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EFFECT OF FOLIAR APPLICATIONS OF GOËMAR® BM 86 AND SOIL APPLIED CALCIUM NITRATE ON YIELD AND BERRY QUALITY OF TWO BLUE HONEYSUCKLE CULTIVARS

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Abstract. In Poland edible honeysuckle becomes more and more popular, especially in amateurish cultivation. There is a little information about cultivation technology. The aim of this study carried out in 2008–2009 was to examine the influence of Goëmar® BM 86 and calcium nitrate on yielding and fruiting quality of two cultivars of blue honeysuckle (*Lonicera caerulea* var. *kamtschatica*): 'Atut' and 'Duet'. Using the fertilization with calcium nitrate, applied to the soil around plants, in April at the rate of 50 kg·ha^{-1}, alone or with Goëmar® BM 86 (applied three times during the bloom period at the dose of 3 l·ha^{-1}) was compared to untreated plants. Fertilizers had no positive effect on the yield and the mass of 100 fruit. Fertilizers did not influence significantly on the dry matter, soluble solids, reductive sugar and anthocyanins content. The influence of Goëmar® BM 86 and calcium nitrate on acidity of berries was inconsistent. Honeysuckle berries of cv. 'Atut', after using the mentioned combination of preparations, reacted by increasing in acid concentrations, however acid content of 'Duet' berries significantly decreased in comparison to the control. The quality features of honeysuckle berries were strongly dependent on the weather conditions during vegetation period.

Key words: edible honeysuckle, quantity and quality of yield, fertilizers

INTRODUCTION

Edible honeysuckle is unique member of *Lonicera* family. According to Bieniek et al. [2005] edible – fruit bearing varieties descent from *Lonicera caerulea*: *L. caerulea* var. *edulis*,. *L. caerulea* var. *tanganica*,. *L. caerulea* var. *kamtschatica* and *L. caerulea* var. *altaica*. *Lonicera caerulea* is a circumpolar species native to northern boreal forests in Asia, Europe and North America. It is mainly found in low lying, wet areas or high mountains. Edible honeysuckle represents a lesser known fruit species in Poland. It is

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called blue honeysuckle (descriptive translation from Russian), edible honeysuckle, haskap (ancient Japanese name of the Anui people), swamp fly honeysuckle (common name coined by botanists who found it growing in swampy areas), sweet berry honeysuckle [Bors 2008]. Recently, in Poland a growing interest has been observed in blue honeysuckle cultivation and breeding, because a blue honeysuckle has a lot of positive features: early ripening (even two weeks before strawberry), exceptional hardiness, no specific demands for soil and climatic conditions or a low susceptibility to pests and diseases. The flesh of fruit is dark-purple, aromatic, sweet, juicy and have a flavour commonly described as a combination of blueberries and raspberries [Kawecki 1996]. Analyses of the berry extracts revealed high contents of β-carotene, polyphenol flavonoids, anthocyanins and vitamin C [Opera et al. 2002, Chaovanalikit et al. 2004]. Their biological activities include: protection against ischemic heart disease mortality [Armstrong et al. 1975] and they have antitumorigenic [Gruia et. al. 2008], antimicrobial, anti-inflammatory-allergic and antimutagenic properties [Svarcova et al. 2007].

Chemical composition of berries varies depending on genetic factors (cultivar), climate, weather conditions, as well as agronomic practices. Sufficient plant nutrition is very important for high production and fruit quality [Wrona 2011]. The positive effect of calcium treatments was recorded for fruit crops. Increases in fruit calcium content prevents physiological fruit disorders in apple [Centkowski and Tomala 2000] and reduces cherry cracking [Mitre et al. 2008]. Calcium fertilizers are important in berry production as well. It is well established that calcium increase berry firmness, rot resistance and storage quality [Wójcik and Lewandowski 2003, Walter et al. 2008].

At present, the growing interest in ecological methods of fruit production as well as decreasing number of synthetic products allowed for use in the orchards, forcing to replace the chemical agents by new biological formulations [Matyjaszczyk 2007, Basak 2008]. Bio-fertilization is very safe for human, animal and environment to get lower pollution and reduce soil salinity via decrease mineral usage fertilization as well as saving fertilization cost. According to Newton [1951] the earliest reference to seaweed manure is in the second half of first century, when the Roman Columella recommended that cabbages be transplanted at the sixth leaf stage and their roots be mulched and manured with seaweed. Plants grown in soils treated with seaweed manures or extracts applied either to the soil or foliage, exhibit a wide range of responses. Benefits in fruit production and commercial qualities of fruit are documented in a number of revives. The variable responses with different cultivars is shown with apples in a multi-year study involving the seaweed preparations Goëmar® BM 86 and Kelpak® [Basak 2008].

