PRE-SOWING TREATMENTS OF POPPY (*PAPAVER SOMNIFERUM* L.) SEED*

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In this experiment possibilities of pre-sowing seed treatment of poppy (*Papaver somniferum* L.) seed were evaluated. Four seed lots of poppy were treated by hydration, hot water treatment, biological and chemical treatments. Hydration treatment did not influence total germination (TG) of treated samples (on average of all seed lots). Lower decrease of germination rate (GR) and increase of mean germination time (MGT) appeared at samples after longer duration of hydration. Hot water treatment at temperatures 50 °C and 52 °C with longer duration 20 and 25 min caused very big damage to treated seeds. Parameters of seed lot 4 with higher vigor decreased less than the other seed lots. Chemical and biological treatments did not influence negatively total germination of treated seed lots, after chemical treatment less decrease of germination rate was found out. Success of pre-sowing treatment is influenced by original seed vigor of treated seed lots. Seed lot 4 with original higher GR had higher seed parameters after treatments.

seed; poppy; pre-sowing treatment; hydration; HWT; biological treatment

INTRODUCTION

Poppy (*Papaver somniferum* L.) is an oil crop with big prospect to the future in the Czech Republic. Growing area increased remarkably in last years and the Czech Republic is the biggest legal producer of poppy in the world now. The poppy becomes the fourth most important oil crop.

Poppy has very small seeds (WTK 0.55 g) and from this reason seed quality must be on high level. The crop stand establishment has big importance for successful growing and for achievement of high yield. Seed emergence is very important limiting factor in this case. Seed health plays big role, too.

Improving of seed germination, seed vigor and seed health can lead to increasing of safer establishment of optimal crop stand.

The seed quality imperfections are compensated in agriculture praxis by higher seed rate, which means only small additional costs for poppy growing, thanks to low price of poppy seed. However, the higher amount of seeds can lead to more dense crop stand in the favorable conditions. Farmer's praxis uses more than five times higher seed rate than it is necessary for optimal crop stand (60 plants.m^{-2} – optimal crop stand, real seed rate 1.5 kg = 2.7 millions of seeds.ha^{-1}).

Pre-sowing seed treatments for improving of seed quality are an important part of seed production technology.

The hydration treatments (prehydration and priming) are used for improving of seed vigor and seed performance. Its principle uses the fact, that seeds must take water into at a moisture level sufficient to initiate the early events of germination in the seeds before sowing, but not sufficient to permit radicle protrusion. The treatment allows faster and uniform germination and emergency of seeds (P a z d e r a , 2002).

Hot water treatment (HWT) means seed treatment for reduction of pathogens on seeds by the non-chemical way. This is an efficient and not very expensive method of seed protection. Although special equipment is necessary for this treatment, the method becomes an important part of pre-sowing seed treatment. Mainly HWT is applied for vegeTable seeds. It is usable for reduction of wide spectrum of bacteria and fungi on seeds of many agriculture crops (F l o y d , 1990; M i l l e r , I v e y , 2005).

Biological and chemical treatments against seed-borne pathogens were used for comparison of their influence on seed quality. Biological treatment is an alternative way for seed-borne pathogens control, which is developed intensively today. Instead of chemical compounds some biological agens (bacteria or fungi) are used (P e d e r s e n et al., 2002; P r o k i n o v á , 1996).

The efficiency of biological treatment is based on ability of bioagens to regulate the present pathogen, amount of propagules on seed, the way of bioagens application and reduction of pathogens in the application process. Biological treatment can be done together with hydration treatment, when bioagens and nutrients are put into the priming solution. The whole process is finished through drying of seeds on the original moisture level (W a r r e n , B e n n e t t , 2000).

The objective of this experiment was to evaluate the possibilities of various pre-sowing treatments for improving of poppy seed parameters.

MATERIALS AND METHODS

Seeds of poppy (*Papaver somniferum* L.) were used in the experiment, 4 seed lots from 4 varieties with different original seed quality (Opal, Malsar, Major – certified seed, Lazur – pre-basic seed).

* This research was supported by Grant Agency CIGA Czech University of Life Sciences in Prague (2006/1311/3139) and research project MSM No 6046070901.

Seeds were treated by hydration treatment, hot water treatment (HWT), biological and chemical treatment in one experiment.

