

## EFFECT OF THE BIOSTIMULATOR 'ASAHI SL' ON SEED GERMINATION OF A FEW CULTIVARS OF TOMATO (*LYCOPERSICON ESCULENTUM* MILL.)

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**Abstract.** The seeds were soaked for 5 hours, in the darkness, at 20°C in the distilled water and 0.25% and 0.75% solutions of biostimulator Asahi SL (0.3% sodium 1-nitrophenolate + 0.2% sodium 4-nitrophenolate + 0.1% sodium 5-nitroguaiacolate). After drying at 20°C for 24 hours, they were then tested for germination at 15°C and 20°C. The significant effect of the used cultivar was found out, when seeds of them were treated with water and bio stimulator. The following responses were recorded: lack of effect, tendency to improve or make worse the investigated parameter and positive or negative effect. The positive effect was found in the case of a few parameters at 20°C. In the cultivar 'Korsarz' Asahi SL increased the germination energy from 33.0% to 37.7% (0.25%) and 45.7% (0.50%), whereas the germination capacity from 49.7% to 64.3%. The effect of shortening the mean germination time (MGT) was reached when using 0.75% Asahi SL (shortening from 5.0 to 4.2 days) and 0.5% Asahi SL (shortening from 5.0 to 4.3 days) in the cultivar 'Ryton'. When 0.25% Asahi SL was used in the cultivar 'Koralik' the  $T_{50}$  was shortened from 9.2 to 8.5 days. The positive effects of the bio stimulator treatments were also found out at 15°C. For the cultivar 'Ju Huang', the conditioning of seeds improved their germination capacity. Treatment of the seeds with water and Asahi SL decreased the percentage of the healthy ungerminated seeds. The conditioning improved  $G_{max}$  in the cultivar 'Ju Huang'. In all tested cultivars, except the cultivar 'Ryton', in majority of cases, the conditioning shortened the MGT and  $T_{50}$ . The best effect was received when 0.5% Asahi SL solution for the cultivar 'Koralik' was applied (shortening from 12.5 to 11.8 days). The received results were analysed statistically using the Duncan test for  $\alpha=0.05$ . The conditioning, in the case of the cultivar 'Jokato' increased or had a tendency to increase the fresh weight of the seedlings. However, no distinct differences were found between the seeds treated with water and Asahi SL.

**Key words:** tomato, *Lycopersicon esculentum*, seed quality, seed germination, seed conditioning, Asahi SL, bio stimulator

### INTRODUCTION

In recent years, there has been a development of physiological methods to improve seed quality based on presowing treatments of seeds using water of solutions of various substances such as acids, alkalis, mineral salts and plant hormones (Geneve, 1998; Halmer, 2000; Tylkowska and Dorna, 2000; Domaradzki and Korpala, 2004; Grzesik et al., 2004). The research also includes use for these purpose bio stimulators (Grzesiuk and Kulka, 1981; Ravindra Mulge et al., 1998; Sadowski, 2002; Bralewski and Hołubowicz, 2003a; b). The main goal of the carried out experiments was to check a possibility to improve tomato seed quality through conditioning them in the solutions of the bio stimulator Asahi SL.

## MATERIALS AND METHODS

The material for the experiment were seeds of 5 cultivars of tomato (*Lycopersicon esculentum* Mill.): 'Koralik', 'Korsarz', 'Jokato' i 'Ryton' (Polish cultivars) and 'Ju Huang' (Chinese cultivar). They are all commercially grown.

The seeds were soaked for 5 hours, in the darkness, at 20°C in the distilled water and 0.25%, 0.50% and 0.75% solutions of bio stimulator Asahi SI [0.3% sodium 1-nitrophenolate + 0.2% sodium 4-nitrophenolate + 0.1% sodium 5-nitroguaiacolate]. After drying at 20°C for 24 hours, they were then tested for germination. It was done at 15°C and 20°C (ISTA, 1999). The tests evaluated energy and capacity of germination after 7 and 14 days, respectively, deformed seedlings, diseased seedling, healthy ungerminated seeds and dead seeds. Every day, for 14 days the number of germinated seeds was counted and using the programme SeedCalculator 2.1 (Janik and van der Schoor, 1999) the  $G_{max}$  (maximum germination), MGT (mean germination time) were calculated. Then  $T_{50}$  (time to 50% of the maximum germination) was also counted. The experiment was done in 6 replications, each of 50 seeds, except the fresh weight measurement which was done in 3 replications of 100 seeds each.

