Influence of Presowing Conditioning and Fungicide Application on the Seed and Seedling Vigour and Yield of Coriander (*Coriandrum Sativum* L.) Seeds

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Abstract

Coriander seeds were matriconditioned with MicroCel-E and osmoconditioned in PEG solution and then treated or not treated with fungicide. The microbiological infestation of conditioned and control seeds were on a similar level. Both tested conditioning methods increased significantly the seed and seedling vigour, whereas fungicide application had no effect. The only significant differences between matriconditioning and osmoconditioning were found in leaf DNA content. The advantageous effect of presowing conditioning was proved also with respect to coriander seed yield, oil content, and oil yield. Depending on the location of field experiments, the coriander crop from osmoconditioned and matriconditioned seeds responded in a different pattern of yielding. The same concerned the fungicide application. The tested methods of presowing treatments did not change the quality and quantity composition of coriander oil significantly.

INTRODUCTION

Coriander seed yield is affected by many factors during the vegetation period. This crop culture starts by direct sowing to the open field in spring. Environmental conditions in this period are often unfavourable for germination and contribute to a delayed and uneven emergence. This, in turn, affects negatively further growth and development of plants and their yield. Various methods of presowing seed treatment have been reported to improve plant stand establishment and yields (Andreoli, 1997). In the case of coriander crop the increase in germination capability and also in leaf yield was noted after seed permeation with gibberellic acid (Badgujar and Warhal, 1988; Banafar, 1994). Jeliazkova et al. (1997) obtained a significantly higher yield of coriander seed and oil after subjecting seeds to γ-irradiation. Previous investigation by Dąbrowska et al. (1999) evidenced an increase both in seedling vigour and in yield due to seed conditioning. The microbiological infestation of many vegetable seeds was found to rise after their presowing priming. The fungicide application showed different results both with respect to initial plant growth and yield (Khan et al., 1992; Szafirowska and Khan, 1995; Tylkowska and Biniek, 1996).

The objective of this study was to determine the effect of presowing conditioning and fungicide application on the seedling vigour and seed yield of coriander crop.

MATERIALS AND METHODS

The initial germination capability of coriander seeds, tested according to ISTA (1993), was 75 %. Presowing treatments of coriander seeds were as follows: MCE – matriconditioning with MicroCel-E (weight ratio of seed:carrier:water as 2:1:4), at 15˚C, in light, for 7 days; PEG – osmoconditioning in polyethylene glycol PEG 6000 solution (280 g kg^{-1}), at 15˚C, in light, for 6 days. After conditioning seeds were rinsed and dried

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at 20±0.5˚C. Non-conditioned seeds were used as a control. Two seed lots of every above combination were tested. The first was dressed with mancozeb (Penncozeb 80WP, 3 g. kg^{-1}), the second was not treated with fungicide. Phytopathological analysis concerned control and conditioned seeds. Incubation on PDA medium was carried out at 20˚C, with NUV irradiation in alternating cycle 12/12 h, for 14 days. Microflora was determined in germinating and non-germinating seeds and recalculated to percentage of infestation. The effect of conditioning and fungicide application on the vigour of seeds was tested after their sowing (8 times 50 seeds in each combination) in peat-moss substrate in the growing chamber MLR 350H at 15/10˚C (day/night) and four-hour irradiation (5000 lux) per day. Emerging seedlings were counted every second day until their number stopped increasing (emergence capability). The relative speed of emergence (number of seeds germinating per day) was calculated according to Maguire (1962). Fresh weight of a seedling and the content of DNA (Rogers and Bendich, 1985) were determined on the 40th day after sowing.

Field experiment was conducted in parallel in two locations, i.e. in Southern Poland (Mydlniki near Krakow) on clayed silt soil and in Central Poland (Wilanów near Warsaw) on alluvial soil with silt formation. It was established in a randomised block design with 4 replications. Seeds were sown in rows 40 cm apart in the 2nd ten days of April. Plants were harvested in the 3rd ten days of August, seed yield after air-drying was determined. Seed essential oil content was determined by steam-distillation. Its quality and quantity composition was analysed by gas chromatography (Hewlett-Packard with instrumentation). The results were subjected to ANOVA at α=0.05. Significant differences of means were marked with different letters.

