Monitoring of Incidence and Determination of Fungi on Caraway, Fennel, Coriander and Anise, Consideration of Disease Importance and Possibility of Chemical Protection

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Abstract

The incidence of fungi on caraway (*Carum carvi* L.), fennel (*Foeniculum vulgare* Mill.), coriander (*Coriandrum sativum* L.) and anise (*Pimpinella anisum* L.) was observed on several localities in the Czech Republic. Incidence of 26 parasitic and saprophytic fungi were found on fennel, 35 species on coriander, 21 species on anise and 34 species on caraway. Small plot trials of spices were evaluated during the whole growing season. The fungicides in caraway were applied in different growth stages. The test results showed high effectiveness of autumn and early spring applications on the most dangerous pathogen of caraway – *Mycocentrospora acerina*. Three fungicides were tested in fennel field trials showing sufficient force against pathogenic fungus *Cercosporidium punctum*. The complex of root fungi causes the serious damage of coriander. Foliar application of fungicides did not present adequate effect. Four growth regulators were tested, but all of them increased incidence of fungi *Fusarium* sp. and *Alternaria alternata*.

Keywords: spices; caraway; *Carum carvi*; coriander; *Coriandrum sativum*; fennel; *Foeniculum vulgare*, anise; *Pimpinella anisum*; fungi; fungicides

INTRODUCTION

Caraway, coriander, fennel and anise are members of the family *Umbelliferae*. These crops are usually cultivated for their nutritional and medicinal importance. They are grown for their seeds which are used as a spice to flavour food and also as a source of essential oils. This work was undertaken to identify and to determine the incidence of fungi which contaminate the seeds.

MATERIAL AND METHODS

Collection of samples. We collected samples of caraway, coriander, fennel and anise from different regions of the Czech Republic. Samples of caraway were collected from 1997 to 2001, samples of coriander, fennel and anise were collected from 1999 to 2002.

Determination of fungi. Microscopic search – 1 g of seeds were dipped in 5 ml of water and stirred for 1 hour. Obtained suspension was centrifugated, supernatant of suspension (4 ml) was removed and 1 ml of pellet was microscopically determined and spores of fungi were enumerated.

Isolation of fungi on agar medium – the seeds were plated on thin layer of Czapek-Dox agar. The fungi were cultivated for 7–15 days and then microscopically determined.

Field trials. The field trials were established in Šumperk in 1997 to 2002. All of them were sown in plots in randomised block design with four replications.

Variants of fungicide treatment in caraway were (Alert – 1 l/ha, Duett – 1 l/ha, Caramba – 1 l/ha and untreated control). Row spacing was 12.5 cm and sowing density was 12 kg/ha. First fungicide application in caraway was in autumn on leaf rosette, the second application was in early spring and the

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third application was at the beginning of flowering, fourth application was in the phase of green maturity. Occurrence of the most dangerous pathogen (*Mycocentrospora acerina*) spores was evaluated on leaves and on harvested seeds.

The main problem in coriander is the destructiveness of seed-borne fungi which cause decreasing emergence and dying of plants at early growth stages. Seed treatment with fungicides was studied in field trials (Vitavax 200 FF – 10 l/ha, Maxim XL – 5 l/ha, Raxil 515 FS – 10 l/ha, Premis 025 FS – 7.5 l/ha and untreated control). Treated seeds were sown in plots 0.6 × 1 m. Row spacing were 10 cm and sowing density was 20 kg/ha. The experiments was assessed via emergence, dynamics of emergence, number of harvested plants and their health, yield of seeds.

Four growth regulators were tested in another trial (Roundup – 3 l/ha, Harvade – 2 l/ha, Reglone 3 l/ha, Basta 2 l/ha and untreated control). Occurrence of fungi especially *Fusarium equiseti* and *Alternaria alternata* as potential toxigenic agents were investigated. The content of essential oils was measured by the process of steam distillation.

The most frequently occurred pathogen of fennel is *Cercosporidium punctum*. Three fungicides were applied on fennel plants in full flowering stage (Rubigan – 0.5 l/ha, Alert – 1.0 l/ha, Duett – 1.0 l/ha). The trial was established in randomised block design with four replications. The effectiveness of application of fungicides was evaluated via the incidence of *Cercosporidium* on leaves 30 days after applications.