## RESULTS AND DISCUSSION

The carried out experiments proved that the used cultivars had a significant effect on the seeds when they were treated with both water and the bio stimulator Asahi SL. It concerned all tested parameters at 15°C and 20°C. The following responses were recorded: lack of effect, tendency to improve or make worse the investigated parameters and positive or negative effect (tables 1-6).

Conditioning of seeds of the cultivars 'Koralik' and 'Jokato' had no effect on their germination energy at 20°C, whereas for the cultivars 'Ryton' and 'Ju Huang' the used bio stimulator decreased it or had a tendency to decrease it. Only for the cultivar 'Korsarz' Asahi SI increased their germination energy from 33.0% to 37.7% (0.25%) and to 45.7% (0.50%). The conditioning effected germination capacity at 20°C only in the case of two cultivars: 'Korsarz' and 'Jokato'. In the first one the parameter increased from 49.7% to 64.3%, in the latter it decreased or had a tendency to decrease the parameter. For the cultivars 'Jokato' and 'Ju Huang', the conditioning showed a tendency to increase a percentage of the deformed seedlings and dead seeds ('Jokato' and 'Ju Huang') and diseased seedlings ('Jokato') at 20°C (table 1).

The conditioning showed a tendency to shorten the MTG at 20°C in all tested cultivars except the cultivar 'Korsarz'. The best effects were received when 0.75% Asahi SL was used (shortening from 3.8 to 3.4 days) for the cultivar 'Jokato', 0.25% (shortening from 5.0 to 4.2 days) and 0.5% (shortening from 5.0 to 4.3 days) for the cultivar 'Ryton'. The positive effect of the conditioning of seeds was also found in the case of the cultivar 'Koralik' resulted in its shortening from 9.2 to 8.5 days (table 2).

Treating seeds of the cultivars 'Ryton' and 'Ju Huang' with water and the bio stimulator Asahi SL had no effect of the fresh weight of seedlings emerged at 20°C, whereas in other cultivars it decreased this parameter or had a tendency in this direction (table 3).

At 15°C, the conditioning decreased or had a tendency to decrease the seed germination capacity of the cultivars 'Koralik' and 'Korsarz' it had no effect on them. The positive effect of it was found for the cultivar 'Ju Huang'. The various effect of conditioning was also found for the diseased seedlings. In some treatments it decreased their percentage ('Koralik'), increased ('Korsarz' and 'Jokato') or had no effect ('Ryton' and 'Ju Huang'). However, in the

cultivars ‘Korsarz’ and ‘Ryton’ the number of dead seeds increased due to the conditioning. Soaking seeds in water and Asahi SL decreased the number of healthy ungerminated seeds (table 4).

Table 1

Effect of treating seeds of various cultivars of tomato with the biostimulator Asahi SL on their germination at 20°C

