P L A N T B R E E D I N G A N D S E E D S C I E N C E
Volume 45 Number 2 2001

Joanna Z. Marcinkowska, Krystyna Borucka

Department of Plant Pathology, Warsaw Agricultural University, Nowoursynowska 166, 02–787 Warsaw, Poland

COLLETOTRICHUM LINDEMUTHIANUM IN *PHASEOLUS VULGARIS* SEEDS

ABSTRACT

There was found significant correlation between incidence of *Colletotrichum lindemuthianum* in *Phaseolus vulgaris* seeds and leaves, pods and stem infection by the pathogen under natural field condition of 1997–1999. In this study the positive relationship was proved in the case of 7 genotypes evaluated at Radzików (Central Poland) and Jankowice (South–East of Poland). Cultivar Nida was infected only sporadically. All plots of cv. Prosna showed symptoms of anthracnose. Infection degrees of cv. Mela were always the highest. Four tested breeding lines were shown to be susceptible to this pathogen.

Key words: *Colletotrichum lindemuthianum*, correlation, field, genotypes, intensity, *Phaseolus vulgaris*, seed

INTRODUCTION

Colletotrichum lindemuthianum (Sacc. et Magn.) Briosi et Cav. causes bean anthracnose, a very dectructive disease, in many areas of this crop plantation in temperate zone (Tu 1992). In Poland the disease has been known since the first decades of the 20th century (Jankowska 1928). The anthracnose was noted commonly on *Phaseolus vulgaris* L. during many years (Włodarczyk 1972, Pięta 1985) but in the early 1990–ties the occurrence of *C. lindemuthianum* was observed quite seldom not only on snap bean but also on dry bean and *Ph. coccineus* L. (Marcinkowska 1994). There were known investigations concerning biological diversity of the pathogen (Włodarczyk 1972, Borucka and Marcinkowska 1997), its presence on seeds (Łacicowa *et al.* 1975, Pięta and Łabuda 1990) and in fields (Pięta 1985, Marcinkowska 1994) but there was no study on relationship between intensity of *C. lindemuthianum* on infected plants under natural field conditions and infection of seeds harvested from these plants. That is why such investigations have been undertaken.

Communicated by Edward Arseniuk

MATERIAL AND METHODS

Observations were carried out on experimental fields of the Plant Breeding and Acclimatization Institute at Radzików (near Warsaw) and its Experimental Station at Jankowice (n. Jarosław) (Table 1). Intensity of anthracnose was assessed on leaves, stems and pods of 4 and 5 genotypes, in 1997, 1998 and 1999, respectively (Table 1). The set of tested cultivars (Mela, Nida, Prosna) and breeding lines (l. 4376, l. 4537, l. 4369, l. 4480), destined to be grown for dry seeds, differed in consecutive years. The severity of the disease was evaluated according to 6–grade score (from 0 to 5) (Marcinkowska *et al.* 1982). The evaluation was performed at the time of the most disease intensity, usually between last days of July and the first of August. Notes were taken on 4 plots of each genotype.

Seed samples were collected from all tested plots. Each sample comprised 400 seeds and was divided into 2 parts that were evaluated separately. Seed surface were sterilized for 2 min. and 4 min. respectively with 70% ethyl alcohol and 1% sodium hypochlorite and then washed in detergent and thoroughly rinse under tap water. Ten seeds were placed on Coon's agar medium (Ali *et al.* 1978) into a Petri plate of 10 cm diameter. Plates were incubated in temperature from 22 to 23°C under fluorescent light (40 W) for 12 hours a day. A number of infected seeds and seedlings was checked 8 days after sowing in plates as acervuli characteristic for the fungus were already present (Mordue 1971).

Statistical calculations were done with use of Statgraphics Plus Type III programme. Percentage data of seed and seedlings infection were transformed to arcsin and infection degrees converted into the logaritmic scale according to the formula: field=log (field+1). Data of disease intensity in field as well as seed infection on plates were subjected to analysis of variance using F test. Means were separated with Tukey's multiple range test (Marcinkowska 1997). The relationship was performed using procedure of canonical correlations.

RESULTS

Plant infection intensity of 7 tested bean genotypes in field condition by *C. lindemuthianum* varied at Jankowice and Radzików in 1997–1999 (Table 1). Each year there were noticed that the genotypes differed significantly in anthracnose intensity although the differences were shown nonsignificant for localities (Table 2). During growing seasons when the cultivars were investigated Mela and Nida were always the most andthe least susceptible respectively. Incidence of the fungus in particular samples of bean seeds harvested from plots where anthracnose intensity was evaluated for all plant organs finding above the ground also varied both at Jankowice and Radzików during growing season of 1997–1999 (Table 3). Differences were always significant for genotypes but

Table 1.

