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Anna Szafirowska, Regina Janas

Research Institute of Vegetable Crops, 96–100 Skierniewice, Poland

MYCOBIOTA DEVELOPMENT DURING MATRICONDITIONIN OF ONION SEEDS…*

ABSTRACT

Physiological conditioning of seeds is applied to improve and enhance seed performance. The treatment is based on prolonged hydration. However it creates suitable conditions for pathogenic seed–borne mycobiota development. One of the conditioning methods is matriconditioning. In this procedure, which employs matric properties of solid water carrier, seeds are for several days sub–jected to hydration.

Onion seeds cv. Czerniakowska were matriconditioned and treated with chemicals in following manners: control "C" –untreated, "CH"– seeds treated with chemicals (carbendasim, thiram, metalaxyl and carbosulphate), "MC"– seeds matriconditioned with Micro Cel–E, "CH+MC" –seeds treated with above mentioned chemicals and then matriconditioned.

Matriconditioning (Micro–Cel E) stimulated development of pathogenic and saprophytic fungi on onion seeds. In population of mycobiota isolated from matriconditioned seeds, occasional patho–gens such as *Alternaria porri, Alternaria tenuis and* fungi of B*otrytis* and *Penicillium sp.* were found.. Matriconditioned seeds were more infected by all the above mentioned fungi than untreated seeds. *In vitro*, fungicides showed different effect on pathogenic and saprophytic fungi, from almost total control up to high tolerance. The lowest seed infection was found on a sole fungicide treatment (carbendasim, thiram, metalaxyl and carbosulphate) without matriconditioning. Chemical seed treatment applied before matriconditioning improved seed health of matriconditioned seeds, how–ever it was not fully effective against the occurring fungi.

Key words: matriconditioning, mycobiota, onion, seedhealth status

INTRODUCTION

Matriconditioning is a physiological method of seed conditioning, which employs matric properties of solid water carrier. Seeds are sub–jected to prolonged hydration under controlled conditions, which results in improvement of seed performance such as uniformity and rate of emergence. In some cases tolerance to suboptimal weather or soil condi–tions as well as higher biomass production are increased (Khan, Ptasznik 1992, Madakadze *et al.* 1993). Early field sowing especially under unfavourable conditions promotes damages caused by soil–borne pathogens. On the other hand a slow seed hydration during conditioning

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by itself is conducive to pathogen development. Time required for seed conditioning depends on plant species and sometimes is prolonged to several days. During that time seed–borne pathogens find favourable conditions to propagate. Although there is extensive literature about pre–sowing seed treatments, but very little is known about response of seed pathogens to slow hydration. Tylkowska and Biniek (1996) observed the development of pathogenic mycophlora on carrot and parsley seeds conditioned with polyethylene glycol. Likewise Janas *et al.* 1999 revealed a promotive effect of matriconditioning on pathogenic seed–borne mycophlora on cucumber and carrot seeds. An addition of pesticides or biological agents in combination with physiological conditioning can be a successful method to keep advantages of conditioning and protect against pathogens (Khan *et al.* 1992, Szafirowska and Khan 1995).

The objectives of the studies were to evaluate of mycobiota development during matriconditioning and the efficiency of commonly used chemical seed treatment.

MATERIALS AND METHODS

Onion seeds cv. Czerniakowska were subjected to matriconditioning and chemical seed treatment. For matriconditioning synthetic silicate Micro–Cel E was used as a water carrier. The ratio seed: carrier: water was as 16:4.8:13. The seeds were treated for 7 days at 15˚C. After matriconditioning the seeds were washed and dried overnight under ambient conditions. The following treatments were applied: untreated control (C), treated with chemicals (CH), matriconditioned (MC) and treated with chemicals before matriconditioning (CH +MC). For chemical seed treatment the commonly recommended fungicides were used: carbendazim 20 + thiram 45–(0.8 and 1.8 g per kg of seeds respectively), metalaxyl 35 (0.35 g per kg of seeds) and insecticide carbosulphane (17.5 g per kg of seeds).

In laboratory experiment, the occurrence of seed fungi was evaluated before and after matriconditioning. Five seeds per Petri dish were sown on PDA medium with addition of bengalic pink and incubated at 20˚C for 6 days. Batches of 250 seeds from each sample were examined. The cultures were then placed in a growth chamber at 20˚C and 100% RH and subjected to NUV radiation of 320–400 nm in a 12 h cycle.