Seed treatment	Cultivar				
	‘Koralik’	‘Korsarz’	‘Jokato’	‘Ryton’	‘Ju Huang’
Energy of germination (%)					
Control	10.0 a*	33.0 ab	36.7 a	14.3 b	35.0 b
H <sub>2</sub> O	12.7 a	23.3 a	42.0 a	19.3 c	30.7 ab
Asahi SL 0,25%	10.0 a	37.7 b	31.0 a	9.7 ab	29.3 ab
Asahi SL 0,50%	13.3 a	45.7 c	37.3 a	8.3 a	26.7 a
Asahi SL 0,75%	13.0 a	31.3 ab	32.7 a	6.7 a	30.7 ab
Germination capacity (%)					
Control	86.0 a	49.7 b	77.7 c	23.7 a	81.3 a
H <sub>2</sub> O	82.7 a	36.0 a	65.3 bc	27.7 a	81.0 a
Asahi SL 0,25%	83.7 a	58.0 bc	54.7 ab	20.0 a	80.7 a
Asahi SL 0,50%	84.7 a	64.3 c	71.7 c	21.3 a	81.7 a
Asahi SL 0,75%	88.0 a	51.7 b	50.7 a	21.0 a	82.7 a
Deformed seedlings (%)					
Control	9.3 a	8.0 a	6.7 ab	5.3 a	9.7 ab
H <sub>2</sub> O	13.0 a	10.3 a	8.0 b	2.0 a	7.3 ab
Asahi SL 0,25%	9.7 a	4.7 a	10.7 b	5.0 a	11.7 b
Asahi SL 0,50%	11.3 a	7.3 a	2.3 a	2.0 a	8.0 ab
Asahi SL 0,75%	7.7 a	12.0 a	8.3 b	3.0 a	6.7 a
Diseased seedlings (%)					
Control	0.7 a	22.0 a	6.7 a	24.3 a	0.3 a
H <sub>2</sub> O	1.7 a	35.7 b	19.3 ab	24.0 a	1.3 a
Asahi SL 0,25%	0.7 a	15.3 a	21.7 ab	25.3 a	0.3 a
Asahi SL 0,50%	0.7 a	15.3 a	13.3 ab	22.3 a	1.0 a
Asahi SL 0,75%	0.0 a	17.3 a	27.0 b	22.3 a	0.7 a
Healthy ungerminated seeds (%)					
Control	4.0 a	15.3 a	6.3 a	24.0 a	8.0 a
H <sub>2</sub> O	2.7 a	12.3 a	4.3 a	20.7 a	9.7 a
Asahi SL 0,25%	6.0 a	15.3 a	8.7 a	23.7 a	6.3 a
Asahi SL 0,50%	3.3 a	10.7 a	7.7 a	23.0 a	9.0 a
Asahi SL 0,75%	4.3 a	11.7 a	9.3 a	21.3 a	8.7 a
Dead seeds (%)					
Control	0.0 a	6.7 b	2.7 a	22.7 a	0.3 a
H <sub>2</sub> O	0.0 a	5.7 ab	3.0 a	25.7 ab	0.7 a
Asahi SL 0,25%	0.0 a	6.7 b	4.0 a	26.0 ab	1.0 a
Asahi SL 0,50%	0.0 a	2.3 a	5.0 a	31.3 b	2.0 a
Asahi SL 0,75%	0.0 a	7.3 b	4.7 a	29.0 ab	1.3 a

\*Means in columns, separately for each parameter, followed by the same letters are not significantly different at  $\alpha = 0.05$  level according to Duncan’s range test

The conditioning increased  $G_{max}$  at 15°C for the cultivar ‘Ju Huang’, whereas had no effect on this parameter in the case of other cultivars. In all tested cultivars, except the cultivar ‘Rytin’, in majority of cases, the conditioning shortened both the MTG and  $T_{50}$ . The best effect was received when using 0.5% Asahi SL for the cultivar ‘Koralik’, shortening of  $T_{50}$  from 12.5 to 11.8 days (table 5).

Table 2

Effect of treating seeds of various cultivars of tomato with the biostimulator Asahi SL on their maximum germination and time of germination at 20°C

Seed treatment	Cultivar				
	`Koralik`	`Korsarz`	`Jokato`	`Ryton`	`Ju Huang`
$G_{\max}$ – maximum germination (%)					
Control	96.0 a*	86.3 a	93.7 ab	51.0 a	92.0 a
H <sub>2</sub> O	97.3 a	87.7 a	95.7 b	59.3 a	90.3 a
Asahi SL 0,25%	93.0 a	84.7 a	91.0 ab	60.3 a	93.7 a
Asahi SL 0,50%	96.7 a	98.3 a	92.3 ab	59.7 a	92.7 a
Asahi SL 0,75%	95.7 a	88.3 a	90.7 a	58.3 a	91.3 a
MGT – mean germination time (days)					
Control	9.2 ab	3.4 a	3.8 c	5.0 b	3.9 b
H <sub>2</sub> O	9.4 b	3.0 a	3.5 ab	4.7 ab	3.5 a
Asahi SL 0,25%	8.6 a	2.9 a	3.7 bc	4.2 a	3.4 a
Asahi SL 0,50%	8.7 ab	3.2 a	3.8 c	4.3 a	3.5 a
Asahi SL 0,75%	9.3 ab	2.7 a	3.4 a	5.0 b	3.7 ab
$T_{50}$ – time to 50% of the maximum germination (days)					
Control	9.2 bc	3.0 b	3.5 c	4.2 b	3.4 b
H <sub>2</sub> O	9.5 c	2.6 a	3.2 a	3.6 ab	3.1 a
Asahi SL 0,25%	8.5 a	2.6 a	3.3 ab	3.5 a	3.1 a
Asahi SL 0,50%	8.7 ab	2.8 ab	3.3 ab	3.6 ab	3.2 ab
Asahi SL 0,75%	9.3 bc	2.6 a	3.2 a	3.9 ab	3.3 b