Methods of treatment

The hydration treatment was realized as prehydration in deionized water, with aeration, at temperature 15 °C. Seeds were put into glass bottles with water, ratio seed: water was 1:10. Durations of prehydration are shown in Table 1.

Hot Water Treatment (HWT) was performed in water bath. Seeds in perforated plastic bags were treated at two temperatures 50 and 52 °C and three durations of treatment of each; see details in Table 1. The temperatures were chosen as average from temperatures used at HWT (Doolan, Leonardi, 1999), because relevant values for poppy HWT treatment are not available in literary sources.

After hydration treatment and HWT seed were dehydrated back on filter paper in two steps: at first free water was quickly drained off and then seed were left open for 24 hours on filter paper at temperature 22 °C and relative humidity (RH) 42%.

The same seed lots were used for biological treatment with commercial biological preparation SUPRESIVIT (biological agens *Trichoderma harzianum*) and for chemical treatment (Cruiser OSR). In both cases seeds were mixed with preparations using dry method of treatment (dosage by recommendation of producer).

Table 1. Methods and durations of treatments

Treatment	Temperature	Duration
Control	–	–
Hydration	15 °C	1, 3, 5, 7 hours
HWT	50 °C	15, 20, 25 min
	52 °C	15, 20, 25 min
	Method	Substance
Biological	dry	SUPRESIVIT
Chemical	dry	Cruiser OSR

Seed quality testing

Total germination, germination rate and mean germination time of treated seeds and untreated controls were tested.

Germination test was evaluated at 20 °C, in plastic boxes on filter paper (crepe, 120 g.m^{-2}), four replications of each sample. Seed germination was counted in 24 hours' intervals and total germination (TG) was calculated as a cumulative germination at the end of test. Radicle protrusion of 1 mm was scored as germination.

Table 2. Seed parameters of poppy samples after prehydration treatment

Duration	Average of all samples			Sample 4 (good)			Sample 2 (bad)		
	GR	TG	MGT	GR	TG	MGT	GR	TG	MGT
Control	90a	93a	2.19b	99a	99a	2.02a	76a	87ab	2.61b
1 hour	90a	93a	2.18b	98a	98a	1.97ab	80a	93a	2.56b
3 hours	80b	91a	2.54a	98a	98a	1.97ab	59bc	85ab	3.48a
5 hours	86a	92a	2.24b	98a	98a	1.95b	68ab	81ab	2.80b
7 hours	78b	90a	2.48a	98a	99a	1.87c	49c	78b	3.49a
Minimal significant difference	6.2	4.8	0.16	4.3	3.9	0.07	15.7	11.5	0.66

Explanatory notes of contractions – see text above
Means marked by the same letter are not significantly different ($P < 0.05$)
Values in Tables are rounded off, significant differences correspond to non-rounded values

Table 3. Seed parameters of poppy samples after hot water treatment

Temperation/Duration	Average of all samples			Sample 4 (good)			Sample 2 (bad)		
	GR	TG	MGT	GR	TG	MGT	GR	TG	MGT
Control	90a	93a	2.19bc	99a	99a	2.02a	76a	87a	2.62ab
50 °C/15 min	74b	86b	2.66bc	92a	96a	2.22a	68a	80a	2.38ab
50 °C/20 min	27c	49c	3.91ab	43b	60b	3.16a	25b	62b	4.62a
50 °C/25 min	5e	16e	–	15c	28c	–	6c	10cd	–
52 °C/15 min	14d	28d	–	40b	72b	3.89a	8c	17c	–
52 °C/20 min	2ef	6f	–	7cd	20c	–	1c	1d	–
52 °C/25 min	0f	1f	–	0d	1d	–	0c	1d	–
Min. significant difference	4.7	5.5	1.9	8.9	11.4	3.00	9.6	9.9	4.10

Explanatory notes of contractions – see text above
Means marked by the same letter are not significantly different ($P < 0.05$)
Values in Tables are rounded off, significant differences correspond to non-rounded values

Table 4. Seed parameters of poppy samples after chemical and biological treatment

