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STIMULATORY EFFECT OF ASAHI SL ON SELECTED PLANT SPECIES

Arkadiusz Przybysz[1], Mariola Wrochna[1], Adam Słowiński[2], Helena Gawrońska[1]
[1]Warsaw University of Life Sciences
[2]Arysta LifeScience Ltd

Abstract. Asahi SL stimulates plant's vital processes like growth and development, affects physiology and biochemistry, what often leads to increased biomass accumulation and yield. However, common is opinion that application of this preparation could be beneficial only, when treated plants are grown under unfavorable conditions. Therefore the aim of this work was the assessment of the stimulatory effect of Asahi SL on *Arabidopsis thaliana* L. and ornamental amaranth plants grown under optimal conditions. Plants treated with Asahi SL were higher and more advanced in development, particularly generative. Biomass accumulation was greater after biostimulator application mainly due to better photosynthetic apparatus efficiency, which was manifested by (i) greater leaf area, (ii) higher total chlorophyll content and (iii) increased intensity of photosynthesis. Effect of Asahi SL on chlorophyll *a* fluorescence was marginal. Despite of higher transpiration and lowered stomatal resistance the RWC was almost unchanged in biostimulator treated plants what was attributed to increased water uptake. Obtained results clearly showed that Asahi SL applied on plants can also be effective and beneficial when they are grown under optimal conditions.

Key words: biomass accumulation, biostimulator, plant growth and development, photosynthetic apparatus efficiency, optimal conditions

INTRODUCTION

Plant biostimulators is a category of relatively new products which are used to obtain possible the highest and the best quality yield, especially under unfavorable, for plant growth and development, environmental conditions. Asahi SL, a Japanese product, internationally known as Atonik or Chaperone, is listed among most frequently

Corresponding author – Adres do korespondencji: Arkadiusz Przybysz, Laboratory of Basic Research in Horticulture, Faculty of Horticulture and Landscape Architecture, Warsaw University of Life Sciences, Nowoursynowska 159, 02-793 Warsaw, Poland, e-mail: arkadiusz_przybysz@sggw.pl

used biostimulators. Its active ingredients are three simple phenolic compounds. Asahi SL improves plant's ability to cope with stresses and in consequence often increases height and quality of yield. The protective role of this biostimulator against stresses was reported for maize and ornamental amaranth plants grown under nitrogen deficiency and salinity stress [Grzyś et al. 2008, Wrochna et al. 2008]. Moreover, it is often claimed that Asahi SL application could be beneficial only, when treated plants are grown under stressful conditions [Vavrina 1998 a, b, c, Harasimowicz-Herman and Borowska 2006, Budzyński et al. 2008]. In this work an attempt was made to evaluate the effect of Asahi SL on *A. thaliana* and ornamental amaranth plants grown under optimal conditions based on selected morphological and physiological processes/parameters.

MATERIAL AND METHODS

The study object were plants of *A. thaliana* and two varieties of ornamental amaranth. Experiments were carried out at the Laboratory of Basic Research of Horticulture, Faculty of Horticulture and Landscape Architecture, Warsaw University of Life Sciences.

Arabidopsis thaliana L. Col 4 seeds (LEHLE SEEDS, Round Rock, TX, USA) were sown onto multiplates filled with substrate (Universal Kronenerde soil and sand in the proportion 2:1 v/v). Uniform, 6-week-old seedlings were transplanted to pots (Ø 10 cm) containing the same substrate. Plants were grown in growth chambers (Simez Control s.r.o. Vsetin, Czech Republic) at 22/18°C, photoperiod 8/16 h day/night with irradiance of 250–280 µmol $m^{-2}s^{-1}$ PAR and a relative humidity of 60%. One week after transplanting Asahi SL was applied once as a foliar spray in concentrations of 0.1% v/v. Before treatment the maximum water capacity (MWC) of the substrate was determined. Plants were cultivated in a substrate at 65% MWC and water was supplied daily *via* pot weighing. Control plants were sprayed with distilled water. After biostimulator treatment plants were grown for further 3 weeks. In this part of the work 11 experiments were carried out.