The first purpose of this study was to determining the time of flowering, fruiting and harvesting of berries of two edible honeysuckle cultivars descent from *Lonicera kamtschatica* [Markowski et al. 2004] or *Lonicera caerulea* var. *edulis* [Dziedzic 2008, Małodobry et al. 2008] in Lubelszczyzna region. The second objectives of this study was to asses the effect of Goëmar® BM 86 and calcium nitrate on yield and fruit quality of two cultivars of blue honeysuckle : ‘Atut’ and ‘Duet’.

MATERIAL AND METHODS

The two cultivars of blue honeysuckle (*Lonicera caerulea* var. *kamtschatica*): 'Atut' and 'Duet' were grown on a plantation near Lublin in Poland (NL: 51°, EL: 22°). Plants were planted in the spring of 2001 in clay loam soil, cultivated under conventional agronomic treatments adequate to low soil and water requirements of the species. The climatic conditions of the site were follows: average temperature during vegetation period 13.1°C, average rainfall 552 mm per year. The actual values of average temperature and rainfall in April–June 2008–2009 are given in Table 1.

Table 1. Climatic conditions. Mean air temperature and total precipitation in 2008 and 2009 versus a background of many-year averages

Tabela 1. Warunki klimatyczne. Średnia temperatura powietrza oraz sumy opadów w latach 2008 i 2009 w stosunku do średnich wieloletnich

	Month Miesiąc	2008				2009				1951–2005
		decade – dekada			mean średnio	decade – dekada			mean średnio	
		I	II	III		I	II	III		
Temperature Temperatura °C	IV	7.81	9.36	10.78	9.3	11.45	9.33	13.47	11.4	7.4
	V	11.31	13.33	13.59	12.7	13.63	13.08	14.16	13.6	13.0
	VI	17.97	16.37	18.82	17.7	15.29	14.98	19.1	16.4	16.2
Precipitation Opady mm	IV	17.6	35.3	2.9	55.8	1.1	1.8	0.0	2.9	40.2
	V	57.1	34.7	9.8	101.6	3.6	34.9	32.9	71.4	57.7
	VI	0.0	19.6	6.3	25.9	28.2	32.7	64.6	125.5	65.7

Blue honeysuckle were planted in a bed system 1 × 1 × 1.2 m. In the years 2008––2009 a study involving the use of Goëmar® BM 86 and calcium nitrate $Ca(NO_3)_2$ was conducted at the Departament of Pomology of the University of Life Sciences in Lublin. To avoid the potential movement of fertilizers, around the plots with plants fertilized by calcium nitrate $Ca(NO_3)_2$, the isolation belts were applied with successive two bushes. The fertilization was applied in the following combinations:

1. The control – untreated plants;
2. Calcium nitrate $Ca(No_3)_2$ applied to the soil around plants in April at the rate of 50 kg·ha^{-1};
3. Goëmar® BM 86 applied three times during the bloom period at the dose of 3 l·ha^{-1};
4. Calcium nitrate $Ca(No_3)_2$ applied to the soil around plants in April at the rate of 50 kg·ha^{-1} and Goëmar ®BM 86 applied three times during the bloom period at the dose of 3 l·ha^{-1}.

No chemical plant protection was applied because of resistance to diseases and pests of *Lonicera* plants. The experiment was a completely randomized block design with 3 replicates. Each consisted of four plants per plot.

Goëmar® BM 86 (Arysta LifeScience) is fertilizer derived from seaweed *Ascophyllum nodosum* and it is a good source of nitrogen (4.2%). It also contains many amino acids, vitamins, polysaccharides, phytohormones. Goëmar® BM 86 is rich in magnesium (4.8% MgO), sulfur (3.9% S), boron (2.0% B) and molybdenum (0.02% Mo). Goëmar® BM 86 is an amine solution and it is possible to add it to any other products applied in a liquid form.