Intensity of anthracnose on selected bean genotypes in 2 localities within the years 1997–1999 (averages of infection degrees from 4 plots according to the scale from 0 to 5)

Year	Locality	Cultivars			Lines			
		Mela	Nida	Prosna	4376	4537	4369	4480
1997	Jankowice	4.85	–	3.0	2.25	3.5	–	–
	Radzików	4.25	–	1.75	–	–	–	–
1998	Jankowice	4.0	0	1.25	–	3.625	–	–
	Radzików	3.0	0.375	2.0	–	2.75	–	–
1999	Jankowice	3.0	0	1	–	–	1.75	1.75
	Radzików	3.5	0.25	0.75	–	–	2.0	1.25

Table 2.

Variance analysis and multiple range analysis of infection degree of selected genotypes attacked by *C. lindemuthianum* in 2 localities within the years 1997–1999.

Year	Sources of variation	D.f.	Mean square	Significance level	Homogenous groups[1]	Extreme values
1997	Genotypes[2]	3	0.7039	0.0182*	2	0.89 for line 4376 – 1.71 for Mela
	Localities[3]	1	0.347237	0.1626 ^{NS}	1	
1998	Genotypes[2]	3	3.06537	0.0000*	3	0.14 for Nida – 1.49 for Mela
	Localities[3]	1	0.011685	0.6957 ^{NS}	1	
1999	Genotypes[2]	4	1.83237	0.000 0*	4	0.17 for Nida – 1.44 for Mela
	Localities[3]	1	0.021142	0.5919 ^{NS}	1	

D. f. – Degrees of freedom, * – significant; ^{NS} – non–significant
[1]. Number of homogenous groups according to Tukey; [2]. Expressed as mean infection over localities; [3]. Expressed as mean infection over genotypes

Table 3.

Incidence of *Colletotrichum lindemuthianum* on seeds of selected bean genotypes from 2 localities within the years 1997–1999 (an average percentage of infected seeds and seedlings)

Year	Locality	Cultivars			Lines			
		Mela	Nida	Prosna	4376	4537	4369	4480
1997	Jankowice	3.0	–	4.0	0	4.25	–	–
	Radzików	8.25	–	3.25	–	–	–	–
1998	Jankowice	4.25	0	0.75	–	5.75	–	–
	Radzików	6.25	0	4.0	–	5	–	–
1999	Jankowice	4.75	0.5	0.75	–	–	1.75	1.25
	Radzików	2.5	0	0.5	–	–	0.5	0.25

nonsignificant for the localities in 1998 (Table 4). In samples from Radzików collected in 1997 there were more seeds inhabited by *C. lindemuthianum* and less in 1999. In 1998 and in 1999, respectively, none or only a few seeds of cv. Nida transmitted the fungus while of seeds of Mela cultivar were infected by the pathogen in 1997 and 1999 in

the highest degree. Seeds of all tested lines transmitted the fungus but the most infected were ones belonging to the line 4537 (in 1998 their seeds were infected even in higher degree than seeds of Mela).

Table 4.
Variance analysis and multiple range analysis of seed infection of selected bean genotypes from 2 localities attacked by *C. lindemuthianum* (within the years 1997–1999)

Year	Sources of variation	D.f.	Mean square	Significance level	Homogenous groups[1]	Extreme values
1997	Genotypes[2]	3	7.03971	0.0198*	3	0.78 for line 4376 – 3.23 for Mela
	Localities[3]	1	9.97531	0.0251*	2	1.47 Jankowice – 3.05 Radzików
1998	Genotypes[2]	3	23.114	0.0002*	2	0.0 for Nida – 3.80 for line 4537
	Localities[3]	1	8.08412	0.0722 NS	1	
1999	Genotypes[2]	4	4.79421	0.0000*	2	0.14 for Nida – 2.08 for Mela
	Localities[3]	1	3.62291	0.0072*	2	0.43 Radzików – 1.03 Jankowice

D.f. – Degrees of freedom; * – significant; NS – non–significant
[1]. Number of homogenous groups according to Tukey; [2]. Expressed as mean infection over localities; [3]. Expressed as mean infection over genotypes

Table 5.
Relationship between infection of selected *Phaseolus vulgaris* genotypes attacked by *C. lindemuthianum* in the field and the fungus occurrence on seeds.

Year	Number of observations	Correlation coefficient	Relationship
1997	24	0.4885	significant
1998	32	0.7012	highly significant
1999	40	0.5428	significant

Investigations concerning intensity of anthracnose on leaves, stems and pods of 7 genotypes when they were growing in the field and seed infection of samples collected from the evaluated plants under natural field infection showed the existence of significant relationship during whole study period (Table 5). The correlation was positive. The highest correlation coefficient (0.7012) was found four 1998 what indicates the most significant relationship between analysed factors.

