THE STORAGE OF VEGETABLE SEED LOTS TREATED BY HYDRATION TREATMENT*

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The storage of 4 vegetable crops after hydration treatment was evaluated. Two storage temperatures 20 °C and –18 °C were used. The storability of treated seeds is influenced by the method and duration of hydration. The prehydration method is better for radish, onion and spinach compared to osmotic priming. Medium durations of the treatment 6 or 9 hours have similar effect on seed parameters. Longer durations of treatment were used for carrot and both methods give similar results. The storability of seeds varies in dependence on the crop and on the way of storage. Short-time storage (up to 6 months) of seed lots after hydration treatment does not have negative effect on seed parameters after storage. The differences among seed lots stored at different temperatures starts to occur after 12 months of storage in onion seed lots.

seed; storability; radish; carrot; onion; spinach; hydration treatment

INTRODUCTION

Using of hydration treatments in seed production increases gradually. More and more seed companies offer these treated seeds for the sale. The sense of this treatment is to improve the seed quality for good establishment of optimal crop stand. The hydration methods positively influence speed and uniformity of germination and emergence, which are reflected in higher uniformity of crop stand, especially in sub-optimal environmental conditions and this positive effect carries over to the harvest (TeKrony, Egli, 1991). Hydrated seeds are treated for direct use in sowing and the storage of these seeds is not presupposed, or only shortly before sowing. But how long does higher quality of these seeds persist? Existing literary sources show different experience in this field.

Bruggink et al. (1999) have presented the strong reduction of longevity as an important practical limitation of seed hydration. Powell et al. (2000) have shown that aerated hydration treatments of cauliflower for 12 and 28 hours at 20 °C resulted in improved or reduced storage potential of low or high vigour seeds, respectively. Podlaski et al. (2003) described the significant decrease of parsley seeds vigour after prehydration treatment.

Korkmaz and Pill (2003) stored lettuce seed lots treated by priming at 4 °C or at 20 °C. They say that short one month storage of treated seeds had little or no effect on the final germination percentage and germination rate, but slight reduction of germination synchrony appeared.

The positive influence of hydration treatment can confirm the results by i.e. Pazdera (2003) in lettuce seeds, Srinivasan and Saxena (2001) in radish, Dearman et al. (1986) in onion or Argerich et al. (1989) in tomato seeds.

The objective of this research was to evaluate the storability of hydrated vegetable seed lots in obvious storage conditions (20 °C) and at low (–18 °C) temperature.

MATERIAL AND METHODS

Standard seed lots of radish, onion, carrot and spinach were used in this experiment. Two seed lots of each kind, appointed for commercial use were evaluated.

Methodology of treatments is based on previous experiments with lettuce seeds (Pazdera, Hosnedl, 2002). Each seed lot was treated by prehydration in distilled water and by osmotic priming in polyethylene glycol (PEG) 6000 solution, prepared according to Michel and Kaufmann (1973). Both methods were performed with aeration by ambient air at 15 °C. Durations of treatments are showed in Table 1.

After both hydration methods seeds were dehydrated in two steps: at first free water was quickly drained off

Table 1. Durations of seed treatments

Treatment	Crop	Duration of the treatment
Prehydration	Radish Onion Spinach	3, 6, 9 hours
	Carrot	12, 18, 24 hours
Osmotic priming (–0.5 MPa)	Carrot	9, 12, 15 days
Osmotic priming (–1.0 MPa)	Radish Onion Spinach	3, 6, 9 days

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and then seeds were let open for 24 hours on filter paper at room temperature 25 °C and relative humidity (RH) 50%.

All treated and untreated (control) samples were stored at two temperatures, 20 °C and –18 °C in closed plastic boxes and were evaluated repeatedly after 0, 2, 6 and 12 months of storage.

Germination percentage was counted each day per 24 hours and total germination percentage, mean germination time (MGT) and germination energy of all treated samples and the non-treated control were evaluated after testing. Seeds with radicle protrusion of 3 mm were scored as germinating seeds. Mean germination time (MGT) was calculated from daily germination values by equation of Nichols and Heydecker (1968) and germination energy was calculated as cumulative germination after 3 days.

Experimental data were analysed 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 AND DISCUSSION

Seed hydration

The total germination and the germination energy of radish after prehydration treatment remained on the same level as non-treated control and MGT was significantly shorter than the control. After priming the shortening of MGT appeared too, but with strong significant decrease of the total germination and the germination energy. Similar effect of prehydration was observed in onion samples, but MGT after priming significantly increased. The spinach MGT after prehydration significantly decreased (by 1.5 days) and on the contrary, the germination energy significantly increased. Both hydration methods give similar results only in carrot samples, identically significant increase of the germination energy and significant decrease of MGT (higher after priming) was determined. For more details see Tables 2–5.