Effect of treatments with Goëmar® BM 86 and calcium nitrate on yield and fruit quality were evaluated on the basis of the following indices:

– Total yield was recorded by collecting two – three times fruits from each bush;

– Mean mass of 100 fruits;

– Dry matter content (with the oven-drying method);

– Soluble solids content was determined using Abbé refractometer;

– Reducing sugar content was determined according to the Loof-Schoorl method [Krełkowska-Kułas 1993];

– Acidity was determined by titrating water extract of berry homogenate with 0.1 N NaOH titration to the end point of pH 8.1 (potentiometric method and were converted to malic acid);

– Anthocyanins content (colorimetric method, converted to cyaniding chloride);

Experimental data were statistically elaborated using analysis of variance for two-factorial experiments and Tukey's test at P = 0.05. Data were analyzed by 'STATISTICA' program.

RESULTS

The small yellow flowers developed in axillary pairs. In 2008 and 2009 it was almost in the same periods (at 17th and 19th of April). After nearly two weeks honeysuckle bushes were in the stage of full bloom. The first ripened berries occurred in 2008 at 11th of June and in 2009 at 9th of June (tab. 2).

The yield of blue honeysuckle, as a response to treatment was differential and cultivar – depended (tab. 4). 'Atut' and 'Duet' responded similar to calcium nitrate and Goëmar® BM 86, however quantity of 'Atut' yield was significantly smaller than 'Duet' (tab. 4). The lowest mean yield from two years of study from control 'Atut' bushes (414.0 g/bush) was harvested and the biggest – from 'Duet' bushes treated with calcium nitrate and Goëmar® BM 86 (1445.6 g/bush; tab. 4).

Analyzing the mass of 100 fruits it was stated, that studied cultivars responded differently to treatments (tab. 4). Berries from bushes of cv. 'Atut', treated calcium nitrate and Goëmar® BM 86, had the smallest average mass of 100 fruits (102.7 g). On the contrary, the same treatment on the bushes cv. 'Dukat' effected with the highest values of described feature (152.3 g). The mean mass of 100 fruits in 2009 was significant bigger (140.8 g) than in 2008 (121.1 g), regardless of cultivar (tab. 3). Berries of 'Duet' had significantly bigger mass of 100 fruits (150.2 g) than 'Atut' (111.7 g; tab. 4).

The individual varieties responded differently to the applied treatments in fruit dry matter content. The dry matter content of fruit cv. 'Atut' has slightly decreased after

fertilizing, but in 'Duet' – increased. Regarding the two-year mean values the fruit of 'Atut' had the significantly higher dry matter content, than 'Duet' (tab. 4).

Table 2. Dates of some phenological observations on edible honeysuckle bushes (mean for `Atut` and `Duet`) in the Lubelszczyzna region

Tabela 2. Daty niektórych stadiów fenologicznych krzewów suchodrzewu jadalnego (średnio dla odmian 'Atut' i 'Duet') w warunkach Lubelszczyzny

Phenological observations Obserwacje fenologiczne	Year – Rok	
	2008	2009
Beginning of vegetation Rozpoczęcie wegetacji	01.04	07.04
Start of leaves developing Początek rozwijania się liści	10.04	13.04
Beginning of flowering Początek kwitnienia	17.04	19.04
Full bloom Pełnia kwitnienia	30.04	29.04
The last flowers opening Otwarcie ostatnich kwiatów	16.05	31.05
Date of the first harvest Termin pierwszego zbioru	11.06	09.06
Date of the second harvest Termin drugiego zbioru	24.06	25.06

Table 3. Effect of vegetative period on some characteristics of fruit of edible honeysuckle (mean for 2008–2009)

Tabela 3. Wpływ sezonu wegetacyjnego na niektóre cechy owoców suchodrzewu jadalnego

Year	Total field ($g \cdot bush^{-1}$) Plon całkowity ($g \cdot krzew^{-1}$)	Mass of 100 fruits Masa 100 owoców (g)	Dry matter content Zawartość suchej masy (%)	Soluble solids content Zawartość ekstraktu (%)	Sugar content Zawartość cukrów (%)	Acidity Kwasowość (%)	Anthocyanins content Zawartość antocyjanów (%)
2008	799.5 a	121.1 a	14.62 b	11.47 b	8.47 b	1.89 b	0.571 b
2009	901.3 a	140.8 b	12.10 a	9.66 a	6.32 a	1.82 a	0.451 a

*Means marked with the same letters within columns do not differ significantly at $p \leq 0.05$.
*Średnie wartości w kolumnach oznaczone tymi samymi literami nie różnią się istotnie przy $p \leq 0.05$.