RESULTS AND DISCUSSION

More than thirty fungal species were isolated from plant samples of caraway, coriander, fennel and anise (Table 1). The most harmful for plants at early stages were *Fusarium oxysporum*, *F. equiseti* etc. In general the complex of root pathogens cause the worse yield loses. The observed spectrum of fungi on caraway was simillar as presented in literature sources (EVENHUIS 1997; NÉMETH 1998). The most important decreasing of yield cause *Mycocentrospora acerina*. The spectrum of fungi on coriander seeds was different than spectrum presented in literature (HASHMI & GHAFFAR 1991; SRIVASTAVA & JAIN 1992; MAHOR *et*

Table 1. The list of occurred fungi on caraway, coriander, fennel and anise

CARAWAY	*Alternaria alternata, Alternaria tenuissima, Ascochyta carvi, Aureobasidium pullulans, Botrytis cinerea, Cladosporium cladosporioides, Cladosporium herbarum, Colletotrichum gloeosporioides, Cylindrocarpon destructans, Dendryphion nanum, Epicoccum purpurascens, Erysiphe heraclei, Fusarium avenaceum, Fusarium equiseti, Fusarium oxysporum, Fusarium* sp.*, Itersonilia pastinaceae, Mycocentrospora acerina, Phoma exigua, Phoma apiicola, Phomopsis* sp.*, Rhizoctonia solani, Sclerotinia sclerotiorum, Septoria carvi, Stemphylium botryosum, Volucrispora* sp.
CORIANDER	*Alternaria alternata, Alternaria dauci, Alternaria tenuissima, Ascochyta phomoides, Aureobasidium pullulans, Botrytis cinerea, Cladosporium cladosporioides, Cladosporium herbarum, Colletotrichum gloeosporioides, Cylindrocarpon destructans, Dendryphion comosum, Dendryphion nanum, Diaporthopsis angelicae, Didymospora* sp.*, Erysiphe heraclei, Fusarium avenaceum, Fusarium equiseti, Fusarium oxysporum, Fusarium* sp.*, Gonatobotrys simplex, Itersonilia pastinaceae, Leptosphaeria purpurea, Leptosphaeria* sp.*, Periconia* sp.*, Phoma apiicola, Phoma* sp.*, Plasmopara nivea, Pythium* sp.*, Ramularia coriandri, Rhizoctonia solani, Sclerotinia sclerotiorum, Septoria coriandri, Stemphylium botryosum*
FENNEL	*Alternaria alternata, Alternaria tenuissima, Ascochyta phomoides, Aureobasidium pullulans, Botrytis cinerea, Cercosporidium punctum, Cladosporium cladosporioides, Cladosporium herbarum, Cladosporium macrocarpum, Colletotrichum gloeosporioides, Dendryphion nanum, Diaporthopsis angelicae, Didymospora* sp.*, Epicoccum purpurascens, Fusarium avenaceum, Fusarium equiseti, Fusarium* sp.*, Gonatobotrys simplex, Itersonilia pastinaceae, Leptosphaeria purpurea, Melanconiales* sp.*, Periconia* sp.*, Phoma apiicola, Ramularia foeniculicola, Stemphylium botryosum, Volucrispora s*p.
ANISE	*Alternaria alternata, Alternaria tenuissima, Aureobasidium pullulans, Botrytis cinerea, Cladosporium cladosporioides, Cladosporium herbarum, Cladosporium macrocarpum, Cylindrocarpon destructans, Dendryphion nanum, Epicoccum purpurascens, Erysiphe heraclei, Fusarium avenaceum, Fusarium equiseti, Fusarium oxysporum, Fusarium* sp.*, Itersonilia pastinaceae, Mycocentrospora acerina, Plasmopara nivea, Rhizoctonia solani, Stemphylium botryosum*

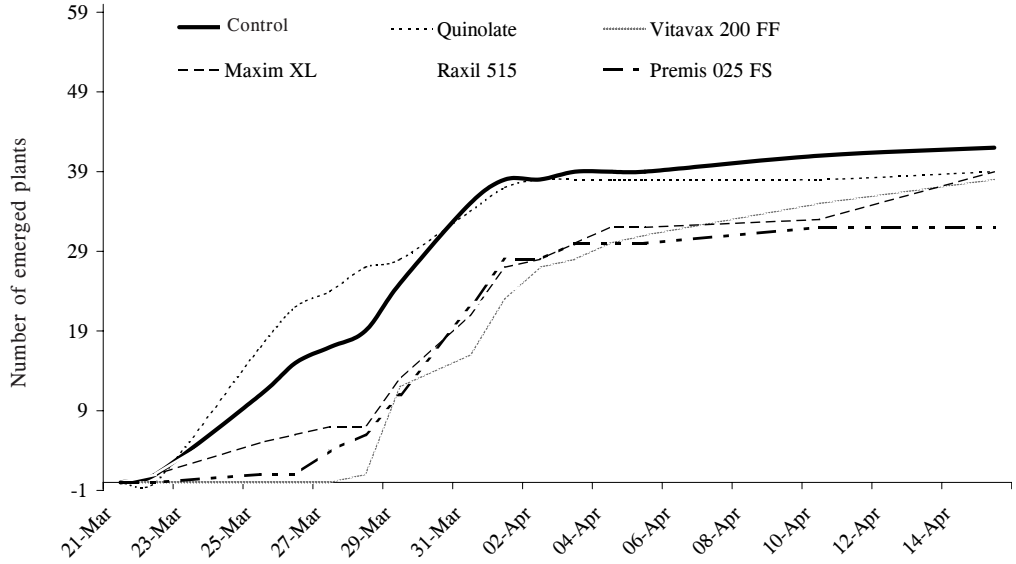

Figure 1. Dynamics of coriander seedlings emergence after fungicide treatment (number of plants per plot; mean of four replications)