Ornamental amaranth (*Amaranthus paniculatus* L.) cv. Copper Mountain and Monarch seeds were sown into sand and cultivated under controlled conditions in Faculty greenhouses. Uniform, 4-week-old seedlings were placed into hydroponics culture (Hoagland solution, continuously aerated), where plants were grown for subsequent 6 weeks. After that time Asahi SL was applied as a single foliar spray in concentration of 0.1% and plants were grown for further 16 days. Controls plants were not sprayed with Asahi SL. In this part of the work 2 experiments were carried out.

During the experiment, in weekly intervals, following parameters were measured (though not all in every experiment):

(i) – plant gas exchange: intensity of photosynthesis and transpiration, stomatal resistance by IRGA methods using the Photosynthesis System LICOR 6200 (Lincoln, Nebraska, USA),

(ii) – chlorophyll *a* fluorescence (Handy PEA, Hansatech, UK or MINI-PAM, Walz, Germany),

(iii) – total chlorophyll content (CCM-200, OPTI-SCIENCES, USA) and
(iv) – water uptake (*via* pot weighing, measured daily).

At harvest, depending on the experiment data on following parameters was collected: height of plant; length and number of inflorescence; number of siliques; leaf area (Leaf Area, Root Length and Image Analysing System, Sky, UK). Also the fresh weight of the above ground parts was recorded and sub-samples for relative water content (RWC, by weighting) and membrane injury (conductometrically, MultiLevel 1, WTW, Germany) were taken. The remaining plant material was oven dried for 2 h at 105°C and then for 24 h at 70°C followed by dry matter recording.

Depending on the experiment and parameter, measurements were performed in between 5 and 15 replications what is indicated in tables. Data, where appropriate, were subjected to the statistical analysis of one factorial ANOVA of the Statgraphics Plus 4.1. Differences between combinations were evaluated by LSD of the t-Student test at $\alpha = 0.05$. Presented data are mean ±SE (where indicated).

Since in all experiments the received results showed very much the same trends, here we present data from experiments either with higher number of replications and/or with more parameters/processes measured.

RESULTS

Effect of Asahi SL on *Arabidopsis thaliana* L. plants grown under optimal conditions. Asahi SL applied as a foliar spray on *A. thaliana* plants had positive effect on majority of measured parameters and processes. Due to biostimulator application *A. thaliana* plants were more advanced in growth and development, especially of generative organs (tab. 1). Asahi SL positively affects plant height and leaf area by 23% and 16.5% respectively. Plants treated with biostimulator were also characterized with higher numbers of inflorescences (56%) and siliques (246%) (tab. 1).

Table 1. Effect of Asahi SL on selected morphological parameters of *A. thaliana* plants. Data are mean ± SE, n = 5

Tabela 1. Wpływ Asahi SL na wybrane parametry morfologiczne roślin rzodkiewnika pospolitego. Dane przedstawiają średnie ± SE, n = 5

Combination Kombinacja	Height $cm \cdot plant^{-1}$ Wysokość $cm \cdot roślina^{-1}$	Number of inflorescence $plant^{-1}$ Liczba kwiatostanów $roślina^{-1}$	Siliques $plant^{-1}$ Łuszczyn $roślina^{-1}$	Leaf area Powierzchnia liści cm^2
- Asahi SL	34.95 (± 2.42)	27.50 (± 3.18)	12.00 (± 2.09)	164.16 (± 9.53)
+ Asahi SL	42.92 (± 1.17)	43.00 (± 5.86)	41.50 (± 9.83)	191.51 (± 4.60)

A. thaliana plants treated with Asahi SL produced more biomass. The fresh weight of plants sprayed with biostimulator increased by 31% and dry matter by 27% (tab. 2). From comparison of biomass distribution, it is clearly seen that the positive effect of

Asahi SL is especially evident in the case of inflorescences, the biomass of which increased to a greater extent than that of rosette when compare with plants untreated with a biostimulator (tab. 2).

