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DILL (*ANETHUM GRAVEOLENS* L.) SEED STALK ARCHITECTURE AND SEEDS INFESTATION WITH FUNGI

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Abstract. In the years 2002-2004 seeds of dill 'Amat' harvested from four different umbel position were evaluated for their infestation with fungi. On the tested seeds *Alternaria alternata, Cladosporium* spp., *Epicoccum purpurascens*, *Gonatobotrys simplex* and *Trichothecium roseum* were occurring the most frequently. The seed stalk architecture influenced infestation of disinfected seeds with *A. alternata* and non-disinfected seeds with *Cladosporium* spp.

Key words: dill, fungi, seeds

INTRODUCTION

Dill has been one of the most important spice vegetable grown in Poland. Mature plants with develop umbels are the basic spices in the production of pickled cucumbers while their extracts are used in food industry, cosmetics and medicine. Nevertheless, there have been problems in some years with obtaining high quality seeds of this plant (Woyke and Komorowska, 1988; Janas et al., 1994; Kołosowski, 1994; Dyduch, 2000). In Poland, many experiments devoted to dill seeds quality, also considering seed stalk architecture, have been performed (Woyke and Łazęcka, 1993; Bralewski et al., 2005). However, there is a lack of the literature data concerning the effect of dill seed stalk architecture on seeds infestation with fungi.

Dill like many herbs is considerably resistant to many common plant diseases. However, the plant can bee strongly affected by seed-borne *Alternaria* sp., causing *Alternaria* blight (Janas et al., 1994; Richardson, 1996). The fungus becomes active during germination process, and gradually spreads throughout the entire plant causing leaves to become discoloured and drop from the plant. Many times, all seeds produced by infected plants were infested with *A. alternata* (Kołosowski, 1994).

MATERIALS AND METHODS

The experiment was carried out in the years 2002-2004. The aim of the experiment was to asses the effect of dill stalk architecture on seed infestation with fungi. Each year twenty mature seed stalks of dill (*Anethum graveolens* L.) cv. 'Amat' were harvested randomly from the seed plantation. The seed stalks were threshed manually and separate seed lots from primary, secondary, tertiary and quaternary umbels were created.

The seed health analysis was performed on 400 non-disinfected and 400 disinfected seeds from each seed lot by the deep-freezing blotter method, according to ISTA Rules (1987). For disinfection seeds were soaked for 10 min in 1% aqueous sodium hypochlorite solution and then rinsed three times in sterile distilled water and drying with sterile blotting paper. Disinfected and non-disinfected seeds were plated on six layers of moistened blotters

in Petri dishes at the rate of 20 seeds per dish. The dishes were kept in darkness at 20°C for three days, at -20°C for 20 h and then for eight days at 20°C, under 12 h alternating cycles of NUV light and darkness. The seeds were examined for presence of fungi using a stereomicroscope and compound microscope. The results obtained were evaluated by analysis of variance followed by Student's multiple range test.

RESULTS AND DISCUSSION

The following fungi were identified in the seeds tested: *Acremoniella atra* (Corda) Sacc., *Alternaria alternata* (Fr.) Keissler, *Bipolaris sorokiniana* (Sacc.) Shoem., *Chaetomium* spp., *Cephalosporium* spp., *Cladosporium* spp., *Epicoccum purpurascens* Ehrenb. ex Schlecht., *Fusarium* spp., *Gonatobotrys simplex* Corda, *Penicillium* spp., *Rhizopus* spp., *Stemphylium botryosum* Wallr., *Trichothecium roseum* (Pers.) Link ex S.F. Gray and *Verticillium* spp. Among them *A. alternata, Cladosporium* spp*., E. purpurascens, G. simplex* and *T. roseum* were occurring the most frequently (Table 1).

Table 1

Effects of dill seed stalk architecture on the seeds infestation with fungi, mean for years 2002-2004