At the same time a greenhouse experiment was conducted. Seeds were sown in peat substrate at about 20/17˚C day/night, 50 seeds per row in 4 replications. Emergence was recorded in 24 h intervals up to stand establishment, when seedlings were cut and fresh weight of plants was measured.

In the field experiment, 100 seeds were sown in 2 m rows in 4 reps. Field experiment was conducted in 1997–1999 in the Skierniewice Experimental Field. Onion seeds were sown on April 1 1997 and April 8 in

the next two years. Significance of differences between means was established by analysis of variance and Newman–Keul's test at $\alpha = 0.05$.

RESULTS

Development of seed borne fungi both pathogenic and saprophytic to onion was induced after matriconditioning (linear increase, sporulation level), Table 1. Higher number of fungi was rather isolated from matriconditioned seeds than from control seeds. The per cent of incidental parasite – collective species of *Alternaria alternata* (Fr.) Keissler and *Alternaria porri* (Ellis) Cif. and also of fungi of *Botrytis* and *Penicillium spp.* in population of matriconditioned seeds was higher than on control seeds. (Table1). Fungicides applied *in vitro* showed different efficiency on both groups either pathogenic or saprophytic, from total control to high tolerance. Fungicide treatment alone (CH) prevented seed infection to a high extent. Chemicals applied before matriconditioning (CH +MC) led to some improvement of seed health in comparison to matriconditioning alone (MC).

Table 1

Influence of matriconditioning (MC) and chemical seed treatment (CH) on mycophlora infection of onion seeds

Fungi species	Control (C)		(CH)		Matriconditioning (MC)		(MC+CH)	
	Range[%]	Mean	Range[%]	Mean	Range[%]	Mean	Range[%]	Mean
*Alternaria alternata**	6.8 – 36.4	21.6	3.2 – 20.0	11.6	10.6 –53.7	32.2	9.2– 51.0	30.1
*Alternaria porri***	6.7 – 17.2	12.0	6.0 – 14.0	10.0	7.2 –23.4	15.3	6.6– 24.0	15.3
Botrytis spp.	10.5 – 19.0	14.8	9.3 – 17.0	13.2	14.1 –20.0	17.1	11.7 – 20.0	15.9
Fusarium spp.	2.0 – 6.3	4.2	0.8 – 4.7	2.8	2.8 – 9.0	5.9	1.9 – 7.6	4.8
Colletotrichum spp.	0.6 – 3.1	1.9	0.0 – 2.1	1.0	1.7 – 4.0	2.9	1.0 – 3.5	2.3
Epicoccum spp.	0.09– 4.4	2.7	0.8 – 4.0	2.4	2.0 – 5.9	4.0	2.3 – 4.7	3.5
Stemphylium spp.	0.0 – 3.9	2.0	0.0 – 3.5	1.8	1.4 – 3.5	2.5	1.5 – 3.0	2.3
Penicillium spp.	10.0 – 48.1	29.1	8.0 – 43.0	25.5	20.2 –50.1	35.2	20.0 – 42.6	31.3

* – *Alternaria alternata* (Fr.) Keisler, ** – *Alternaria porri* (Ellis) Cif.

Table 2

Rate of seedling emergence of onion in greenhouse experiment (1997)

Seed treatment	T_{50} *	Pieper's coefficient	Maguire's coefficient
Control – untreated (C)	4.5	4.60_{ab}	15.72_{b}
Chemical treatment (CH)**	4.5	5.60_{b}	17.50_{ab}
Matriconditioning (MC)	3.5	4.37_{ab}	20.31_{ab}
MC+CH	3.5	3.90_{a}	24.62_{a}

* days to 50% emergence
** seeds treated with carbendazim 20 + thiram 45, metalaxyl 35 and carbosulphate 25.
Means followed by the same letters ($_a$ or $_b$) are not different significantly at $\alpha = 0.05$ according to Newman–Keul's test

Table 3

Onion seedling emergence and weight in greenhouse experiment (1997)

Treatment	Number of plants	Fresh weight [g]
Control (C)	92.8 $_{ab}$	1.38 $_{ab}$
Chemical treatment (CH)*	90.4 $_{b}$	1.29 $_{b}$
Matriconditioning (MC)	95.2 $_{ab}$	1.43 $_{ab}$
MC + CH	99.2 $_{a}$	1.52 $_{a}$