Substance	Average of all samples			Sample 4 (good)			Sample 2 (bad)		
	GR	TG	MGT	GR	TG	MGT	GR	TG	MGT
Control	90a	93a	2.19b	99a	99a	2.02b	76a	87a	2.61a
SUPRESIVIT	91a	95a	2.22b	97a	98a	2.15ab	75a	87a	2.50a
Cruiser OSR	82b	94a	2.51a	96a	99a	2.19a	68a	97a	3.0a
Min. significant difference	5.8	3.1	0.13	4.9	3.4	0.15	17.8	13.3	0.52

Explanatory notes of contractions – see text above
Means marked by the same letter are not significantly different ($P < 0.05$)
Values in Tables are rounded off, significant differences correspond to non-rounded values

Mean germination time (MGT) was calculated from daily germination values by the equation of Nichols and Heydecker (1968).

Germination rate (GR) was counted from values of daily germination as cumulative germination after 3 days.

Statistical evaluation

Experimental data were analyzed with statistical packet SAS, version 8.02 (SAS Institute, Inc. Cary, NC USA). Analysis of variance was used for evaluation, exactly SAS GLM (General Linear Model) procedure. Means were compared by Tukey's test.

RESULTS

The results show that exert of poppy seed pre-sowing treatments is not fully explored research area.

Prehydration treatment

Hydration treatment did not influence total germination (TG) of treated samples (on average of all seed lots). Less decrease of germination rate (GR) and increase of mean germination time (MGT) appeared at samples after longer duration of hydration.

Though the differences between sample 4 (pre-basic seed) with the better quality and sample 2 (poor quality, certified seed) were sharp; non-significant differences at GR and TG and slight decrease of MGT (significant after 5 and 7 hours of treatment) between control and treated seeds at sample 4 were found out and conversely decrease of GR a TG and increase of MGT at sample 2 (Table 2).

The differences in germination curves are shown in Figs 1 and 2. Germination curves at sample 4 after treatment were very similar, germination course of sample 4 was quite different from sample 4.

The demanding effect of MGT decrease (with the same TG) after hydration was achieved at sample 4 (5 and 7 hours of treatment), on the average of samples and at poor sample 2, whose effect did not appear.

Hot Water Treatment

Sharp decrease in seed parameters after HWT (in average of all samples) was found out at all treated variants, except variant 50 °C/15 min. In case of better sample 4 less decrease of seed parameters was recorded at variants 50 °C/20 min and 52 °C/15 min; in case of worse sample 2 similar parameters as control had only treated variant 50 °C/15 min (Table 3).

MGT of samples after HWT with low total germination is very influenced by this TG. Counted values of MGT at variants with low germination were non sense and in this case they were deleted.

Differences between treated variants are shown in Figs 3 and 4.

Biological and chemical treatment

The significant decrease of GR and less (significant) increase of MGT were detected after chemical treatment (in average of all samples), in comparison with non-treated control and with biological treatment. Total germination was the same at control and both variants of treatment. Differences in seed parameters at better sample 4 were non-significant, except less increase of MGT after chemical treatment. Differences at sample 2 were non-significant, too (Table 4). Slower germination of sample 2 after chemical treatment is detectable in Figs 5 and 6.

DISCUSSION

Basic differences between samples in this experiment arise from different original seed lots quality. Seed lot 4 was pre-basic multiplication material, which is not used usually for normal growing, and seed lots 1–3 were certified multiplication material. Pre-basic material is, thanks to production on smaller areas (than commercial certified seed material), more homogenous than certified seed material and its vigor is usually higher.

There are differences between germination curves of used seed lots in Fig. 7. Seed lot 4 got to maximal germination per 24 hours; conversely germination of seed lot 2 was slower and total germination was lower, too. These differences in germination curves are possible to characterize as differences in seed vigor.

