

## INFLUENCE OF SEED TREATMENT ON ORGANIC AND CONVENTIONAL RED BEET SEEDS

### Summary

Three methods of pre-sowing treatments – seed priming, rinsing and rubbing were applied on organic and conventional red beet seeds of Karmazyn variety from PlantiCo Zielonki Sp. z o.o. In most cases the improvement of germination ability, speed and uniformity were observed. Seed lots from different reproduction systems showed different reactions – rinsing was most efficient method for organic seeds, for conventional ones – priming of seeds. All used methods improved organic seed quality, but conventional seeds germination ability and speed was decreased by rinsing. Examined methods are safe for the environment and plants and are allowed to use in ecological crop production.

**Key words:** red beet, seed, rubbing, rinsing, priming, organic seed

## WPLYW USZLACHETNIANIA NA EKOLOGICZNE I KONWENCJONALNE NASIONA BURAKA ĆWIKŁOWEGO

### Streszczenie

Trzy metody przedsiwnej poprawy jakości nasion – ocieranie, płukanie i pobudzanie użyte zostały do ekologicznych i konwencjonalnych nasion buraka ćwikłowego odmiany Karmazyn pochodzących z PlantiCo Zielonki sp. z o.o. W większości doświadczeń obserwowano zwiększenie zdolności, szybkości i równomierności kiełkowania. Nasiona pochodzące z różnych systemów reprodukcji odmiennie reagowały na zabiegi uszlachetniające. W przypadku nasion ekologicznych najlepszą metodą było płukanie. Natomiast zdolność i szybkość kiełkowania nasion konwencjonalnych po płukaniu zmniejszała się. Używane metody były bezpieczne dla środowiska i roślin i mogły być wykorzystane w rolnictwie ekologicznym.

**Słowa kluczowe:** burak ćwikłowy, nasiona, ocieranie, płukanie, pobudzanie, nasiona ekologiczne

### 1. Introduction

In organic farms sowing material of high purity, high germination speed, spread and ability, free from pathogens enables proper course of field emergence. Young plants develop quicker and are more competitive to weeds, so the yield loss is minimized. Apart from agrotechnical methods used on maternal plants, seed quality can be increased by some post-harvest methods of treatment [5].

Washing and priming are methods consisting on water effect on true seed inside the pericarp and the pericarp alone (biochemical and physical processes). Rubbing is a mechanical (physical) method removing part of the pericarp and it makes a water access to the seed easier.

Organic farmers declare that a purchase of certified organic seed of chosen species and varieties showing good quality and for reasonable price is difficult for 40% of them. Methods of pre-sowing seed treatment which are easy to conduct by farmer and allowed to use in organic production should be a subject of research. Farmers expect complex advisory and simple, ready to follow instructions in seed quality improvement [8].

### 2. Material and methods

Two seed lots of red beet variety Karmazyn from breeding company PlantiCo Zielonki Sp. z o.o. came from organic and conventional system of reproduction. Seeds (botanical multigerminant fruits) were raw, untreated by a producer. Both seed lots were treated with the same methods:

- rinsing in running water in temperature 20°C for 2 hours, and then air drying;

- hydro-priming for 24 hours at 20°C in plastic boxes filled with blotting paper of optimum water content (according to PN-R-65950), and then air drying;
- rubbing of the pericarp with rubbing paper (gradation K120).

Untreated organic and conventional seeds were control combination.

Seeds were put into plastic boxes on blotting paper (60% of water content) in 3 replications and inserted into climate chambers in temperature 8 and 20°C. Every day germinating seed were counted and removed from boxes. Ability, speed and spread of germination were assessed after 7 and 10 days (in 20°C) and after 10 and 20 days (in 8°C) from the sowing.