DISCUSSION

The obtained results revealed a positive correlation between incidence of *C. lindemuthianum* in bean seeds and intensity of anthracnose on leaves, stems and pods under natural field conditions what agrees with studies of Vechiato *et al.* (1997a) and investigations on *Ascochyta* fungi complex on peas (Marcinkowska 1996). Correlation coefficient in the last two researches was significant only when rainy season occurred in Brazil (Vechiato *et al.* 1997a) and growing periods in Poland were not as dry as in 1992 and 1993 (Marcinkowska 1996). These results underlined

the importance of weather conditions, among other factors, influensing relationship between infection intensity of different parts of plant. Then, if the weather is typical for growing season of temperate zone a bean producer can predict incidence of the fungus in harvested seeds after field inspection of anthracnose intensity (Marcinkowska 1996). Araujo *et al.* (1994), studying 6 races of *C. lindemuthianum,* found a correlation between seed infection and pod reaction and only a partial correlation between reactions of seedlings, pods and seeds. Vechiato *et al.* (1997b) in their investigations led under controlled conditions proved significant correlation between inhabitance of seeds by the fungus and percentage of infected seedlings. The coefficient was not significant for seed transmission and emergence. According to Li Yonghao *et al.* (1992) relationship between resistance of bean pods and leaves to *C. lindemuthianum* was highly significant

Set of the evaluated genotypes was not the same every time during all 3 seasons of observations performed in breeder plots and breeders changed number of lines each year. The goal of these study – selection of susceptible lines – was in contrary to their task. Nevertheless, these investigations supported this one made by Borucka and Marcinkowska (1997) under controlled environment that not only Mela but also Nida and Prosna cultivars were infected by the pathogen. However, much higher susceptibility distinguished Mela cultivar.

REFERENCES

Ali S., Nitschke L. F., Dube A. J., Krause M. R., Cameron B. 1978. Selection of pea lines for resistance to pathotypes of *Ascochyta pinodes, A. pisi,* and *Phoma medicaginis* var. *pinodella.* Aust. J. Agric. Res. 29: 841–849.

Araujo E., Zambolim L., Vieira C., Chaves G. M., Araujo G. A. de A. 1994. Reacoes de plantulas, vagens e sementes de feijao, a seis racas fisiologicas de *Colletotrichum lindemuthianum* (Sacc. et Magn.) Scrib. Revista–Ceres. 41: 237, 584–594.

Borucka K., Marcinkowska J. 1997. Podatność odmian fasoli (*Phaseolus vulgaris* L.) wyhodowanych w IHAR Radzików na *Colletotrichum lindemuthianum.* Mat. I Kr. Konf. Hodowla Roślin, Poznań, 19–20 listopada: 535–538.

Jankowska K. 1928. Spostrzeżenia nad występowaniem chorób roślin uprawnych w woj. lubelskim w latach 1927 i 1928. Pam. PINGW 9: 574–595.

Li Yonghao, Qin Zhiwei, Xu Fengying 1992. Study on the resistance of bean pods and leaves to anthracnose and their correlation. J. Northeast Agric. College 23 (1): 17–19.

Łacicowa B., Machowicz Z., Sułek D. 1975. Metody przydatne do oceny porażenia nasion fasoli przez *Colletotrichum lindemuthianum* oraz grzyby z rodzaju *Fusarium.* Acta Mycologica IX (2): 79–91.

Marcinkowska J.1994. Choroby fasoli notowane w Polsce. Biul. IHAR 190: 169–175.

Marcinkowska J. 1996. *Ascochyta* blight in *Pisum sativum* L. seeds. Pl. Breed Seed Sci. 40 (3–4): 59–71.

Marcinkowska J. 1997. A response of the new Polish dry pea genotypes to *Peronospora viciae* f. sp. *pisi.* Pl. Breed Seed Sci. 41 (1): 51–59.

Marcinkowska J., Tomala–Bednarek J. W., Schollenberger M. 1982. Soybean diseases in Poland. Acta Agrobot. 35 (2): 213–224.

Mordue J. E. M. 1971. Colletotrichum lindemuthianum. Description of Pathogenic Fungi and Bacteria. CMI, Kew, Surrey, 316.

Pięta D. 1985. Mikozy występujące na organach nadziemnych fasoli (*Phaseolus vulgaris* L.) uprawianej na Lubelszczyźnie. Roczniki Nauk Roln., Seria E, 15 (1–2): 23–37.

Pięta D., Łabuda H. 1990. The seed mycoflora of the runner beans (*Phaseolus coccineus* L.). Folia Horticulturae Ann. II/2: 63–75.

Tu J. C. 1992. Bean anthracnose. In: Plant Diseases of Intern. Importance. Vol. II. Diseases of Vegetables and Oil Seed Crops: 1–15.
Vechiato M. H., Castro J. L. de, Ishimura I., Sabino J. C., Menten J. O. M. 1997 (a). Antracnose do feijoeiro: correlaçâo entre severidade em vagens e a incidencia do patogeno nas sementes. (Bean antracnose: reletionship between pod severity and the incidence of the pathogen in the seed.) Fitopatologia Brasileira 22 (2): 159–163.
Vechiato M. H., Kohara E. Y., Menten J. O. M. 1997 (b). Transmissâo de *Colletotrichum lindemuthianum* em semente de feijoeiro comum. (Bean seed transmission by *Colletotrichum lindemuthianum*.) Summa Phytopathologica 23 (3/4): 265–268.
Włodarczyk A. 1972. Oznaczanie ras *Colletotrichum lindemuthianum* występujących na terenie Polski. Biul. Warzywn. XII: 199–203.