Seed lots with higher vigor have a good (positive) response on pre-sowing treatments or in reverse view pre-sowing treatments have no influence on seed lots with high quality; it means they have no sense. For seed with

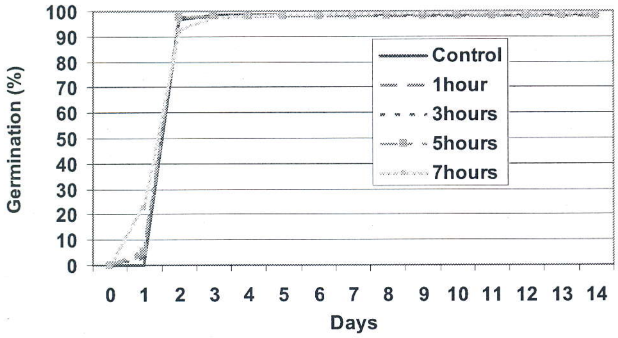

Fig. 1. Germination curves after prehydration – good sample 4

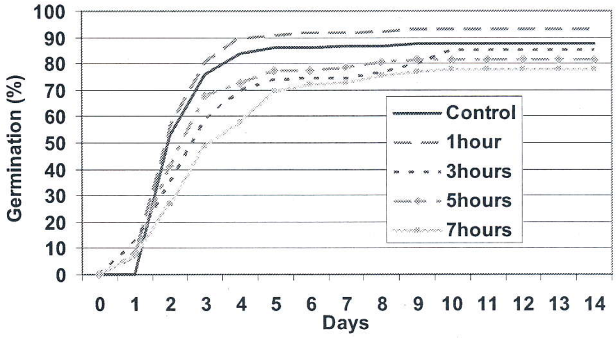

Fig. 2. Germination curves after prehydration – poor sample 2

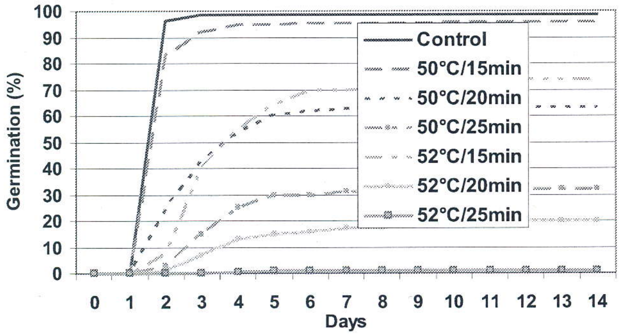

Fig. 3. Germination curves after HWT – good sample 4

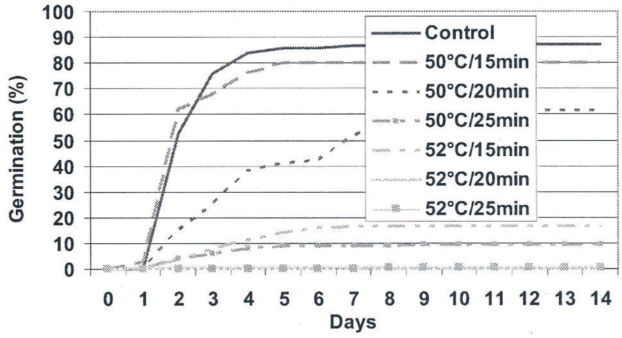

Fig. 4. Germination curves after HWT – poor sample 2

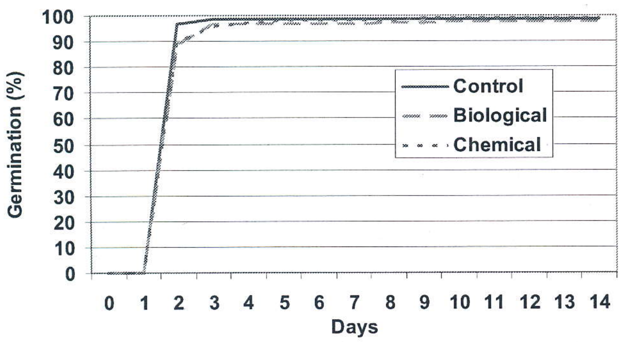

Fig. 5. Germination curves after biological and chemical treatment – good sample 4

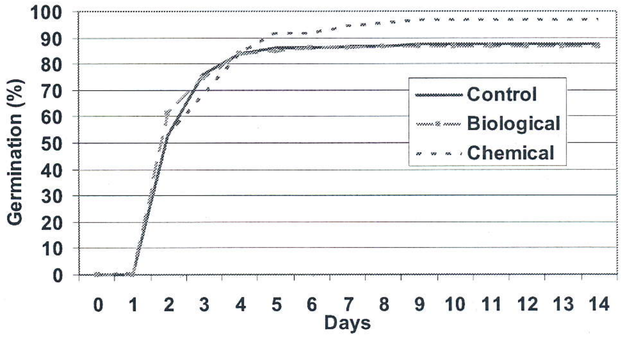

Fig. 6. Germination curves after biological and chemical treatment – poor sample 2