Seed storage

The storability of seeds varies in dependence on crops. Total germination and germination energy of radish seeds decreased significantly against the control variant after 12 months of storage. Differences among different ways of storage at the end of storage were significant too. Mean germination time of radish seeds after 12 months of storage (both ways) slightly increased (significantly). Total germination and germination energy in onion significantly decreased after storage at 20 °C; after storage at –18 °C the total germination and the germination energy were on the same level and MGT in this case was significantly shorter than the control variant. Seed parameters of spinach samples after storage remained on the same level as before storage (non-significant differences); the differences between ways of storage are also non-significant. Significant shortening of MGT in carrot seeds was determined after 12 months of storage at –18 °C.

Slight decrease of MGT in onion, carrot and spinach samples was detected after 2 months of storage, MGT in radish increased after 2 months. Some small significant differences were found among seed parameters at the beginning of storage and after 6 months of storage. For more details see Tables 6–9.

The results confirm experience of other authors about different response of various crops after storage of primed seeds (Bruggink, 1999). Shorter storage period has not had a negative effect on seed parameters of hydrated seeds, similar experience shows Cantliffe (1981), too.

Storability depends on a used method and on duration of hydration treatment (Tables 2 and 3 for radish and onion); Tarquis and Bradford (1992) found similar results in lettuce seeds.

Table 2. Seed parameters of radish seed lots after storage (average of 2 seed lots and all variants of storage, $\alpha = 0.05$)

Treatment	Duration	Germination	Sign.	Mean germination time	Sign.	Germination energy	Sign.
Control	0 hours	92	A	2.37	A	91	A
Prehydration	3 hours	90	A	2.23	B	89	A
Prehydration	6 hours	90	A	2.12	C	89	A
Prehydration	9 hours	90	A	2.12	C	89	A
Priming	3 days	91	A	2.16	C	90	A
Priming	6 days	78	B	1.83	D	77	B
Priming	9 days	80	B	1.78	D	79	B
		Minimum significant difference = 2.50		Minimum significant difference = 0.06		Minimum significant difference = 2.55	

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 onion seed lots after storage (average of 2 seed lots and all variants of storage, $\alpha = 0.05$)

Treatment	Duration	Germination	Sign.	Mean germination time	Sign.	Germination energy	Sign.
Control	0 hours	66	A	4.14	B	64	A
Prehydration	3 hours	65	A	4.04	B	64	A
Prehydration	6 hours	66	A	3.99	C	65	A
Prehydration	9 hours	65	A	3.97	C	64	A
Priming	3 days	58	B	4.38	A	52	B
Priming	6 days	56	BC	4.14	B	51	B
Priming	9 days	55	C	4.30	A	50	B
		Minimum significant difference = 3.48		Minimum significant difference = 0.15		Minimum significant difference = 3.59	

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 carrot seed lots after storage (average of 2 seed lots and all variants of storage, $\alpha = 0.05$)

Treatment	Duration	Germination	Sign.	Mean germination time	Sign.	Germination energy	Sign.
Control	0 hours	76	AB	4.89	A	71	BC
Prehydration	12 hours	79	A	4.12	BC	77	A
Prehydration	18 hours	79	A	3.86	D	77	A
Prehydration	24 hours	78	A	4.19	B	75	AB
Priming	9 days	78	A	4.00	C	76	A
Priming	12 days	74	B	4.05	C	71	C
Priming	15 days	78	A	3.63	E	76	A
		Minimum significant difference = 3.50		Minimum significant difference = 0.39		Minimum significant difference = 3.45	

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 5. Seed parameters of spinach seed lots after storage (average of 2 seed lots and all variants of storage, $\alpha = 0.05$)

Treatment	Duration	Germination	Sign.	Mean germination time	Sign.	Germination energy	Sign.
Control	0 hours	84	A	5.11	AB	73	B
Prehydration	3 hours	85	A	3.58	D	81	A
Prehydration	6 hours	85	A	3.63	D	80	A
Prehydration	9 hours	85	A	3.52	D	81	A
Priming	3 days	79	B	4.97	BC	67	C
Priming	6 days	77	B	5.43	A	62	D
Priming	9 days	78	B	4.69	C	67	C
		Minimum significant difference = 3.04		Minimum significant difference = 0.12		Minimum significant difference = 3.28	

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 6. Seed parameters of radish seed lots after storage (average of 2 seed lots and all kinds of treatment, $\alpha = 0.05$)

Storage		Germination	Sign.	Mean germination time	Sign.	Germination energy	Sign.
Temperature (°C)	Duration (months)						
20 °C	0	91	A	1.97	E	91	A
20 °C	2	86	B	2.09	BC	85	B
20 °C	6	86	B	2.15	AB	85	B
20 °C	12	81	C	2.11	BC	80	C
−18 °C	0	92	A	2.01	DE	91	A
−18 °C	2	87	B	2.05	CD	86	B
−18 °C	6	86	B	2.19	A	86	B
−18 °C	12	88	B	2.11	BC	87	B
		Minimum significant difference = 2.75		Minimum significant difference = 0.07		Minimum significant difference = 2.80	