RESULTS AND DISCUSSION

The applied methods of presowing conditioning did not increase the degree of coriander seed infestation by microorganisms (Table 1), while other authors (Tylkowska and Biniek, 1996) stressed that seed treating with PEG solution caused a rise in microflora infestation. The vigour of coriander seeds and seedlings after osmo- and matriconditioning were significantly higher than that of control (Table 2). The differences between PEG and MCE were found significant only in DNA content of seedlings. Fungicide treatment did not affect the vigour of seeds. The only significant differences between treated and non-treated mancozeb were found in DNA content of seedlings from control and matriconditioned seeds.

Yields and quality do not always confirm the advantageous effect of presowing seed priming on the emergence and initial growth of plants (Parera and Cantliffe, 1994). In the present investigation the effect of applied methods of conditioning lasted during coriander vegetation in the field, which was evidenced in the yield (Table 3). The yield of seeds, content and yield of essential oil were significantly higher with the crop from conditioned seeds than from control ones. Nevertheless, the response of plants to the two methods was different in the two locations of coriander growing. In Krakow the highest yield of seeds and oil and also oil content were determined with the crop from osmoconditioned seeds, while in Warsaw the same was obtained from the crop raised with matriconditioned seeds, which was consistent with the previous work (Capecka et al., 2000). Such contradictory effects of PEG and MCE treatments on the final yield of coriander grown in the two locations, together with no differences between both these methods with respect to seed vigour, suggested that results of presowing conditioning were modified further during plant growth, depending on environmental conditions. The similar observations concerned the fungicide application. In Krakow it contributed to the higher yield of seeds and oil but usually lower oil content in seeds, while in Warsaw it remained without a significant effect (Table 3). Khan et al. (1992) and Szafirowska and Khan (1995) also reported on different results of fungicide application combined with seed conditioning. The content of 16 identified compounds in coriander essential oil (Table 4) did not change significantly either in presowing seed conditioning or fungicide application.

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Tables

Table 1. Infestation of coriander seeds by microorganisms as depending on presowing treatment (%).

Microorganism	Seed treatment*		
	Control	MCE	PEG
Acremoniella atra (Corda) Sacc.	1.0	-	-
Alternaria alternata (Fr.) Keissler	20.5	18.0	15.0
Ascochyta sp.	-	-	0.5
Aspergillus spp.	9.5	10.0	13.5
Aureobasidium pullulans (de Bary) Am.	10.5	14.0	12.5
Bipolaris sorokiniana (Sacc.) Shoem.	2.5	2.0	-
Cephalosporium sp.	0.5	0.5	1.0
Chaetomium sp.	0.5	0.5	-
Cladosporium herbarum (Pers.) Link ex Fr.	4.5	4.0	3.0
Drechslera sp.	-	-	0.5
Drechslera avenae (M.A. Curtis ex Cooke) Shoem.	-	-	0.5
Drechslera dematioidea (Bub. & Wrob.)Subram. & Jain	-	-	0.5
Epicoccum purpurascens Ehrenb. ex Schlecht.	4.0	5.5	5.5
Fusarium equiseti (Corda) Sacc.	0.5	0.5	-
Fusarium solani (Mart.) Appel & Wollenw.emend. Snyd. & Hans.	0.5	0.5	1.0
Mucor spp.	1.0	1.5	2.5
Penicillium spp.	11.0	9.5	9.0
Saccharomyces sp.	11.5	8.5	11.5
Stemphylium botryosum Wallr.	-	-	2.0
Stemphylium consortiale (Thüm.) Groves & Skolko	-	0.5	-
Tricothecium roseum Link ex Fries	-	-	0.5
Non sporulating fungus colonies	-	3.5	2.0
Bacteria	27.5	20.5	24.0
Total fungus infestation	78.0	79.0	81.0
Total infestation	105.5	99.5	105.0

*MCE - matriconditioning with MicroCel-E,
PEG - osmoconditioning in PEG6000 solution

Table 2. Effect of presowing treatment on vigour of coriander seeds and seedlings.