* Seeds treated with carbendazim 20 + thiram 45, metalaxyl 35 and carbosulphate 25.
Means followed by the same letters ($_{a}$ or $_{b}$) are not different significantly at $\alpha = 0.05$ according to Newman–Keul's test

Matriconditioning enhanced seedling emergence in greenhouse (Tables 2 and 3) and improved stand establishment in the field. Three coefficients of emergence rate (T_{50}, Piper's and Maguire's coefficients) were better for matriconditioned seeds than for controls. Chemical seed treatment significantly slowed down seedling emergence, which was reflected not only in the values of Pieper's and Maguire"s coefficients, but also in the fresh weight of seedlings at stand establishment (Table 3). Matriconditioning combined with chemicals increased number of seeds germinating during one day (Maguire's coefficient), the speed of emergence and total number of plants and their fresh weight at stand establishment. The similar response to seed treatment was observed in the field experiment. The highest number of plants per 1 m^2 was obtained as a result of combined chemical seed treatment with matriconditioning (CH+MC), Table 4. The effect of chemical seed treatment (CH) and matriconditioning alone (MC), depended on the year and led to the lower number of plants at stand establishment in comparison with CH+MC treatment (Table 4).

Table 4

Effect of matriconditioning at stand establishment of onion in field experiment

Treatment	Number of plants per 1 m^2		
	1997	1998	1999
Control (C)	77.0	79.8 $_{ab}$	72.8 $_{ab}$
Chemical treatment (CH)*	78.0	86.0 $_{ab}$	59.8 $_{b}$
Matriconditioning (MC)	81.5	78.3 $_{b}$	70.0 $_{ab}$
MC + CH	83.0	88.5 $_{a}$	86.3 $_{a}$

* seeds treated with carbendazim 20 + thiram 45, metalaxyl 35 and carbosulphate 25
Means followed by the same letters ($_{a}$ or $_{b}$) are not different significantly at $\alpha = 0.05$ according to Newman–Keul's test

DISCUSSION

Essential prerequisites to optimise stand establishment are rapid and uniform field emergence under different environmental conditions. Physiological seed treatment seems to solve the problem, but a strong

protection against fungi infection is required, as early as at the stage of seed treatment, mainly before conditioning (Szafirowska, Khan 1995a,b).These authors found the snap bean seeds sensitive to fungi infection during a pre–sowing humidification and the same held for corn seeds during matriconditioning. Habdas *et al.* (1999) proved, that matriconditioning stimulated fungi development of artificially deteriorated cucumber seeds. An evident increase of fungi infection after matriconditioning was observed by Janas *et al.* (2000), both of pathogenic and saprophytic fungi on carrot, cucumber and onion seeds. Earlier Janas *et al.* (1999) observed, that the response of seeds to fungi development depended on seed morphology. Endospermic seeds, such as onion, were less destroyed by fungi during matriconditioning, than nonendospermic like cucumber and Chinese aster. In endospermic seeds the strongest damage occurred in seed coat and endosperm with little penetration to embryo. In the nonendospermic seeds, hydrolysis of storage proteins and lysis of embryo tissues were observed. Fungicides applied before matriconditioning not fully protected the seeds against pathogens. Szafirowska and Janas (2000) suggested, that imbibed carrot seeds were more sensitive not only to fungi infection, but also to fungicide treatment as compared with dry seeds. The authors revealed, that although the chemical control of carrot seeds before matriconditioning was necessary, but a kind of pesticides and a way of chemical treatment were of great importance.

Our three year field studies proved a prolonged influence of pre–sowing seed treatment combined with chemicals, up to time of stand establishment. It resulted in higher number of plants per $m^{2,}$ which was consistent with the results obtained earlier by Szafirowska and Janas (2000) with carrot. According to these authors application of commercially recommended chemicals before matriconditioning improved the yield of carrot roots.

CONCLUSIONS

1. Slow seed hydration during matriconditioning induced development of fungi– residents of spermoplane of onion seeds.
2. Fungicides applied before matriconditioning inhibited development of fungi to some extent only.
3. Integration of matriconditioning and chemical seed treatment enhanced seedling emergence both in greenhouse and in the field and additionally increased number of plants.

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