Speed and spread of germination were calculated using the formula (Pieper's coefficient):

$$\text{Pieper's coefficient} = \frac{\sum(d_n \times a_n)}{\sum a_n}$$

where:

$d_n$  – day after sowing,

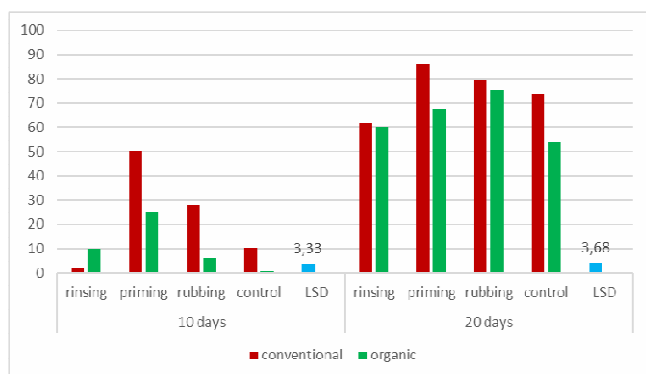
$a_n$  – number of seeds germinating on this day.

For speed of germination the first day after sowing was established as a day one ( $d_1$ ). In case of spread of germination  $d_1$  was the day, when the first germinating seeds were noticed (for a combination). Low values of Pieper's coefficient indicate high seed vigour which occurs in fast and uniform germination.

Analysis of variance was made with program STATISTICA 10.0 and homogenous groups were divided using HSD Tukey test on relevance level  $\alpha = 0.05$ .

### 3. Results

In 8°C primed conventional seeds showed the highest level of germination ability (fig. 1). Even after 10 days they germinated in 50% (control seeds 10%). Germination level in organic seeds was significantly lower than in conventional ones, but after 20 days of germination, the differences were smaller. Organic seeds of red beet showed a positive reaction to a method of rinsing, while conventional ones inversely.

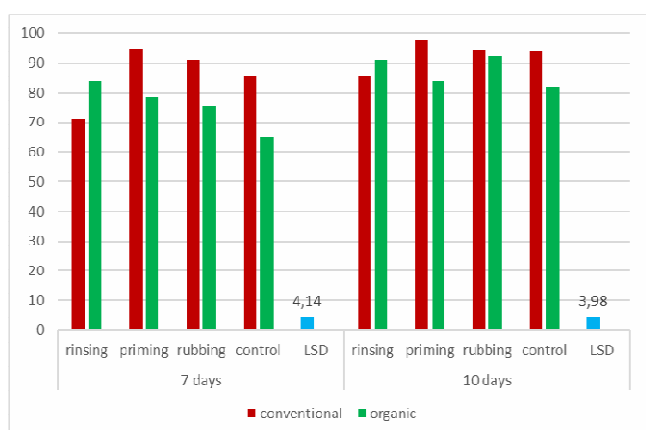


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Fig. 1. Germination ability [%] in 8°C of conventional and organic red beet seeds prepared using different methods

Rys. 1. Zdolność kiełkowania [%] w temperaturze 8°C konwencjonalnych i ekologicznych nasion buraka ćwikłowego uszlachetnianych różnymi metodami

In 20°C germination ability of all seed combinations was much higher than in 8°C (fig. 2) and varied from 65% (untreated organic seeds after 7 days of germination) to 97,7% (primed conventional seeds after 10 days of germination). All methods improved germination ability of organic seeds – most effective were rinsing and rubbing. In conventional seeds priming was the most effective method of germination ability improvement. Rinsing worsened their germination ability level comparing to untreated control seeds.

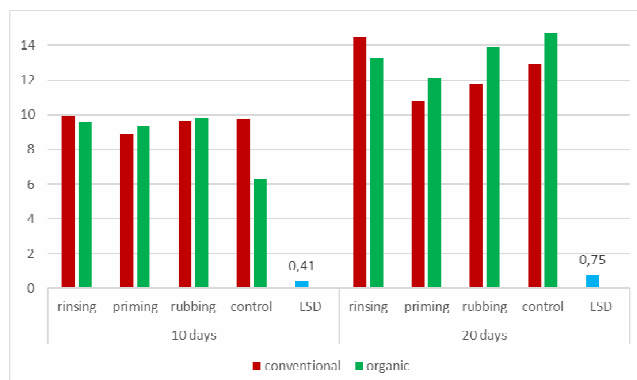


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Fig. 2. Germination ability [%] in 20°C of conventional and organic red beet seeds prepared using different methods

Rys. 2. Zdolność kiełkowania [%] w temperaturze 20°C konwencjonalnych i ekologicznych nasion buraka ćwikłowego uszlachetnianych różnymi metodami