Table 2. Effect of Asahi SL on fresh weight and dry matter of whole above ground part, inflorescence and rosette of *A. thaliana* plants ($g \cdot plant^{-1}$). Data are mean ± SE, n = 5
Tabela 2. Wpływ Asahi SL na świeżą i suchą masę całej części nadziemnej, kwiatostanu i rozety roślin rzodkiewnika pospolitego ($g \cdot roślina^{-1}$). Dane przedstawiają średnie ± SE, n = 5

Combination Kombinacja	Measured parameter Badany parametr	Above ground part Część nadziemna	Inflorescences Kwiatostany	Rosette Rozeta
Fresh weight Świeża masa	- Asahi SL	18,28 (± 0,97)	5,49 (± 0,57)	12,78 (± 0,49)
	+ Asahi SL	23,97 (± 0,62)	8,28 (± 0,79)	15,69 (± 0,48)
Dry matter Sucha masa	- Asahi SL	2,03 (± 0,10)	0,68 (± 0,07)	1,35 (± 0,05)
	+ Asahi SL	2,58 (± 0,05)	1,07 (± 0,09)	1,51 (± 0,05)

Efficiency of the photosynthetic apparatus of *A. thaliana* plants grown under optimal conditions was positively affected by the Asahi SL (tab. 3). The intensity of photosynthesis was higher in treated plants by 22% and 37% respectively for measurements taken 7 and 14 days after biostimulator treatment. Increased intensity of photosynthesis corresponded well with the lowered stomatal resistance, which was significantly higher in plants untreated with Asahi SL. The effect of biostimulator on chlorophyll content was not uniform. Measurements taken 7 days after the treatment showed that biostimulator increased chlorophyll content, while after 14 days from treatment was lower (tab. 3).

Table 3. Effect of Asahi SL on intensity of photosynthesis, stomatal resistance, chlorophyll content and transpiration of *A. thaliana* L. plants. Presented data are mean ± SE, n = 15
Tabela 3. Wpływ Asahi SL na intensywność fotosyntezy, opory dyfuzyjne aparatów szparkowych, całkowitą zawartość chlorofilu oraz intensywność transpiracji roślin rzodkiewnika pospolitego. Dane przedstawiają średnie ± SE, n = 15

Termin Term	Combination Kombinacja	*Photosynthesis* Fotosynteza $\mu mol\ CO_2\ m^{-2}\ s^{-1}$	Stomatal resistance Opory szparkowe $s\ cm^{-1}$	Chlorophyll content (reletive values) Zawartość chlorofilu (wartości względne)	Transpiration Transpiracja $\mu mol\ H_2O\ m^{-2}\ s^{-1}$
7 days 7 dni	- Asahi SL	7.34 (± 0.17)	4.85 (± 0.51)	11.25 (± 0.31)	2.36 (± 0.12)
	+ Asahi SL	8.98* (± 0.12)	0.86* (± 0.02)	11.61 (± 0.41)	5.55* (± 0.07)
14 days 14 dni	- Asahi SL	7.57 (± 0.19)	1.83 (± 0.04)	11.31 (± 0.85)	3.67 (± 0.02)
	+ Asahi SL	10.38* (± 0.05)	0.44* (±0.01)	11.08 (±0.98)	8.21* (± 0.10)

* values differing significantly at $\alpha = 0.05$ as determined by LSD of t-Student test
* wartości istotnie różniące się przy poziomie istotności $\alpha = 0,05$ oszacowane za pomocą NIR testu t-Studenta

Biostimulator applied in optimal conditions had only marginal effect on measured parameters of chlorophyll *a* fluorescence in *A. thaliana* plants (tab. 4).

