvety at the initial growth period. Later light grey concave concentric rings appear above. They take turns with convex pink-orange rings where numerous acervulus with rich conidia sporulation develop (Fig. 1b). The upper colony surface is gray-pink. At late age of agent culture colony the colour doesn't change.

GDI² colonies are rounded, have a light, elated centre and down oriented edge, the mycelium is wadding like, dense interweaved, at the initial stage it is light grey, later it becomes dark grey and black (Fig. 1a).

The upper colony surface is black. Mixed isolates colonies have characters of the 1 and 2 group and very large spore cushion (Fig. 1c).

Table 1 informs that GDI² differ from GPI¹ with more rapid colony growth.

GPI¹ had intense conidia development, GDI² – intense mycelium development. In 6 days 77 spores of GPI¹ were in 1 mm³, in GDI² only single spores were detected. In 12 days in the first case numerous spores have been detected (about 700) (Fig. 2), in the second case mycelium and a small number of spores (about 50) have been noticed (Fig. 3).

In GPI¹ and GDI² mixture there were about 1500 spores in 1 mm³, at the same time it could be possible to see both spores and mycelium hyphae under microscope.

Fungus conidia (spores) of both groups are colourless, most of them are straight, oval, rounded in one or both edge. There are some oval conidia with sharp edge (Fig. 2–3). Conidia size in GPI¹ is 3–8 x 9–9 mcm, GDI² – 3–7 x 7–18 mcm. Sometimes 1⁻² fat drops could be seen inside spores.

The most available phenotypic character for fungi pathogen is virulence (quantitative character describing pathogen/host plant relationship) to particularly selected differentiator–varieties. This analytical method is widely used in world practice.

Data of the Table 2 suggest that GDI² is more virulent for yellow and narrow–leafed lupins under laboratory conditions. What about white lupin it is less virulent for it. GDI¹ is more virulent for white lupin and less for yellow and narrow–leafed ones. GPI¹/GDI² mixture strengthen seedlings disease infection most of all in narrow–leafed and white lupines.

Under field conditions anthracnose development depends on weather conditions. The first half of lupin vegetation period in 2007 was dry and hot (35°C), there was no rain during 1.5 month. These conditions depress infection development. Weather conditions in early vegetation period 2008 were favourable for epyphytoty anthracnose spreading. It was noticed that GDI² have shorter incubation period: 10 days on white lupin, 14 days on narrow–leafed lupin, 12 days on yellow lupins. GPI¹ incubation period was 21 days on white lupin, 19 days on narrow–leafed and 16 days on yellow lupins.

Under field conditions GDI² was more virulent on the stem formation stage for all lupin species (Table 2). White lupin lines were more infected. They have lesions and wilt peduncles, lateral branches and main stem were distorted (Fig. 4). GDI² infection level of yellow lupin was lower compared to white and narrow–leafed ones. GPI¹ infects yellow lupin stronger than white and narrow–leafed ones (Table 2). White lupin (as narrow–leafed one) has only infected (lesions, wilting) total plant appearance was well (Fig. 5).

Mixed GPI¹ and GDI² result in heavier infection of each species both under field and laboratory conditions compared to their separate activity. Isolates mixture is more harmful for white lupin. Maximum stem infection is noticed on var. Deter 1–93.8% (Fig. 6).

It should be noted that we recorded stem anthracnose infection at the flowering stage (stem infection is maximum at this stage). On 28/07/2008 only white lupin blooms, while yellow and narrow–leafed lupins bloom later, and we think stem infection of these species will increase later.

Thus results of our tests demonstrate the presence of 2 anthracnose agent isolates in Russia. One of them is more virulent and in mixed form they are more aggressive for cultivated lupin species.

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Table 1. Colonies growth speed of different lupin anthracnose agent isolates on PGA 1994–1996 and 2006–2007.

No. of isolate	Isolate origin	Fungi colonies size in mm			
		3 days	6 days	9 days	12 days
1 group, pink coloured isolates (GPI¹)					
83	Yellow lupin (Bryansk, 1994–1996)	13.0	29.8	38.4	40.0
81	Yellow lupin (Vladimir, 1994, 1996)	10.9	27.4	39.2	42.6
82	Narrow-leafed lupin (Vladimir, 1994, 1996)	12	30.0	40.0	44.0
90	Narrow-leafed lupin (Pskov region, 1996)	11.6	30.4	41.2	45.0
114	Yellow lupin (Smolensk region, 1996)	10.6	30.6	40.8	44.3
126	Yellow lupin (Bryansk region, 2007)	13.2	30.2	38.8	45.6
2 group, dark coloured isolates (GDI²)					
137	Yellow lupin (Novozybkov, 2007)	19.6	45.0	61.8	79.0
136	Yellow lupin (Novozybkov, 2007)	21.6	45.8	62.0	79.5
133	Narrow-leafed lupin (Bryansk, 2007)	21.6	45.8	62.2	78.8
122	Narrow-leafed lupin (Pskov, 2006)	23.2	46.1	63.0	82.4
123	Narrow-leafed lupin (Vladimir, 2006)	22.0	44.7	62.0	80.0

Table 2. Anthracnose isolates virulence of different lupin species under laboratory and field conditions (2006, 2008).