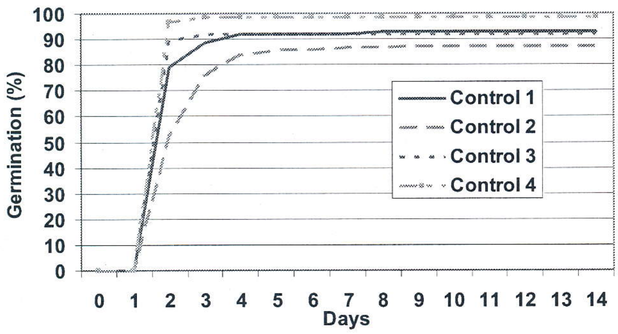

Fig. 7. Germination curves of non-treated seed lots

less vigor pre-sowing treatments can lead to increasing of germination and emergency uniformity and performance of seed, connected with higher safety for crop stand establishment.

The differences in influence of seed hydration on seed parameters just reflect differences in seed lots vigor. For the best sample 4 with the highest vigor is possible to use 7 hours long hydration treatment for decreasing of MGT. For the average seed lots the same duration of treatment can lead to decrease of seed parameters after treatment. In this case the importance of seed vigor for evaluation of seed suitability for hydration treatment is evident, as Basu (1995) pretends too.

Hot water treatment at temperatures 50 °C and 52 °C with longer duration 20 and 25 min causes very big damage of treated seeds and seed parameters after these treatments significantly decreases. Parameters of seed lot 4 with higher vigor decreased less than the other seed lots.

Consequential influence on seed vigor is possible to show through comparison of results after biological and chemical treatment with non-treated control. Chemical treatment can support a survival of some weak germinating plants (sample 2, Table 4), but in other case can lead to decreasing of GR and vigor.

CONCLUSION

Hydration treatment of poppy seeds did not achieve demanding effect of MGT decrease (on average of all seed lots). Some differences between seed lots appeared after treatment.

Influence of HWT on seed parameters of poppy seeds was considerable. Temperature and 52 °C is not suitable for HWT of poppy and cause big damage of seeds.

Chemical and biological treatments did not influence negatively total germination of treated seed lots, after chemical treatment less decrease of germination rate was found out.

Success of pre-sowing treatment is influenced by original seed vigor of treated seed lots.

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Received for publication on January 31, 2007
Accepted for publication on April 30, 2007

PAZDERA, J. – PŠENIČKA, P. – KETTNEROVÁ, J. (Česká zemědělská univerzita, Fakulta agrobiologie, potravinových a přírodních zdrojů, Praha, Česká republika):

Předseťové úpravy osiva máku (*Papaver somniferum* L.).

Scientia Agric. Bohem., *38*, 2007: 123–127.

V experimentu byly hodnoceny možnosti využití předseťových úprav osiva máku (*Papaver somniferum* L.). Pro úpravy čtyř vzorků osiva máku byly použity hydratace, HWT, biologické a chemické ošetření.

Hydratační úpravy neměly vliv na celkovou klíčivost upravených vzorků (v průměru všech vzorků). Malý pokles energie klíčení a nárůst střední doby klíčení (MGT) byl zjištěn u vzorků s delším trváním hydratační úpravy.

Moření horkou vodou (HWT) při teplotách 50 °C a 52 °C s delšími expozicemi 20 a 25 minut způsobilo velké poškození upravených semen. Semenářské parametry vzorku 4 s vysokou vitalitou poklesly méně než u dalších variant úprav.

Chemické a biologické ošetření neovlivnilo negativně celkovou klíčivost upravených vzorků, po chemickém ošetření došlo k mírnému poklesu energie klíčivosti v průměru upravených vzorků.

Úspěch předseťových úprav je ovlivněn vitalitou původní partie osiv před úpravou. Vzorek partie 4 s originální vyšší energií klíčení dosáhl vyšších osivových hodnot i po úpravách.

osivo; mák; předseťová úprava; hydratace; HWT; biologické ošetření

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