Investigation of Fungi Infesting the Caraway Seeds (*Carum carvi* L.) in the South Region of Poland

A. SZCZEPONEK and S. MAZUR

Department of Plant Protection, Agricultural University of Cracow, 31-425 Cracow, Poland

E-mail: awaksmundzka@poczta.onet.pl

Abstract

Studies on the incidence the caraway seeds for pathogen infestation and test the pathogenicity of isolated fungi to caraway seedlings were carried out. A total of 383 fungi were isolated from seeds with evident symptoms of disease and without symptoms of disease. In this case a complex of different pathogens was isolated, among which *Alternaria, Fusarium* and *Epicoccum* were predominant. Pathogenicity assay on caraway seedlings was performed using isolates originating from caraway seeds. All tested fungi showed a very high aggressiveness in pathogenicity test.

Keywords: caraway; fruits; healthiness; pathogenicity; fungi

INTRODUCTION

Fruits of caraway (*Carum carvi* L.) have a lot of essential oil composition and for centuries they were major components of medicine chest and used in the kitchen. Caraway is naturally occurring species on meadows and pastures but for the flavouring and medicinal purposes is mainly collected from the cultivated area. In order to satisfy the demand of consumers for high quality crops for pharmaceuticals, plant breading research has to focus on the impact of fruits composition and on the health state of the plants. Thus, fruits should be free from the parasitic microorganisms that decrease the quality of material. There is also an important problem of a possibility of a propagation of pathogens not yet recognised in the region (MAZUR *et al*. 2001). Caraway is often attacked by many species, which can cause a great damage in crop production. In ONŘEJ's studies (1983) obtained results, showing that there are 33 species of fungi, pathogenic and saprophytic infesting the caraway in Czech Republic. There were fungi from the *Fusarium* genus*, Sclerotinia sclerotiorum, Colletotrichum gleosporioides, Ascochyta carvi*, all these fungi were isolated from leaves, stems, roots and seeds. GABLER and EHRIG (2000) considered *Phomopsis dianchenii* as the main reason of browning umbels annual caraway on plantations in Germany. Studies of EVENHUIS *et al*. (1995) showed that *Mycocentrospora acerina* and *Sclerotinia sclerotiorum* are the main fungi infesting caraway in Holland, transmitted by contaminated soil and infested seeds. The best results for the control of diseases incidence is to determine the factors infesting the caraway fruits in the south region of Poland.

MATERIAL AND METHODS

Experiment started in 2001. The observations were conducted on plantations in the south region of Poland. Their surface area is about a few acres. During period of ripening seeds the field analysis were conducted. 75% of infested umbels had from white to grey coating. The samples of seeds from umbels with these symptoms and without symptoms of infestation were obtained. In laboratory the detailed mycologic investigation were conducted. On plates with potato dextrose agar PDA (Difco) 200 seeds isolated from diseased umbels and 200 seeds without visual symptoms of infection were maintained. The samples of 100 seeds from each group were disinfectioned with 70% of ethanol. Identification of fungi was based on their growth characteristic and conidial morphology.

The pathogenicity of isolated fungi to caraway seedlings was also determined. Test involved inoculation healthy seedlings with the desired fungus and was carried out on two weeks caraway seedlings. Four

species of fungi: *Alternaria alternata, Epicoccum purpurascens, Fusarium avenaceum* and *F. oxysporum* were tested. Seeds of caraway were placed in test tubes on filter paper. After 14 days seedlings without visible symptoms of disease were sprayed suspension of spores (density $10^6/cm^3$ distilled water). Control seedlings were sprayed distilled water. Each treatment contained 10 seedlings and the experiment was performed with four replications. Disease rating were taken after seven days and after fourteen days and were based on the estimated percentage of diseased seedlings. The data obtained were subjected to an analysis of variance. Duncan's multiple range test at 5% level of significance was used for means separation.

RESULTS AND DISCUSSION

The total number of 383 colonies of fungi and 140 colonies of bacteria was identified. 166 colonies of fungi were isolated from seeds without evident symptoms of disease. Surface disinfection of seeds had influence on quality and quantity composition obtained isolates, both fungi and bacteria. *Alternaria alternata* was the commonest one and constituted 36.8% to 85.5% all isolated pathogens in each variant of the experiment (Table 1). *Alternaria alternata* has been found to be a common inhabitant of caraway seeds. *Alternaria alternata* is a surface contaminant and very likely an internal inhabitant of disinfected and nondisinfected seeds. However, fungi incidence on seeds is destructive because they are transmitted later on plants and can cause rot of plant organs (GAUR & SINGH 1990). In studies of MACHOWICZ-STEFANIAK and ZIMOWSKA (1998) *Alternaria alternata* is a common inhabitant of many medicinal plants. Second identified species *Alternaria tenuissima* was present only on seeds nondisinfected, it means that this form was saprophytic. It was also noted that in the genus *Fusarium* two species: *F. avenaceum* and *F. oxysporum* were identified. The last one was gain from seeds without symptoms of disease (Table 1). Every time but in different intensity, species *Epicoccum purpurascens* was isolated from seeds. It is seems to be that this fungus has features of parasitic organism, especially when germination seeds are delayed weather conditions or another pathogens. We conclude that fungus was isolated from disinfected seeds surface, it means that pathogen is inside the seeds, probably in resting stage. This fungus is considered for some authors for saprogenic, another time for obligatory parasitic. In our experiment was very pathogenic for seedlings (Table 2). From nondisinfected seeds without symptoms of disease species *Phoma exiqua* var. *exiqua* was also obtained (Table 1). In this part of seeds, percentage contribution was 11.1% and was on second place in relation to frequency of occurrence fungi. This species was also isolated from caraway through another scientists but mainly from roots and stems and caused very often rotting this part of plants (ONDŘEJ 1983). This species has also ability to inhibition germination of different kind of species. Surface disinfecting only partly inhibited occurrence of bacteria, it means that bacteria can cause development of disease later especially they can cause scale of inflorescence and necrosis of sprouts (STUDZIŃSKI & MIKOŁAJEWICZ 1989). In all, the quantity of isolated species is lower then in experiments leaded by MACHOWICZ-STEFANIAK and ZIMOWSKA (1998), ONDŘEJ (1983). This event can be caused very strong infestation through