Soluble solids content was highly variable between the cultivars because in fruit of cv. 'Atut' was significantly bigger than in 'Duet' (tab. 4). However there was no clear influence of used preparations on values of described feature. In the case of cv. 'Atut' fruit from treated bushes characterized by significantly lower values of soluble solids content than control fruit. However in 'Duet' the differences were not statistically sig-

Table 4. Some characteristics of the yield of edible honeysuckle in dependence on fertilizing and cultivar (mean for 2008–2009)
Tabela 4. Niektóre cechy plonu owoców suchodrzewu jadalnego w zależności od nawożenia i odmiany (średnio dla lat 2008–2009)

Treatments Kombinacje	Cultivar Odmiana	Total yield ($g \cdot bush^{-1}$) Plon całkowity ($g \cdot krzew^{-1}$)	Mass of 100 fruits Masa 100 owoców (g)	Dry matter content Zawartość suchej masy (%)	Soluble solids content Zawartość ekstraktu (%)	Sugar content Zawartość cukrów (%)	Acidity content Zawartość kwasów (%)	Anthocyanins content Zawartość antocyjanów (%)
Control Kontrola	‘Atut’	414.0 a*	106.3 a	14.71 b	11.90 b	6.98 a	2.29 c	0.561 cd
Calcium nitrate Saletra wapniowa		510.3 a	119.2 a	14.61 b	10.18 a	6.83 a	2.26 c	0.571 d
Goëmar® BM 86		429.8 a	118.5 a	14.33 b	10.55 a	6.82 a	2.51 e	0.538 cd
Goëmar® BM 86 + calcium nitrate Goëmar® BM 86 + saletra wapniowa		523.9 a	102.7 a	14.14 b	10.45 a	7.07 a	2.42 d	0.510 b-d
The mean for ‘Atut’ treatment Srednia dla kombinacji ‘Atut’		469,5 A	111,7 A	14,45 B	10,77 B	6,93 A	2,37 B	0,545 B
Control Kontrola	‘Duet’	1167.8 bc	152.1 b	12.12 a	10.48 a	8.06 c	1.38 b	0.503 bc
Calcium nitrate Saletra wapniowa		1259.6 bc	147.9 b	12.20 a	10.48 a	8.17 c	1.35 b	0.453 ab
Goëmar® BM BM 86		1052.3 b	147.9 b	12.49 a	10.38 a	7.62 b	1.39 b	0.534 cd
Goëmar® BM 86 + calcium nitrate Goëmar® BM 86 + saletra wapniowa		1445.6 c	152.3 b	12.28 a	10.10 a	7.59 b	1.26 a	0.418 a
The mean for ‘Duet’ treatment Srednia dla kombinacji ‘Duet’		1231,3 B	150,2 B	12,27 A	10,36 A	7,86 B	1,34 A	0,477 A

*Means marked with the same letters within columns do not differ significantly at $p \leq 0.05$.
*Średnie wartości w kolumnach oznaczone tymi samymi literami nie różnią się istotnie przy $p \leq 0.05$.

nificant. The significant influence of vegetative seasons on fruit soluble solids content was evident, because in 2008 fruits had significant more soluble solids content than in 2009 (tab. 3).

Berries of 'Duet' honeysuckle had significantly more sugar than cv. 'Atut' (tab. 4). There were no significant influence of preparations on sugar content of fruit cv. 'Atut', however in fruit of cv. 'Duet' the negative influence of Goëmar® 86 and Goëmar® 86 + calcium nitrate on sugar content was evident as compared to the control fruit (tab. 4). In 2008 sugar content in honeysuckle berries was significantly bigger than in 2009 (tab. 3).

Fruit of cv. 'Atut' had significantly higher acidity than 'Duet' (tab. 4). In the case of cv. 'Atut' the usage of Goëmar® 86 and Goëmar® 86+calcium nitrate affected significant increasing in acidity in compared to the control berries (tab. 4). The adverse reaction to Goëmar® 86 + calcium nitrate was found for 'Duet' berries. This treatment significant decreasing acidity of berries as compared to the control fruit. In 2008 acidity of berries was significant higher than in 2009 (tab. 3).

Fruit of cv. 'Atut' characterized significant higher content of anthocyanins than 'Duet' (tab. 4). In the case of 'Atut' there was no significant influence of used preparations as compared to the control, however fruits from 'Duet' bushes treated with Goëmar® 86 + calcium nitrate had significant lower anthocyanins content than control fruits (tab. 4). The significant effect of vegetative season on values of described feature was observed, because in 2008 fruits had much more anthocyjanins than in 2009 (tab. 3).