al. 1982). In India the main problem is *Protomyces macrosporus* and *Erysiphe heraclei* (SITARAMA *et al*. 1982; BHARDWAJ *et al*. 1985). In our conditions *Erysipe* is not so damaging, the fungus *Protomyces* did not occur but the most important problem is complex of root fungi (*Rhizoctonia solani*, *Pythium* sp., *Fusarium oxysporum* and others). On fennel and anise the literature sources presents occurrence of *Penicillium*, *Mucor*, *Aspergilus* and *Rhizopus* (MOHARRAM *et al*. 1989). These fungi are the most dangerous

Table 2. Influence of fungicide application in different growth stages of caraway on incidence of *Mycocentrospora acerina* on leaves and harvested seeds

	Number of pathogen spores on leaves				Number of pahogen spores on harvested seeds			
	Growth stage at application				Growth stage at application			
	leaf rosette	early flowering	full flowering	green maturity	leaf rosette	early flowering	full flowering	green maturity
Untreated	4.8				2.7			
Alert	5.0	3.6	0.3	0.0	3.0	1.6	0.0	0.0
Duett	4.9	3.2	0.3	0.0	3.1	1.5	0.0	0.0
Caramba	5.2	2.5	0.4	0.0	3.1	1.8	0.0	0.0

Table 3. Influence of seed treatment on number of harvested plants and on yield of coriander seeds

	Number of emerged plants	Number of harvested plants		Yield of seed (t/ha)
		healthy	attacked by root diseases	
Untreated	181.25	90.25	78.0	2.8
Vitavax 200 FF	181.25	106.67	69.67	2.7
Maxim XL	190.25	107.25	67.75	2.7
Raxil 515	185.50	98.25	75.50	2.8
Premis 025 FS	201.75	111.25	83.50	2.7

Table 4. Influence of growth regulators on yield and quality of harvested coriander seeds

	Number of plants per 1 m^2	Number of occurred spores in		Content of essential oils (% FW)	Yield of seeds (t/ha)
		Fusarium	*Alternaria*		
Untreated	113.33	8.40	2.40	0.96	0.61
Roundup	100.00	10.80	2.83	0.93	0.61
Basta	124.33	12.77	3.20	0.87	0.54
Reglone	118.67	5.23	3.33	0.59	0.50
Harvade	115.33	6.00	2.33	1.06	0.44

for their production of mycotoxins but they occur in bad stored commodity.

Application of fungicides at the stage of leaf rosette did not influence the incidence of pathogen spores. Even the stage of early flowering was not critical for the incidence of developmental fungal spores on leaves or seeds. Critical stage for effective fungicide treatment was the stage of full flowering (Table 2).

The dynamics of emergence was strongly affected with early applications of fungicides. All chemical treatments under study decreased the dynamics of emergence – the most retardic fungicide was Vitavax 200 FF. The best results were obtained in variants treated with Maxim XL and Premis 025 FS. Nevertheless, as visible from Figure 1, in further development all variants increased viability nearly to the same level.

Seed treatment in all variants used in this experiments with coriander did not influence significantly the plants fitness or yield of seeds (Table 3).

After application growth regulators we observed changes in the incidence of *Fusarium* spp. Roundup and Basta caused increase of spore number of *Fusarium* spp. compared with control. *Alternaria* occurrence was not affected with the treatment of regulators. Differences in yield of seeds were caused by non-uniform growth and they were not statistically significant. The lowest content of essential oils was on plot treated with Reglone. From the data presented in Table 4 we conclude that the best influing growth regulator was Harvade.

High significant differences among incidence of *Cercosporidium* spores on leaves in experiments with fennel were found. The best results of treatment gave Duett and Alert (Table 5). The fungicide applications in fennel showed a good effectiveness on *Cercosporidium* but there are problems with application mechanisation because the plants are very high when start to flower.

Table 5. Influence of fungicide application on *Cercosporidium* incidence on fennel leaves

	Number of *Cercosporidium* spores
Untreated	4.83
Rubigan	1.33
Alert	0.03
Duett	0.00

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