Table 4. Effect of Asahi SL on maximum quantum efficiency of photosystem II (Fv/Fm), efficiency of oxygen evolving complex (Fv/Fo) and performance index (P.I.) of *A. thaliana* L. plants. Presented data are mean ± SE, n = 10

Tabela 4. Wpływ Asahi SL na maksymalną wydajność kwantową fotosystemu II (Fv/Fm), efektywność kompleksu rozkładu wody (Fv/Fo) oraz indeks witalności (P.I.) u roślin rzodkiewnika pospolitego. Dane przedstawiają średnie ± SE, n = 10

Termin Term	Combination Kombinacja	Fv/Fm	Fv/Fo	P.I.
7 days 7 dni	- Asahi SL	0.832 (± 0.0011)	4.956 (± 0.0405)	1.766 (± 0.0597)
	+ Asahi SL	0.833 (± 0.0017)	5.002 (± 0.0572)	1.668 (± 0.0563)
14 days 14 dni	- Asahi SL	0.828 (± 0.0011)	4.824 (± 0.0375)	2.790 (± 0.0587)
	+ Asahi SL	0.828 (± 0.0011)	4.825 (± 0.0375)	2.688 (± 0.0668)

Asahi SL had also positive influence on plant water status of *A. thaliana* plants grown under optimal conditions. As it could be expected, lower stomatal resistance in biostimulator sprayed plants resulted in higher intensity of transpiration (tab. 3). Despite of higher transpiration and lowered stomatal resistance the RWC was almost unchanged in Asahi SL treated plants, mainly because of greater water uptake from the soil (tab. 5).

Table 5. Effect of Asahi SL on relative water content (RWC), water uptake and membrane integrity of *A. thaliana* plants. Presented data are mean ± SE, n = 5

Tabela 5. Wpływ Asahi SL na względną zawartość wody, pobieranie wody oraz uszkodzenia błon plazmatycznych u roślin rzodkiewnika pospolitego. Dane przedstawiają średnie ± SE, n = 5

Combination Kombinacja	Relative water content Względna zawartość wody %	Water uptake ml pot^{-1} Pobieranie wody ml $doniczka^{-1}$	Membrane integrity % of control* Uszkodzenia błon plazmatycznych % kontroli*
- Asahi SL	90.98 (± 0.74)	21.22 (0.56)	0
+ Asahi SL	(± 1.28)	24.00 (0.50)	-0.1102

* control (- Asahi SL) is defined as having 0% injuries
* przyjęto, że uszkodzenia w kontroli (- Asahi SL) wynoszą 0%

Biostimulator had also slightly positive effect on membrane integrity of *A. thaliana* plants (tab. 5).

Effect of Asahi SL on ornamental amaranth plants grown under optimal conditions. Asahi SL applied on ornamental amaranth plants had diverse effect on studied parameters of chlorophyll *a* fluorescence (tab. 6). Influence of biostimulator on ab-

Table 6. Effect of Asahi SL on selected parameters of photosynthetic apparatus efficiency of ornamental amaranth plants. Presented data are mean ± SE, n = 8

Tabela 6. Wpływ Asahi SL na wybrane parametry sprawności aparatu fotosyntetycznego roślin szarłatu ozdobnego. Dane przedstawiają średnie ± SE, n = 8