DISCUSSION

The mean total yield of cv. 'Atut' bushes was 469.5 g, whereas cv. 'Duet' 1231.3 g. According to Kawecki [1996] five-year-old bush produces 1000 g per bush whereas Ochmian et al. [2008] and Skupień et al. [2007] reports 459; 519; 755 and 825 g for four-year-old bushes of respectively 'Czarna', seedling 'N', 'Wojtek' and 'Zielona'. The poorer yield of honeysuckles cv. 'Atut' than 'Duet' in present study could be affected by genetics features like it was evident in the experiment of Małodobry et al. [2008]. But as well it could be resulted from severe density of bushes on plantation. Plants of 'Duet' grew much intense than 'Atut' so the lowest and inner branches could had not enough light for flower bud setting.

In this study Goëmar® BM 86 did not improved yield of both studied cultivars of blue honeysuckle, however Masny et al. [2004] noted after using Goëmar® BM 86 the significant improvement in yield of one from two checked strawberry cultivars, with fruit quality reducing by decreasing of fruit firmness. Sas-Paszt et al. [2008] reported that strawberry plants of the cv. 'Elkat' produces higher yields after treatments with Goëmar® BM 86. However this preparation do not affect fruit yield in the cv. 'Salut'. Krawiec [2008] stated that Goëmar® BM 86 has positive effect on chokeberry yield only in the year when a severe drought occur. According to Eman et al. [2008] application three times of algal extract at 50–100% on grapevines significant improves the yield, especially in the second year of the study. Spraying by algal improves chemical

parameters in terms of increasing soluble solids content, total sugars and reducing total acidity compared to untreated vines.

It is well established that nitrogen regulates yield. Walter et al. [2008] checking how the differ nutrient nitrogen managements influence on strawberry plants, stated that more fruit were produced in treatments containing nitrogen than in the control. In this study the calcium nitrate slightly increased yield of both cultivars as compared to the control. Cultivar 'Atut' also characterized by the some bigger the mass of 100 fruit than control. However the calcium nitrate treatments did not improved the studied quality features.

As for the mean values for the cultivars in 2008–2009, compared with Juríková and Matuškovič [2007], the both 'Atut' and' 'Duet', in the conditions of the experiments, had lower accumulation of dry matter, organic acids, but similar sugar content. These differences could be explained by the varied climatic conditions Nitra and Lublin and some differences in kind of studied material (different cultivars). The mass of 100 fruits, soluble solids content and acidity, which characterized berries of 'Atut' are comparable with edible honeysuckle cv. 'Czarna' as was previously determined by Skupień et al. [2009]. The soluble solids content is a measurement of the mass ratio of dissolved sugar to water in a liquid. Soluble solids content is representative of sugar concentration (sucrose, glucose, fructose, etc.). In this study. soluble solids content varied from 10.36 for 'Duet' berries and 10.77 for 'Atut' berries and it was in accordance with data obtained by Kamzolova et al. [2006] who reported for 15 honeysuckle cultivars 9.1–12.6%. In study of Skupień et al [2009] berries of seedlings 'N' had higher soluble solids content that these of 'Czarna'. For both cultivars late berries which ripened at higher temperatures had significantly higher content of soluble solids. Poll and Petersen [2003] observed that sour cherries obtained in a cold and rainy seasons showed soluble solids concentration 16–18°Brix whereas in the year of higher temperatures 26–28°Brix. For comfort taste feeling very important is not only sugar or soluble solids content, but fruit should have sufficient ratio of soluble solids to acid content. Grajkowski [1995] stated, that favorable feeling of apple cv. 'Cox Orange' is then the soluble solids content is 14% and acid – 0,5%. Among berries the fruit of edible honeysuckle are quite distinct in flavor because soluble solids content and acid content of blueberries [Skupień 2006] and strawberries [Tõnutare et al. 2009] are respectively: 13,0%; 0,76% and 10.15%; 0.98%. In this study the soluble solids content and acidity on the level 10.57% and 1.86% was noted, so the taste feeling could be similar like during eating blackcurrant berries for witch Sasnauskas et al. [2009] stated respectively: 15.0 % and 3.02%. Berries of edible honeysuckle cv. 'Duet' were in this study were gentler in taste than 'Atut' because the soluble solids to acid ratio of cv. Duet' fruits was higher (7.73) than 'Atut' (4.54).