Varieties	Disease development level at isolates infection, %		
	First group	Second group	The mixture
Yellow lupin, vars.:			
Iputskii	68.6/28.4	72.5/48.0	95.8/71.0
Nadezhny	41.1/8.2	51.7/21.1	67.2/36.2
Demidovskii	32.5/6.8	57.7/17.0	61.3/27.8
BL-2954 (13)3,1,3	42.9/10.8	51.2/22.8	63.2/35.9
Narrow-leafed lupin, vars.:			
Christall	57.6/9.0	73.9/59.3	89.7/76.5
Tanjil	30.1/2.7	45.7/27.6	61.5/47.4
BL-9707	34.1/3.9	49.0/26.3	80.0/53.8
BL-9712	38.4/3.8	59.1/34.3	78.9/58.5
White lupin, vars.:			
Dega	74.1/2.5	55.4/16.7	60.2/75.0
Deter 1	71.4/6.3	43.5/69.2	85.8/93.8
Desnyanskii	78.9/6.1	57.8/21.6	88.7/81.7
BL-8811	46.1/6.3	42.9/33.3	63.1/81.7

Note: Disease development level on seedlings determined under laboratory/field conditions.

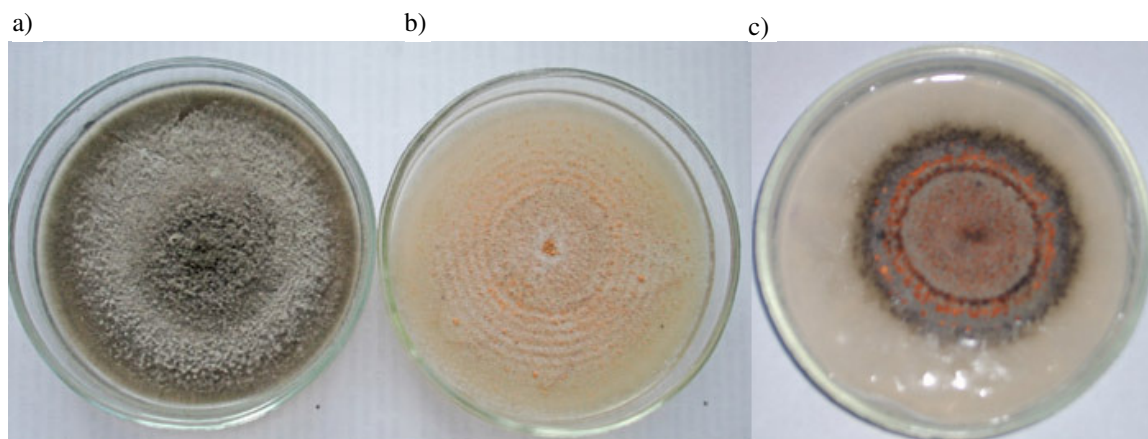


Fig. 1. a) Anthracnose agent colony on PGA (GDI^1); b) Anthracnose agent colony on PGA (GDI^2); c) mixed isolates of GPI^1 and GDI^2 .

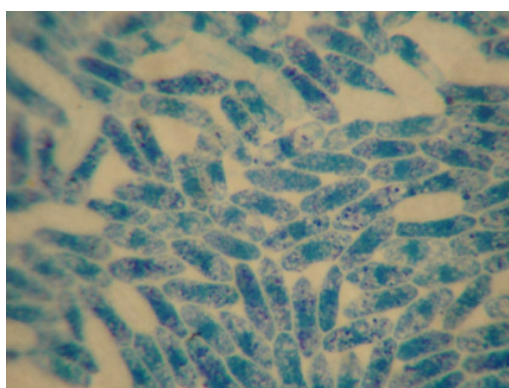


Fig. 2. Anthracnose agent conidia (GPI^1).

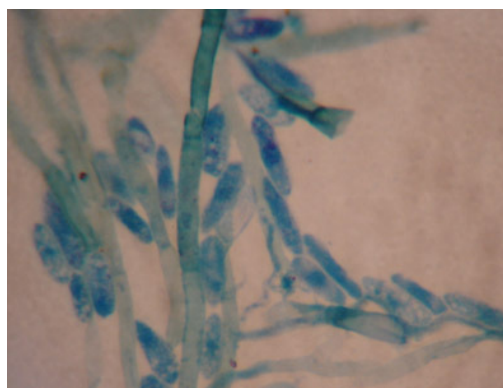


Fig. 3. Anthracnose agent conidia (GDI^2).



Fig. 4. White lupin infection (var. Deter 1 – white flowers) of GPI^1 isolates.



Fig. 5. White lupin infection (var. Deter 1 – white flowers) of GDI^2 isolates.



Fig. 6. Mixed isolates (GPI^1 and GPI^2) infection of white lupin.