\*Means in columns, separately for each parameter, followed by the same letters are not significantly different at  $\alpha = 0.05$  level according to Duncan's range test

Table 3

Effect of treating seeds of various cultivars of tomato with the biostimulator Asahi SL on the fresh weight of seedlings emerged at 20°C

Seed treatment	Cultivar				
	`Koralik`	`Korsarz`	`Jokato`	`Ryton`	`Ju Huang`
Fresh weight of 100 seedlings (g)					
Control	6.2 c*	3.3 b	3.9 b	3.6 a	3.1 a
H <sub>2</sub> O	5.1 bc	3.3 b	3.3 a	3.5 a	3.6 a
Asahi SL 0,25%	5.6 c	2.5 a	3.9 b	3.5 a	3.9 a
Asahi SL 0,50%	3.5 a	3.2 b	3.7 ab	3.3 a	3.6 a
Asahi SL 0,75%	4.0 ab	3.0 ab	3.4 a	3.3 a	3.2 a

\*Means in columns, separately for each parameter, followed by the same letters are not significantly different at  $\alpha = 0.05$  level according to Duncan's range test

In the case of the cultivar 'Jokato', the conditioning increased or showed a tendency to increase the fresh weights of seedlings emerged at 15°C. However, no significant differences for the tested cultivars were found (table 6).

Many authors have reported a possibility to improve germination of tomato seeds by conditioning them (Wolf and Sims, 1982; Alvaro and Brandford, 1988; Dąbrowska and Tulo, 1993; Sadowski 2002). Such procedure affects not only their germination but may affect the final yields (Wolfe and Sims, 1982; Sadowski, 2002).

Table 4

Effect of treating seeds of various cultivars of tomato with the biostimulator Asahi SL on their germination at 15°C

Seed treatment	Cultivar				
	'Koralik'	'Korsarz'	'Jokato'	'Ryton'	'Ju Huang'
Energy of germination (%)					
Control	0.0 a*	0.0 a	0.0 a	0.0 a	0.0 a
H <sub>2</sub> O	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Asahi SL 0,25%	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Asahi SL 0,50%	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Asahi SL 0,75%	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Germination capacity (%)					
Control	2.3 a	53.3 a	69.7 b	21.0 b	33.0 a
H <sub>2</sub> O	3.7 a	50.0 a	55.0 a	17.3 ab	70.3 bc
Asahi SL 0,25%	1.3 a	58.7 a	62.0 ab	15.7 ab	62.0 b
Asahi SL 0,50%	3.0 a	50.7 a	63.7 ab	13.0 a	73.0 c
Asahi SL 0,75%	1.7 a	45.3 a	71.0 b	21.3 b	65.3 bc
Deformed seedlings (%)					
Control	63.0 a	20.7 a	22.0 a	18.3 a	31.0 c
H <sub>2</sub> O	73.0 ab	13.0 a	21.7 a	23.3 a	20.0 ab
Asahi SL 0,25%	78.0 b	16.7 a	15.7 a	20.0 a	24.0 bc
Asahi SL 0,50%	75.3 ab	17.3 a	21.3 a	17.3 a	14.3 a
Asahi SL 0,75%	75.0 ab	14.7 a	11.7 a	18.3 a	20.3 ab
Diseased seedlings (%)					
Control	1.3 b	7.7 ab	4.0 a	11.3 a	1.0 a
H <sub>2</sub> O	1.3 b	21.7 c	16.7 b	12.0 a	1.7 a
Asahi SL 0,25%	0.3 ab	5.0 a	13.7 b	13.3 a	2.0 a
Asahi SL 0,50%	0.0 a	18.0 bc	7.0 a	16.7 a	0.7 a
Asahi SL 0,75%	0.0 a	26.0 c	7.0 a	12.7 a	2.0 a
Healthy ungerminated seeds (%)					
Control	33.3 b	18.0 b	4.3 a	36.0 b	20.0 b
H <sub>2</sub> O	22.0 ab	14.0 ab	6.7 a	23.0 a	8.0 a
Asahi SL 0,25%	20.3 a	9.7 a	8.7 a	29.7 ab	12.0 a
Asahi SL 0,50%	21.3 ab	9.7 a	8.0 a	31.7 ab	11.7 a
Asahi SL 0,75%	23.3 ab	11.3 ab	10.3 a	35.7 b	12.0 a
Dead seeds (%)					
Control	0.0 a	0.3 a	0.0 a	11.7 a	0.0 a
H <sub>2</sub> O	0.0 a	2.0 ab	0.0 a	24.3 b	0.0 a
Asahi SL 0,25%	0.0 a	6.7 c	0.0 a	21.3 b	0.0 a
Asahi SL 0,50%	0.3 a	4.3 bc	0.0 a	21.3 b	0.3 a
Asahi SL 0,75%	0.0 a	2.7 ab	0.0 a	12.0 a	0.3 a