Cultivar Odmiana	Termin Term	Combination Kombinacja	Yield	%qP	%qN	%NPQ	Fv/Fo	Fv/Fm	Clorophyll content (relative values) Zawartość chlorofilu (wartości względne)
Copper Moutain	1 day 1 dzień	- Asahi SL	0.254 (± 0.012)	29.5	32.5	38.1	3.279 (± 0.096)	0.764 (± 0.006)	19.55 (± 1.041)
		+ Asahi SL	0.235 (± 0008)	34.8	31.7	33.5	3.516*(± 0.026)	0.778*(± 0.001)	26.51*(± 2.090)
	7 days 7 dni	- Asahi SL	0.354*(± 0012)	35.0	29.2	35.8	3.979 (± 0.034)	0.798 (± 0.001)	17.35 (± 0.902)
		+ Asahi SL	0.323 (± 0.008)	32.8	30.1	37.1	3.862 (± 0.046)	0.794 (± 0.002)	20.83 (± 1.041)
	14 days 14 dni	- Asahi SL	0.280 (± 0.018)	25.3	31.5	43.2	4.122 (± 0.041)	0.804 (± 0.022)	26.67 (± 1.307)
		+ Asahi SL	0.270 (± 0.006)	25.8	32.3	41.9	4.006 (± 0.032)	0.800 (± 0.001)	26.74 (± 1.804)
Monarch	1 day 1 dzień	- Asahi SL	0.229 (± 0.001)	33.2	33.2	37.0	3.100 (± 0.083)	0.777*(± 0.005)	12.44 (± 0.669)
		+ Asahi SL	0.250 (± 0.011)	32.8	32.8	37.8	3.504*(± 0.036)	0.755 (± 0.002)	20.86*(± 1.457)
	7 days 7 dni	- Asahi SL	0.276 (± 0.008)	30.2	30.2	40.2	3.609*(± 0.077)	0.782 (± 0.004)	18.73 (± 1.358)
		+ Asahi SL	0.321*(± 0008)	31.8	31.8	36.6	3.308 (± 0.028)	0.778 (± 0.001)	16.46 (± 0.974)
	14 days 14 dni	- Asahi SL	0.246 (± 0.011)	29.5	32.6	37.9	3.796 (± 0.020)	0.791 (± 0.001)	19.33 (± 0.761)
		+ Asahi SL	0.289*(± 0.012)	32.7	30.8	36.5	3.731 (± 0.061)	0.788 (± 0.003)	24.10*(± 0.395)

* values differing significantly at $\alpha = 0.05$ as determined by LSD of t-Student test

* wartości istotnie różniące się przy poziomie istotności $\alpha = 0,05$ oszacowane za pomocą NIR testu t-Studenta

sorbed energy distribution in amaranth leaves was usually positive but obtained results strongly depended on tested cultivar, studied parameter and term of measurment. Asahi SL in most cases increased photochemical quenching (qP) with simultaneous reduction portion of energy loss as heat (NPQ) and fluorescence (qN). Application of biostimulator in case of cv. Copper Mountain negatively affected actual photochemical quantum (Yield) and this was true for all three terms of measurements. On the other hand treated plants of cv. Monarch, independently from term of measurements, were always characterized with higher values of Yield. Asahi SL had usually negative influence on measured selected parameters of chlorophyll *a* fluorescence in dark-adapted leaves with slightly positive effect on F_v/F_m and F_v/F_o noted 1 day after preparation application. In this study, with only one exception, increase of total chlorophyll content in range of 0.5% and 68%, in both examined cultivars, was recorded (tab. 6).

DISCUSSION

In this work effect of plant biostimulator Asahi SL on *A. thaliana* and ornamental amaranth plants grown under optimal, controlled conditions was examined. It is often claimed that recorded lack of stimulation after Asahi SL application could be due to fact that plants are grown under favourable, close to optimal, conditions [Vavrina 1998 a, b, c]. Harasimowicz-Herman and Borowska [2006], Budzyński et al. [2008] and Krawiec [2008] pointed out that positive effect of this preparation on yield of oilseed rape and chokeberry strongly depended on weather conditions. Contrary to above, results of this work clearly showed that Asahi SL could be also effective when is applied on plants grown under optimal conditions.

Obtained results showed that plants treated with Asahi SL were more vigorous and advanced in growth and development, especially generative. Sprayed with biostimulator *A. thaliana* plants were higher, mostly due to longer inflorescences. Positive effect on plant height was also noted when Asahi SL was applied on feverfew [Gruszczyk and Berbeć 2004], maize [Michalski et al. 2008] and soya-bean [Kozak et al. 2008]. Longer after Asahi SL treatment were shoots of *Torenia fournieri* and *Fuchsia hybrida* [Bąblewski and Dębicz 2006] and shoots and roots of tomato seedlings [Djanaguiraman et al. 2005a].