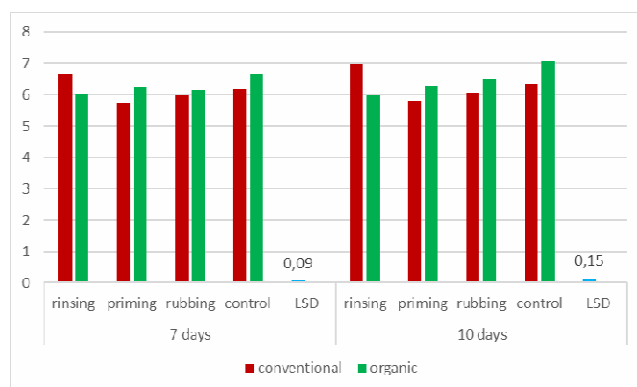
Mean time of germination was shortened by most of methods of treatment, except rinsing in case of conventional seeds. Similar situation was observed during the germination in 8°C (fig. 3) and 20°C (fig. 4). Short time and low spread of germination of control organic seeds in 8°C was caused by low germination ability (0,7%).



Source: own work / Źródło: opracowanie własne

Fig. 3. Time of germination [germination speed – days] in 8°C of conventional and organic red beet seeds prepared using different methods

Rys. 3. Szybkość kiełkowania [dni] w temperaturze 8°C konwencjonalnych i ekologicznych nasion buraka ćwikłowego uszlachetnianych różnymi metodami



Source: own work / Źródło: opracowanie własne

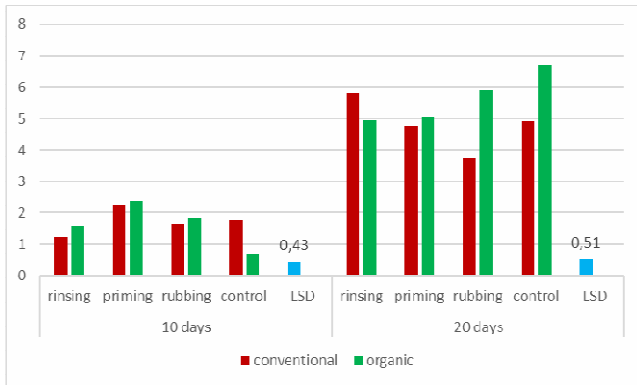
Fig. 4. Time of germination [germination speed – days] in 20°C of conventional and organic red beet seeds prepared using different methods

Rys. 4. Szybkość kiełkowania [dni] w temperaturze 20°C konwencjonalnych i ekologicznych nasion buraka ćwikłowego uszlachetnianych różnymi metodami

In 8°C after 10 days of germination spread of germination of treated seeds was similar or worse comparing to untreated control (fig. 5). After 20 days of germination it was visible that only rubbing improved spread of conventional seed germination. Organic seeds germination spread was improved by all methods of treatment.

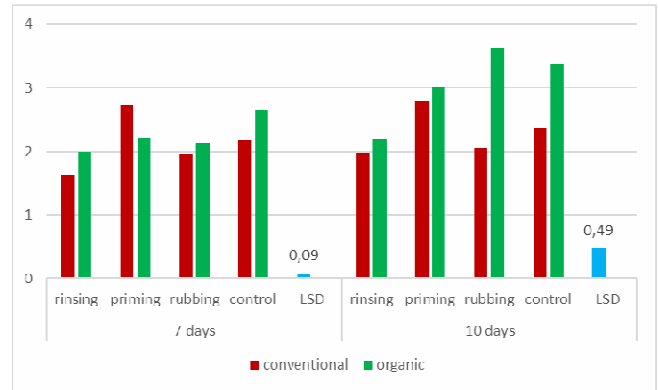
In 20°C all used methods improved spread of organic seed germination after 7 days (fig. 6). After 10 days of germination only rinsed seeds germinated with higher spread. For conventional seeds the only improvement of spread of germination was noticed for rinsed and rubbed seeds, but after 10 days differences were insignificant.

Summary effect of all used methods on conventional and organic seeds are showed in table 1 (in 8°C) and table 2 (in 20°C).