\* Means in columns, separately for each parameter, followed by the same letters are not significantly different at  $\alpha = 0.05$  level according to Duncan's range test

For conditioning of seeds, the solutions of biostimulators can be used, amongst them Asahi SL [0.3% sodium 1-nitrophenolate + 0.2% sodium 4-nitrophenolate + 0.1% sodium 5-nitroguaiacolate]. In the former experiments of Bralewski and Hołubowicz (2003b) Asahi SL (0.04%) and Biozyme Crop + [natural enzymes] (0.04%) increased the germination energy and the concentrations 0.02%, 0.03% and 0.04% sped up the germination of carrot seeds, Bio stimulators for improving germination of tomato seeds were also used by Sadowski (2002). He has pointed out that Atomik (= Asahi SL) improved, in comparison with the check seeds both energy and capacity of germination, as well as their vigour, field energy of emergences

and increased the seedlings weights. The received by him results are partly in accordance with the results got by the authors. However, Sadowski (2002) carried out his experiment on one cultivar, whereas this experiment proved the effect of a cultivar on the effect of seed conditioning.

Table 5

Effect of treating seeds of various cultivars of tomato with the biostimulator Asahi SL on their maximum germination and time of germination at 20°C

Seed treatment	Cultivar				
	`Koralik`	`Korsarz`	`Jokato`	`Ryton`	`Ju Huang`
<b>G<sub>max</sub> – maximum germination (%)</b>					
Control	66.3 a*	80.3 a	91.7 a	54.0 a	67.0 a
H <sub>2</sub> O	76.6 a	84.0 a	89.3 a	52.7 a	90.3 b
Asahi SL 0,25%	79.7 a	80.3 a	91.3 a	49.0 a	86.3 b
Asahi SL 0,50%	78.0 a	86.0 a	92.0 a	46.7 a	88.0 b
Asahi SL 0,75%	73.3 a	86.0 a	89.7 a	52.3 a	86.3 b
<b>MGT – mean germination time (days)</b>					
Control	12.4 b	7.7 b	7.9 b	8.9 a	9.3 d
H <sub>2</sub> O	12.2 ab	7.5 a	7.7 a	8.5 a	7.8 a
Asahi SL 0,25%	12.2 ab	7.6 b	7.6 a	8.3 a	8.1 bc
Asahi SL 0,50%	12.0 a	7.6 b	7.6 a	9.0 a	8.0 ab
Asahi SL 0,75%	12.1 a	7.6 b	7.7 a	8.3 a	8.4 c
<b>T<sub>50</sub> – time to 50% of the maximum germination (days)</b>					
Control	12.5 c	7.7 b	7.8 c	8.0 a	8.2 c
H <sub>2</sub> O	12.2 bc	7.5 a	7.6 a	7.8 a	7.7 a
Asahi SL 0,25%	12.2 a-c	7.6 b	7.6 ab	7.9 a	7.8 ab
Asahi SL 0,50%	11.8 a	7.6 b	7.6 ab	7.9 a	7.8 b
Asahi SL 0,75%	12.1 ab	7.6 b	7.7 bc	7.8 a	7.9 b