Fungi	The percentage of seeds infested							
	Disinfected seeds				Non-disinfected seeds			
	Primary umbels	Secondary umbels	Tertiary umbels	Quaternary umbels	Primary umbels	Secondary umbels	Tertiary umbels	Quaternary umbels
Acremoniella atra	-*	-	-	-	0 a**	0 a	0 a	0.2 a
Alternaria alternata	97.7 c	94.5 c	64.0 b	33.2 a	100.0 a	99.8 a	100.0a	100.0 a
Bipolaris sorokiniana	-	-	-	-	1.3 b	0.2 a	0.2 a	0.5 a
Chaetomium spp.	0.2 a	0 a	0 a	0 a	-	-	-	-
Cephalosporium spp.	0 a	0.2 a	0.2 a	0 a	0.2 a	0 a	0 a	0 a
Cladosporium ssp.	0.3 a	1.3 a	0.5 a	0.2 a	7.0 a	7.8 a	28.2 b	75.7 c
Epicoccum purpurascens	0.8 a	0.5 a	0 a	0.5 a	9.5 a	10.2 a	9.0 a	23.5 a
Fusarium spp.	0.2 a	0.2 a	0.3 a	0 a	1.0 a	1.3 a	0.2 a	0.2 a
Gonatobotrys simplex	1.0 a	0.2 a	0 a	0 a	19.2 a	11.7 a	15.2 a	13.0 a
Penicillium spp.	0.5 a	0 a	1.2 a	0 a	-	-	-	-
Rhizopus spp.	-	-	-	-	0.3 a	0 a	0 a	0.2 a
Stemphylium botryosum	0.7 a	0.7 a	1.0 a	0 a	3.7 a	0.7 a	1.2 a	0.5 a
Stemphylium consortiale	0 a	1.0 a	0.2 a	0 a	0.8 a	0.5 a	0.2 a	0.7 a
Trichothecium roseum	0 a	0 a	0.3 a	0 a	16.8 a	27.3 a	21.8 a	32.5 a
Verticillium spp.	0.2 a	0 a	0 a	0 a	0 a	0.2 a	0 a	0 a
Non-sporulating fungi	0.2 a	0.3 a	0 a	0 a	0.2 a	0.3 a	0.2 a	0 a
Seeds free from fungi	2.0 a	5.2 b	34.5 c	57.0 d	0 a	0 a	0 a	0 a

Explanations: * Not detected.

** Means in the same row, separately for disinfected and non-disinfected seeds, followed by the same letter are not significantly different at $\alpha = 0.05$ level according to Student range test.

The results obtained varied depending on the treatment methods and place of seed formation on the seed stalks. Surface sterilization resulted in decrease in seed infestation, especially with *Cladosporium* spp., *E. purpurascens*, *G. simplex* and *T. roseum*. Non-disinfected seeds were characterized with very high level of infestation with *A. alternata*. Even after disinfection the fungus was still present in 97.7% of seeds from primary and 94.5% of seeds from secondary umbels, although the number of infested seeds decreased in the lots from higher-order umbels. It was correlated with increase of number of seeds free from fungi. High dill seed infestation with these fungi was noted by many researchers, which simultaneously emphasized dominant role of *A. alternata* in total seed infection (Janas, 1994; Kołosowski, 1994). Maude (1996) suggested that necrotrophic pathogens, such as *A. alternata*, generally were located on the seed surface, as contaminating organism, or in the seed coat tissues. Obtained results showed tendency of the fungus to grow inside seed during maturation. This phenomenon may favour *A. alternata* seed transmission. The fungus, which being a facultative parasite, may quickly change itself into a pathogenic one and accelerate the occurrence and intensity of disease on certain plants (Kwaśna, 1992). Janas *et al.* (1994) reported that seed infestation with *Alternaria* sp. was inversely proportional to their germination and plant emergence. Additionally, high level of seed infestation with the fungus, create possibility of contamination of herbal material with *Alternaria* toxins. *A. alternata* is known producer of different mykotoxins harmful for humans and animals, such as: alternariol, alternariol methyl ether, altenuene, tenuazonic acid and altertoxin I (Tylkowska et al., 2003).

The seed stalk architecture influenced also significantly contamination of non-disinfected seeds with *Cladosporium* spp. Contrary to *A. alternata*, the fungus infested mainly seeds from tertiary and quaternary umbels. Tylkowska (1991) suggested that younger and undeveloped seeds from higher-order umbels could be easily affected, unlike the mature seeds produced by primary or secondary umbels. Besides, poorer ventilation of lower parts of plants and a following increase of humidity favour growth of the most of fungi.

The results showed that umbels position on dill stalk significantly influenced seed infestation with some fungi and that the further studies should be taken, because the presence of fungi not only deteriorate seed germination and emergence, but also could be harmful to the health of consumers.

CONCLUSIONS

Tested seeds were strongly affected by fungi. Among them *A. alternata, Cladosporium* spp*., E. purpurascens, G. simplex* and *T. roseum* were occurring the most frequently.

In general, disinfection decrease the number of seeds infested with fungi. The umbels position significantly affected seed infestation with *A. alternata* and *Cladosporium* spp.

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REZUMAT

ARHITECTURA TULPINILOR FLORIFERE DE MĂRAR (*ANETHUM GRAVEOLENS* L.) ŞI INFESTAREA SEMINȚELOR CU FUNGI

În anii 2002-2004 semințe ale soiului ‘Amat’, recoltate din patru poziții diferite ale umblelor, au fost evaluate în privința infestării lor cu fungi. La semințele analizate, cei mai frecvenți agenți patogeni au fost *Alternaria alternata, Cladosporium* spp., *Epicoccum purpurascens*, *Gonatobotrys simplex* şi *Trichothecium roseum.* Arhitectura tulpinilor semincerilor a influențat în special infestarea cu *A. alternata* (a semințelor dezinfectate) şi *Cladosporium* spp. (a semințelor nedezinfectate).