In this study from the appearance of the typical colour to fully ripened fruit it was 5–10 days. From flowering to fruit ripening it was 55 days in 2008 and 51 days in 2009 which is not in accordance with Plekhanova [2000] who reported 30–42 days and Jurikova et al. [2009] 37–41 days. Jurikova et al. [2009] determined only 5–6 weeks for fruit development. In the present study the honeysuckle berries achieved fully ripened stage 7–8 weeks after fertilization, so almost the same like early ripening cherries for which Bőhm et al. [1988] reported 8–12 weeks. The blue honeysuckle are quite early ripening species in Poland and could be a good source of vitamins and anthocyanins after winter

[Skupień et al. 2007]. When weather conditions are favorable the fruit start ripening even in May [Arus and Kask 2007, Małodobry et al. 2008]. In the present study fruit of cv. `Atut` ripped a few days before `Duet` but these cultivars are not the earliest ripening cultivars of edible honeysuckle in Poland. It correspondents with findings of Małodobry et al. [2008], who during three years of their study, twice determined the beginning of ripening the first fruits at the first decades of June.

The effect of temperature and water on fruit development and ripening was studied by Plekhanova [1995]. She emphasized that temperature is the most important factor influencing nutrition content, growth, maturation and storage of edible honeysuckle fruits. According to Skupień et al. [2009] the increase in fruit mass was accompanied by enhancement of fruit dimensions. Both diameter and length of fruit significantly increased at the end of cropping. They explained it as a result for higher temperatures later in the season and that fruit collected earlier grew in less favorable weather conditions.

CONCLUSIONS

1. Fertilizers had no positive effect on the yield and the mass of 100 fruit. Fertilizers did not influence concentration of dry matter, soluble solids, sugar and anthocyanins. The influence of Goëmar® BM 86 and calcium nitrate on acid content in berries was inconsistent.

2. Honeysuckle berries of cv. 'Atut' after using of mentioned combination of preparations reacted by increasing in acid concentrations, however acid content of 'Duet' berries significantly decreased in comparison with the control.

3. Edible honeysuckle of cv. 'Atut' and 'Duet' are quite early ripening fruits in Lubelszczyzna region and their features of quality are strongly dependent on the weather conditions during vegetation period. The total yield of honeysuckle in 2009 was similar like in 2008 but the mass of 100 fruits in the second year of experiment was significant bigger then in previous. Fruits in the 2009 had significantly lower internal quality than in 2008, because characterized by lower concentration of dry matter, soluble solids, sugars, acid and anthocyanins.

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WPŁYW DOLISTNEGO NAWOŻENIA PREPARATEM GOËMAR® BM 86 I DOGLEBOWEGO SALETRĄ WAPNIOWĄ NA PLON I JAKOŚĆ OWOCÓW DWÓCH ODMIAN SUCHODRZEWU JADALNEGO

Streszczenie. Suchodrzew jadalny staje się w Polsce coraz bardziej popularną rośliną, zwłaszcza w uprawie amatorskiej. Mało jest informacji o technologii jej uprawy. Celem doświadczenia przeprowadzonego w latach 2008–2009 było zbadanie wpływu preparatu Goëmar® BM 86 i saletry wapniowej na plon i jakość owoców dwóch odmian jagody kamczackiej (*Lonicera kamtschatica*) 'Atut' i 'Duet'. Nawożenie saletrą wapniową wykonane posypowo, stosując nawóz dookoła roślin w kwietniu w dawce 50 kg·ha^{-1} samodzielnie lub wraz z preparatem Goëmar® BM 86 (stosowanego trzykrotnie w czasie kwit-

nienia w dawce 3 l·ha^{-1}), porównywano z nienawożoną kontrolą. Nawozy nie miały korzystnego wpływu na plon i masę 100 owoców. Nawożenie nie wpłynęło istotnie na zawartość suchej masy, ekstraktu, cukrów i antocyjanów w porównaniu z kontrolą. Wpływ preparatu Goëmar® BM 86 i saletry wapniowej na kwasowość owoców nie był jednoznaczny, Owoce jagody kamczackiej odmiany 'Atut' po zastosowaniu wspomnianych preparatów charakteryzowały się zwiększoną kwasowością, podczas gdy kwasowość jagód odmiany 'Duet' istotnie obniżyła się w porównaniu z kontrolą. Cechy jakościowe jagód były silnie zależne od warunków pogodowych panujących w danym sezonie wegetacyjnym.

Słowa kluczowe: suchodrzew jadalny, wielkość i jakość plonu, nawozy

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