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 7. Seed parameters of onion seed lots after storage (average of 2 seed lots and all kinds of treatment, $\alpha = 0.05$)

Storage		Germination	Sign.	Mean germination time	Sign.	Germination energy	Sign.
Temperature (°C)	Duration (months)						
20 °C	0	64	A	4.19	AB	61	A
20 °C	2	62	A	4.07	BC	60	A
20 °C	6	62	A	4.16	AB	58	A
20 °C	12	56	B	4.21	AB	52	B
−18 °C	0	62	A	4.24	A	60	A
−18 °C	2	62	A	3.95	C	60	A
−18 °C	6	62	A	4.19	AB	58	A
−18 °C	12	64	A	4.07	BC	60	A
		Minimum significant difference = 3.83		Minimum significant difference = 0.16		Minimum significant difference = 3.94	

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 8. Seed parameters of carrot seed lots after storage (average of 2 seed lots and all kinds of treatment, $\alpha = 0.05$)

Storage		Germination	Sign.	Mean germination time	Sign.	Germination energy	Sign.
Temperature (°C)	Duration (months)						
20 °C	0	76	BC	4.26	B	72	CD
20 °C	2	77	ABC	3.69	C	75	ABC
20 °C	6	79	A	4.48	A	76	AB
20 °C	12	74	C	4.29	B	71	D
−18 °C	0	77	ABC	4.29	B	73	BCD
−18 °C	2	78	AB	3.62	C	76	AB
−18 °C	6	78	AB	4.48	A	75	ABC
−18 °C	12	79	A	3.73	C	78	A
		Minimum significant difference = 3.35		Minimum significant difference = 0.13		Minimum significant difference = 3.61	

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 9. Seed parameters of spinach seed lots after storage (average of 2 seed lots and all kinds of treatment, $\alpha = 0.05$)

Storage		Germination	Sign.	Mean germination time	Sign.	Germination energy	Sign.
Temperature (°C)	Duration (months)						
20 °C	0	85	A	4.88	A	73	A
20 °C	2	81	B	3.81	D	74	A
20 °C	6	82	AB	4.29	BC	74	A
20 °C	12	82	AB	4.67	AB	73	A
–18 °C	0	84	AB	4.96	A	71	A
–18 °C	2	80	B	3.77	D	74	A
–18 °C	6	80	B	4.19	CD	74	A
–18 °C	12	82	AB	4.79	A	71	A
		Minimum significant difference = 3.84		Minimum significant difference = 0.43		Minimum significant difference = 3.79	

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

CONCLUSION

The storability of treated seeds is influenced by the method and duration of hydration. The prehydration method is better for radish, onion and spinach compared to osmotic priming. Medium durations of the treatment (6 or 9 hours) have similar effect on seed parameters. Longer durations of treatment were used for carrot and both methods give similar results.

The storability of seeds varies in dependence on the crop and on the way of storage. Generally it is possible to say that short-time storage (up to 6 months) of these seed lots after hydration treatment does not have a negative effect on seed parameters after storage. The differences among seed lots stored at different temperatures start to occur after 12 months of storage in onion seed lots.

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Skladování hydratačně upraveného osiva zeleniny.

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Využití hydratačních úprav semen při produkci osiv postupně narůstá. V souvislosti s tím nabývají na významu otázky skladovatelnosti takto upraveného osiva. Cílem práce bylo posoudit skladovatelnost hydratačně upravených osiv při různých způsobech skladování.

V experimentu byly hodnoceny vzorky ředkvičky, mrkve, cibule a špenátu po hydratačních úpravách ve vztahu k jejich skladovatelnosti. Upravené i neupravené (kontrolní) vzorky byly skladovány ve dvou režimech, při teplotě 20 °C v místnosti a –18 °C v mrazicím boxu.

Skladovatelnost je ovlivněna metodou úpravy a její délkou. Pro ředkvičku, cibuli a špenát byla vhodnější prehydratace než úprava primingem. Střední délky úpravy šest a devět hodin měly na semenářské parametry skladovaného osiva podobný vliv. U mrkve byly použity delší doby trvání úprav a obě hydratační metody měly na semenářské parametry prakticky stejný vliv.

Skladovatelnost se liší v závislosti na plodině a způsobu skladování. Krátkodobé skladování do šesti měsíců nemá žádný negativní vliv na semenářské parametry osiv. Rozdíly ve skladovatelnosti se začaly projevovat po 12 měsících uskladnění u vzorků cibule.

osivo; skladovatelnost; ředkvička; mrkev; cibule; špenát; hydratační úpravy

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