Seed treatment*	Speed of emergence (seedlings per day)			Capability of emergence (%)			Fresh weight of a seedling (g)			DNA content in seedling leaf tissue (mg g^{-1} d.w.)		
	Fungicide application**			Fungicide application**			Fungicide application**			Fungicide application**		
	–	+	mean	–	+	mean	–	+	mean	–	+	mean
Control	7.8 a	8.4 a	8.1 A	74.2 a	77.8 a	76.0 A	0.35 a	0.40 ab	0.37 A	393 a	429 b	411 A
MCE	12.3 bc	13.1 c	12.7 B	85.9 b	86.0 b	85.9 B	0.61 d	0.59 cd	0.60 B	486 e	472 d	479 C
PEG	11.6 b	12.5 bc	12.1 B	84.1 b	84.8 b	84.5 B	0.53 cd	0.49 bc	0.51 C	457 c	452 c	455 B
mean	10.6	11.3		81.4	82.9		0.50	0.49		445	451	

* MCE - matriconditioning with MicroCel-E, PEG - osmoconditioning in PEG6000 solution
** fungicide seed dressing before sowing: – not applied, + applied

Table 3. Characteristic of coriander yield from two locations as affected by presownig seed conditioning and fungicide application.

Location of field experiments	Presowing seed treatment*	Seed yield (dt ha^{-1})			Seed essential oil content (ml 100 g^{-1})			Essential oil yield (dt ha^{-1})		
		Fungicide application**			Fungicide application**			Fungicide application**		
		–	+	Mean	–	+	Mean	–	+	Mean
Kraków Mydlniki	Control	19.33	20.97	20.15 A	1.63 b	1.55 a	1.59 A	31.49 a	32.49 ab	31.99 A
	MCE	20.93	29.17	25.05 B	1.72 c	1.65 b	1.68 B	35.90 b	47.94 c	41.92 B
	PEG	26.83	31.33	29.08 C	1.72 cd	1.75 d	1.74 C	46.19 c	54.92 d	50.55 C
	mean	22.37 a	27.15 b		1.69 B	1.65 A		37.86 A	45.12 B	
Warsaw Wilanów	Control	18.73 a	21.19 b	19.96 A	1.58	1.57	1.57 A	29.62	33.26	31.44 A
	MCE	26.69 d	25.63 d	26.16 C	1.74	1.73	1.74 C	46.48	44.45	45.47 C
	PEG	23.45 c	22.97 bc	23.21 B	1.67	1.68	1.68 B	39.24	38.68	38.96 B
	Mean	22.95	23.26		1.67	1.66		38.45	38.80	

*, ** - as in Table 2

Table 4. Effect of seed treatment on the content of identified compounds in coriander essential oil (%).

Compound	Seed treatment*					
	Control		MCE		PEG	
	–	+	–	+	–	+
α-thujene	0.02	0.02	0.02	0.02	0.02	0.02
α-pinene	4.51	4.38	4.65	4.80	4.76	4.91
camphene	0.69	0.76	0.79	0.70	0.91	0.87
β-pinene	0.25	0.23	0.28	0.26	0.28	0.28
sabinene	0.26	0.23	0.24	0.26	0.30	0.29
β-mircene	0.67	0.73	0.74	0.69	0.77	0.76
limonene	1.56	1.84	1.84	1.60	1.89	1.84
γ-terpinene	7.40	6.58	7.09	7.01	6.80	7.38
p-cymene	0.71	0.67	0.70	0.73	0.61	0.66
o-cymene	0.43	0.49	0.43	0.36	0.43	0.50
camphor	4.24	5.06	4.86	4.43	5.03	4.74
linalool	73.95	73.29	71.49	73.18	72.15	71.90
terpinene-4-ol	0.22	0.18	0.25	0.25	0.25	0.30
α-terpineol	0.18	0.18	0.18	0.33	0.29	0.25
borneol	0.24	0.37	0.38	0.23	0.33	0.35
geranyl acetate	1.96	2.09	2.32	2.15	2.39	2.11
geraniol	2.64	2.89	2.96	2.83	2.67	2.73

* MCE - matriconditioning with MicroCel-E, PEG - osmoconditioning in PEG6000 solution, – without fungicide seed dressing before sowing, + with fungicide seed dressing before sowing