\*Means in columns, separately for each parameter, followed by the same letters are not significantly different at  $\alpha = 0.05$  level according to Duncan's range test

Table 6

Effect of treating seeds of various cultivars of tomato with the biostimulator Asahi SL on the fresh weight of seedlings emerged at 15°C

Seed treatment	Cultivar				
	`Koralik`	`Korsarz`	`Jokato`	`Ryton`	`Ju Huang`
<b>Fresh weight of seedlings (g)</b>					
Control	1.3 ab	2.6 ab	2.3 a	3.2 a	2.7 a
H <sub>2</sub> O	1.4 ab	2.7 ab	2.7 b	3.0 a	2.8 a
Asahi SL 0,25%	2.4 b	2.8 b	2.5 ab	3.3 a	2.9 a
Asahi SL 0,50%	1.9 ab	2.5 a	2.5 ab	2.9 a	2.9 a
Asahi SL 0,75%	1.0 a	2.5 a	2.5 ab	2.2 a	2.9 a

\*Means in columns, separately for each parameter, followed by the same letters are not significantly different at  $\alpha = 0.05$  level according to Duncan's range test

Summarising, the bio stimulator Asahi SL can be used to conditioning seeds of some cultivars of tomato in order to improve their germination capacity. However, for each cultivar, the exact concentration of the biostimulator must be first individually described.

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## REZUMAT

### EFFECTUL BIOSTIMULATORULUI ASAHI SL ASUPRA GERMINAȚIEI SEMINȚELOR UNOR CULTIVARE DE TOMATE (*LYCOPERSICON ESCULENTUM* MILL.)

Semințele au fost ținute timp de cinci ore, la întuneric, la temperatura de 20°C, în apă distilată și soluții 0,25% și 0,75% de biostimulator Asahi SL (0,3% 1-nitrophenolat de sodiu + 0,2% 4-nitrophenolat de sodiu + 0,1% 5-nitroguaiacolat de sodiu). După uscarea la 20°C, timp de 24 de ore, ele au fost testate pentru germinație, la 15°C și 20°C. Efectul semnificativ al cultivarului utilizat a fost identificat când semințele au fost tratate cu apă și biostimulator. S-au înregistrat următoarele reacții: lipsa de efect, tendința de a îmbunătăți sau a înrăutăți parametrul cercetat și efect pozitiv sau negativ. Efectul pozitiv a fost identificat în cazul unor parametri la 20°C. La cultivarul 'Korsarz', Asahi SL a mărit energia germinativă de la 33,0% la 37,7% (0,25 %) și 45,7% (0,50%), iar capacitatea germinativă de la 49,7% la 64,3%. Efectul de scurtare a timpului mediu de germinare (MGT) s-a realizat cu Asahi SL 0,75% (scurtare de la 5,0 la 4,2 zile) și Asahi SL 0,5% (scurtare de la 5,0 la 4,3 zile) la cultivarul 'Ryton'. Când Asahi SL 0,25% s-a folosit la cultivarul 'Koralik',  $T_{50}$  s-a scurtat de la 9,2 la 8,5 zile. Efectele pozitive ale tratamentelor cu biostimulatori au fost identificate și la 15°C. La cultivarul 'Ju Huang' condiționarea semințelor a îmbunătățit capacitatea lor germinativă. Tratamentul semințelor cu apă și Asahi SL a scăzut procentajul de semințe sănătoase negerminate. Condiționarea a îmbunătățit  $G_{max}$  la cultivarul 'Ju Huang'. La cultivarele testate, în majoritatea cazurilor, cu excepția cultivarului 'Ryton', condiționarea a scurtat MGT și  $T_{50}$ . Cel mai bun efect s-a obținut când s-a aplicat soluție Asahi SL 0,5% la cultivarul 'Koralik' (scurtare de la 12,5 la 11,8 zile). Rezultatele obținute au fost analizate statistic folosind testul Duncan cu  $\alpha=0,05$ . Condiționarea, în cazul cultivarului 'Jokato', a crescut sau a avut tendința de a crește masa verde a răsadurilor. Cu toate acestea, nu s-au identificat diferențe distincte între semințele tratate cu apă și cele tratate cu Asahi SL.