One of the possible explanation for stimulation of elongative growth after Asahi SL application could be higher concentration and/or activity of auxins. Increased concentration of those hormones in biostimulator treated plants was shown by Djanaguiraman et al. [2004, 2005a]. Plants sprayed with Asahi SL were also characterised by higher inhibition of IAA oxidase, what ensures greater activity of naturally synthesised auxins [Stutte and Clark 1990]. What is more, when a phosphorylated form of *para*-nitrophenolate (one of the ingredients of Asahi SL) is used as a substrate for phosphatases the number of high-affinity binding sites of IAA increases [Libbenga and Mennes 1987]. On the other hand Vavrina [1998 a, b, c] and Csizinszky [2001] did not notice any positive effect of the examined biostimulator on height of pepper, cucumber and tomato plants.

After Asahi SL application number of inflorescences and siliques in *A. thaliana* plants increased. Stimulation of generative development as a result of biostimulator application was noted for oilseed rape [Harasimowicz-Herman 2008, Budzyński et al. 2008, Malarz et al. 2008, Słowiński and Jarosz 2008]. Similar results were obtained also for other species like cotton [Djanaguiraman et al. 2005b] and soya-bean [Kozak et al. 2008]. Opposite to the above Vavrina [1998 a, b, c] did not recorded any positive effects of Atonik on fruit number and fruit size of bell pepper, cucumber and tomato.

In this work we showed that Asahi SL have positive effect on biomass accumulation in *A. thaliana* plants. It is worth mentioning that due to biostimulator treatment, the increase of biomass accumulated in generative organs (inflorescences and siliques) was greater than in vegetative ones (rosette), which additionally supports the previously discussed promotion of generative development. Stimulation of biomass accumulation after Asahi SL application was also recorded for tomato seedlings [Djanaguiraman et al. 2005a], roots and leaves of *Bergenia* and *Hosta* [Krajewska and Latkowska 2008], feverfew [Gruszczyk and Berbeć 2004] and ginseng [Kołodziej 2004]. Contrary to above Krawiec [2008] noted that biostimulator did not affect dry matter of chokeberries fruits. Czeczko and Mikos-Bielak [2004] showed that, in some cases, treatment with a Asahi SL might even have negative effect on dry matter accumulation in some vegetables species.

Biomass accumulation was stimulated by Asahi SL application mostly due to better photosynthetic efficiency manifested by (i) greater leaf area, (ii) higher total chlorophyll content and (iii) increased intensity of photosynthesis. Sprayed with biostimulator *A. thaliana* plants were characterized with greater leaf area. Similar results were obtain by Krajewska and Latkowska [2008] and Djanaguiraman et al. [2005b]. Asahi SL treatment, in both examined species, usually positively affected total chlorophyll content. These results are in agreement with those obtained on *Hosta* and *Bergenia* [Krajewska and Latkowska 2008] and maize [Grzyś et al. 2008]. In this work biostimulator treated *A. thaliana* plants had a higher intensity of photosynthesis what is in line with the data of Djanaguiraman et al. [2009] on cotton and Wróbel and Woźniak [2008] on common osier. Although the obtained in our study levels of positive effects on the particular parameters of the photosynthetic apparatus are not very spectacular, it has to be taken into consideration that they "work additively". For example photosynthesis takes place over several hours a day during most of the sunny days of the vegetation season, which, together with the positive effects on other processes, would substantially contribute to final plant productivity.

In this work Asahi SL had only marginal and diverse effect on chlorophyll *a* fluorescence in dark-adapted leaves of *A. thaliana* and ornament amaranth plants, being both stimulatory, *via* no effect to inhibitory. Influence of biostimulator on absorbed energy distribution measured in ornamental amaranth plants was often positive but obtained results strongly depended on examiened cultivar, studied parameter and term of measurment. Application of Asahi SL, independently from term of measurement, positively affected Yield in cv. Monarch plants. Contrary to above cv. Copper Mountain plants treated with biostimulator had always lower values of this parameter. This rather slight and diverse effect of Asahi SL on chlorophyll *a* fluorescence of plants grown under optimal conditions could be explained by the fact that chlorophyll *a* fluorescence, among others, is a measure of plants response to stresses [Kalaji and Guo 2008]. Opposite to above positive effect of Asahi SL on chlorophyll *a* fluorescence was noted by Wrochna et al. [2008] on *Amaranthus sp*. plants grown under salinity stress and Djanaguiraman et al. [2009] who showed that Atonik had positive influence on Fv/Fm parameter in cotton plants.