Table 1. The species of microorganisms isolated from caraway seeds (in %)

Microorganisms	Seeds without symptoms of disease		Seeds with evident symptoms of disease	
	disinfected	nondisinfected	disinfected	nondisinfected
Alternaria alternata (Fr.) Keissl.	53.8	36.80	85.50	51.10
Alternaria tenuissima (Kunze) Wittshire	–	3.50	–	12.20
Epicoccum purpurascens Ehrenb. & Schl.	0.85	2.00	1.44	3.80
Fusarium avenaceum (Corda ex Fr.) Sacc.	0.85	6.25	–	9.20
Fusarium oxysporum Schlecht. ex Fries. emend. Snyd. et Hans.	0.85	6.25	–	–
Phoma exiqua Desm. var. *exiqua*	–	11.10	–	–
Bacteria	44	34.10	12.90	23.70
Total	100	100	100	100

Alternaria alternata. The main reason could be climatic factors especially benefits for development this pathogen, which according to Indian scientists (BHARGAVA & KHARE 1988) can very quickly infect seeds in temperature above 25°C and humidity above 80%. This fungus probably caused visibly symptoms of infestation. Earlier investigations of GABLER (2001) concerning diseased caraway plants showed that this species was one of the main reason of browning umbels and *Phomopsis diachenii* which was not isolated in our research.

All tested fungi in laboratory conditions were pathogenic for caraway seedlings (Table 2). Pathogenicity was differentiated in relation to tested fungi and duration of the experiment. First symptoms of disease caused *Fusarium avenaceum*. After seven days 65% seedlings were infested, and after fourteen days all tested seedlings were diseased. *Alternaria alternata* was very pathogenic and the infection was 95%. Disease evaluation caused by *Alternaria alternata* and *Fusarium oxysporum* was lower, because after seven days 32.5% and 17.5% seedlings, relatively was infected. After two weeks such symptoms were observed in 95% seedlings sprayed *Alternaria alternata* and 80% seedlings were diseased by *Fusarium oxysporum*. *Epicoccum purpurascens* caused 75% diseased seedlings, it confirmed our earlier investigations about its pathogenicity. All tested fungi were isolated from caraway fruits. Reisolation after ending of the experiment confirmed pathogenicity of these fungi.

Table 2. Pathogenicity of fungi to caraway seedlings

Species of fungi	Percentage of diseased seedlings after	
	7 days	14 days
Alternaria alternata	32.5 c	95.0 d
Epicoccum purpurascens	55.0 d	75.0 b
Fusarium avenaceum	65.0 e	100.0 e
Fusarium oxysporum	17.5 b	80.0 c
Control	0.0 a	0.0 a

Means followed by the same letter do not differ with 5% of significance (Duncan's multiple range test).
Means separation for each column.

References

BHARGAVA P.K., KHARE M.N. (1988): Epidemiology of *Alternaria* blight on chickpea. Indian Phytopathology, **41**: 195–198.

EVENHUIS A., VERDAM B., GERLAGH M., VAN DE GOOSEN-GEIJN H.M. (1995): Studies on major diseases of caraway (*Carum carvi* L.) in the Netherlands. Ind. Crops Products, **4**: 53–61.

GABLER J. (2001): Neue Erkenntnisse über die Doldenbräune des einjährigen Kümmels (*Carum carvi* L. var. annuum hort.). Z. Arznei Gewürz-Pfl., **6**: 115–119.

GABLER J., EHRIG F. (2000): *Phomopsis diachenii* Sacc., ein aggressiver Krankheitserreger an Kümmel (*Carum carvi* L.) – Erstnachweis für Deutschland. Z. Arznei Gewürz.-Pfl., **1**: 36–39.

GAUR V.K., SINGH R.D. (1990): A new report of *Alternaria* blight of chickpea from Rajasthan, India. Indian J. Mycol. Plant Pathol., **20**: 77–78.

MACHOWICZ-STEFANIAK Z., ZIMOWSKA B. (1998): Grzyby zasiedlające nasiona niektórych roślin zielarskich. Zesz. Nauk. AR Krakow, Nr. 333, Sesja Naukowa z., **57**: 187–190.

MAZUR S., NAWROCKI J., KUĆMIERZ J. (2001): Fungi isolates from chickpea (*Cicer arietinum* L.) seeds. Veg. Crops Res. Bull., **54**: 77–81.

ONDŘEJ M. (1983): Výskyt hub na kmínu (*Carum carvi* L.) v ČSSR. Ochr. Rostl., **19**: 235–237.

STUDZIŃSKI A., MIKOŁAJEWICZ M. (1989): Choroby i szkodniki roślin zielarskich. Cz. V. Kminek zwyczajny. Wiadomości Zielarskie, **6**: 5–7.