Source: own work / Źródło: opracowanie własne

Fig. 5. Spread of germination [days] in 8°C of conventional and organic red beet seeds prepared using different methods  
Rys. 5. Równomierność kiełkowania [dni] w temperaturze 8°C konwencjonalnych i ekologicznych nasion buraka ćwikłowego uszlachetnianych różnymi metodami



Source: own work / Źródło: opracowanie własne

Fig. 6. Spread of germination [days] in 20°C of conventional and organic red beet seeds prepared using different methods  
Rys. 6. Równomierność kiełkowania [dni] w temperaturze 20°C konwencjonalnych i ekologicznych nasion buraka ćwikłowego uszlachetnianych różnymi metodami

Table 1. Comparison of conventional and organic seed reaction (referring to the control combination) to different methods of pre-sowing treatment in 8°C

Tab. 1. Porównanie reakcji nasion konwencjonalnych i ekologicznych (w porównaniu z kontrolą) na stosowane metody przedsięwziętej poprawy jakości w 8°C

Seeds		conventional						organic					
Temperature		8°C											
Time		10 days			20 days			10 days			20 days		
Method	Rinsing	-	0	+	-	-	0	+	-	-	+	+	+
	Priming	+	+	-	+	+	0	+	-	-	+	+	+
	Rubbing	+	0	0	+	+	+	+	-	-	+	+	+
Germination		ability	speed	spread	ability	speed	spread	ability	speed	spread	ability	speed	spread

+ increase, - decrease, 0 no effect

Source: own work / Źródło: opracowanie własne

Table 2. Comparison of conventional and organic seed reaction (referring to the control combination) to different methods of pre-sowing treatment in 20°C

Tab. 2. Porównanie reakcji nasion konwencjonalnych i ekologicznych (w porównaniu z kontrolą) na stosowane metody przedsięwziętej poprawy jakości w 20°C

Seeds		conventional						organic					
Temperature		20°C											
Time		7 days			10 days			7 days			10 days		
Method	Rinsing	-	-	+	-	-	0	+	+	+	+	+	+
	Priming	+	+	-	0	+	-	+	+	+	0	+	0
	Rubbing	+	+	+	0	+	0	+	+	+	+	+	0
Germination		ability	speed	spread	ability	speed	spread	ability	speed	spread	ability	speed	spread

+ increase, - decrease, 0 no effect

Source: own work / Źródło: opracowanie własne

#### 4. Discussion

In optimum temperature germination ability of conventional seeds was satisfactory (94%). The same seeds in 8°C (simulating field, spring conditions) germinated in much lower per cent – 10,3% after 10 days and 73,3% after 20 days of incubation. In this temperature the most effective method of germination ability and speed improvement was priming (by 40% and 0,9 days respectively after 10 days of germination). Priming is a frequently used method of seed improvement, especially for vegetables and ornamental plants [1, 3, 4, 6, 7].

Rubbing was another method improving quality of conventional seeds. This method reduces the thickness of the pericarp, removing inhibitors of germination and crystals of salts which inhibit water uptake by the seed. According to Podlaski [9] this method additionally helps to remove pathogens from the pericarp surface and the outer layers. Also Domoradzki et al [2] confirm effectiveness of rubbing as a method improving beet seed quality, decreasing number of infections and making sowing easier.

Organic red beet seed germination ability in 20°C was only 82% (control combination after 10 days of germination). All applied methods improved course of

germination of organic seeds. The most effective method appeared to be rinsing. According to Domoradzki et al [2] process of rinsing in combination with rubbing can remove 85% of inhibitors and ions from beet pericarp. Number of microorganisms colonizing rubbed and rinsed seeds was 2 times lower comparing to control seeds.

After any used method of pre-sowing treatment organic seed showed much better parameters of germination in 8°C comparing to untreated organic seeds, available on the market. Seed treatment of organic sowing material appears to be effective and worth of further elaboration.

## 5. Conclusions

1. Raw organic red beet seeds showed much lower germination ability than conventional ones.
2. Both seed bulks reacted to pre-sowing treatment differently.
3. All used methods improved germination ability and speed for organic seeds. I was most noticeable in temperature 8°C, simulating spring field conditions.
4. Rinsing was the most effective method for organic seeds.
5. Priming was the most effective method of conventional seeds quality improvement.
6. Conventional red beet seeds reacted negatively to the process of rinsing.

## 6. References

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