Application of Asahi SL lowered stomatal resistance of *A. thaliana* plants, what corresponds well with the results of Borowski and Blamowski [2008], who demonstrated that biostimulator treated plants had higher stomatal conductance (parameter opposite to stomatal resistance). Lowered stomatal resistance ensures easier and greater CO_2 flow to chloroplast, and this, at least partially, explains the described earlier higher intensity of photosynthesis. On the other hand, lowered stomatal resistance leads to a higher intensity of transpiration, which was also recorded in this study for *A. thaliana* plants. Higher transpiration means greater water loss and, in consequence, it could be expected that the RWC should also be lowered. Surprisingly, RWC measured in *A. thaliana* plants was usually almost unchanged after treatment, mainly because of greater water uptake from the soil. Improved RWC in Asahi SL sprayed plants was also reported by Wrochna et al. [2008].

Asahi SL had also slightly positive effect on membrane integrity of *A. thaliana* plants. Similar results were obtain by Wrochna et al. [2008] and Djanaguiraman et al. [2009] on *Amaranthus sp*. and cotton plants.

CONCLUSIONS

1. Asahi SL applied on plants grown under optimal conditions had positive effect on majority of measured processes/parameters.
2. Application of Asahi SL stimulates growth and development of *A. thaliana* plants, especially of generative organs.
3. Biostimulator positively affects biomass accumulation of *A. thaliana* plants.
4. Asahi SL application results in better efficiency of photosynthetic apparatus *via* increased: (i) leaf area, (ii) total chlorophyll content and (iii) intensity of photosynthesis.
5. Effect of Asahi SL on measured chlorophyll *a* fluorescence parameters of *A. thaliana* and ornamental amaranth plants grown under optimal conditions is only marginal.
6. The RWC of Asahi SL treated plants is almost unchanged despite higher transpiration and lower stomatal resistance mainly because greater water uptake from the soil.

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STYMULUJĄCY WPŁYW ASAHI SL NA WYBRANE GATUNKI ROŚLIN

Streszczenie. Asahi SL stymuluje procesy życiowe roślin, jak również wzrost i rozwój oraz wpływa ma procesy fizjologiczne i biochemiczne, co często prowadzi do zwiększenia wytwarzanej biomasy i plonowania. Powszechną jest jednak opinia, że pozytywny wpływ preparatu ma miejsce, tylko wtedy, gdy rośliny rosną w niekorzystnych warunkach. Celem pracy były ocena stymulującego wpływu Asahi SL na rośliny rzodkiewnika pospolitego oraz szarłatu ozdobnego rosnące w warunkach optymalnych. Rośliny traktowane Asahi SL były, wyższe oraz bardziej zaawansowane w rozwoju, szczególnie generatywnym. Preparat podwyższał akumulację biomasy głównie poprzez poprawę sprawności aparatu fotosyntetycznego, która przejawiała się zwiększeniem (i) powierzchni liści, (ii) zawartości chlorofilu oraz (iii) intensywności fotosyntezy. Preparat miał niewielki wpływ na mierzone parametry fluorescencji chlorofilu *a*. Mimo wyższej transpiracji i obniżonych oporów dyfuzyjnych, u roślin traktowanych preparatem, ich RWC się nie zmieniło, co tłumaczyć można zwiększonym pobieraniem wody z podłoża. Uzyskane w tych badaniach wyniki dowodzą, że Asahi SL działa pozytywnie także na rośliny rosnące w warunkach optymalnych.

Słowa kluczowe: akumulacja biomasy, biostymulator, rozwój roślin, sprawność aparatu fotosyntetycznego, warunki optymalne

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