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YIELDING AND BIOLOGICAL VALUE OF SWEET PEPPER FRUITS DEPENDING ON FOLIAR FEEDING USING CALCIUM

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Abstract. Experiments involving sweet pepper of 'Red Knight' F_1 cultivar were carried out in 2008–2010 in a greenhouse. They aimed at evaluating the influence of foliar feeding using diverse preparations and rates of calcium on yielding, dry matter, sugars, and vitamin C contents in sweet pepper fruits. Following forms of calcium were used in the experiment: $Ca(NO_3)_2$, Librel Ca, and Wapnowit. Calcium was applied in the amounts of 0.4 g Ca · plant^{-1} (10 treatments) and 0.2 g Ca · plant^{-1} (5 treatments). No significant influence of applied calcium feeding on the pepper fruit yield size was recorded, while it significantly reduced the number of fruits infected by apical blossom-end rot (BER) at calcium-fed of Librel Ca plants as compared to the control. No significant effect of studied factors on dry matter content was found, although its lower level in pepper fruits harvested at the initial stage of fruiting was prominent. The influence of calcium feeding on monosaccharides and total sugars concentrations was positive when 0.2 g Ca · plant^{-1} (5 treatments) in a form of Wapnowit was applied. Considerably higher vitamin C concentration in calcium foliar-fed pepper fruits as compared to the control was recorded.

Key words: foliar feeding, calcium, yield, vitamin C, sugars, sweet pepper

INTRODUCTION

Foliar feeding is a very efficient way to supplement the nutrient pool. Its main virtue consist in quick effects and high rates of nutrients utilization. Sometimes it happens in practice that nutrients can be present in a soil environment at insufficient amounts or in forms that is hardly available for plants, which makes stress and disturbances of plant's metabolism, and in consequence, lower yields and worse quality. Therefore, there is a need of fast supply necessary components and providing them directly onto the leaf or fruit surface during spraying is the simplest and most effective way.

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Calcium is one of the hardest transferring nutrient within a plant, because it is transported in acropetal manner, and its supply to upper parts of a plant is reduced [Ho et al. 1999, Morard et al. 2000, Starck 2003, Cabanero et al. 2004]. The limited calcium quantities in plant's tissues results in some disturbances invoking physiological diseases, that make crop's size and quality are diminished [Marcelis and Ho 1999, White and Broadley 2003, Suzuki et al. 2003]. Calcium used as foliar application in a form of bivalent ions Ca^{2+} hardly penetrates the leaf blade than any other monovalent ions, e.g. K^+ [Mengel 2002, Michałojć and Szewczuk 2003]. Nevertheless, numerous studies unveiled that foliar feeding is commonly applied during plant cultivation, because it significantly increases the yields and crop quality [Lee and Kader 2000, Mengel 2002, Szewczuk and Michałojć 2003, Kosterna et al. 2009]. At the same time, improved quality of yields due to foliar feeding can be achieved only at optimum supply with nutrients in the soil.

Present study aimed at evaluating the influence of foliar feeding using diverse preparations and rates of calcium on yielding and biological value of sweet pepper fruits.

MATERIALS AND METHODS

Experiments involving sweet pepper (*Capsicum annuum* L.) of 'Red Knight' F_1 cultivar were carried out in 2008–2010 in a greenhouse on tables. In all experimental years, seeds were sown at the beginning of March, while the seedling was set into the soil at the end of April; the experiment was completed at the beginning of October.

Plants were grown in cylinders of 10 dm^3 capacity filled with horticultural peat at initial pH 4.6, then limed using $CaCO_3$ up to pH 6.5 at plant density of 4 plants per m^2. The experiment was set up in complete randomized pattern in 8 replicates. A single plant formed the experimental unit.

Fertilization during the whole vegetation season was (in g · plant^{-1}): N – 10 in forms of NH_4NO_3 (34% N) and KNO_3 (37.3% K, 15.5% N); P – 6.0 as $Ca(H_2PO_4)_2 \cdot H_2O$ (20.2% P); K – 15 as KNO_3 (37.3% K, 15.5% N); Mg – 7.0 as $MgSO_4 \cdot H_2O$ (17.4% Mg), microelements (in mg·plant^{-1}): Fe – 400 as EDTA Fe; Cu – 66.0 as $CuSO_4 \cdot 5H_2O$; Zn – 7.4 as $ZnSO_4 \cdot 7H_2O$; Mn – 51.0 in a form of $MnSO_4 \cdot H_2O$; B – 8.0 as H_3BO_3; and Mo – 18.0 as $(NH_4)_2Mo_7O_{24} \cdot 4H_2O$. When seedlings were set into the soil, contents of nutrients in a subsoil amounted to (in mg·dm^{-3}): N-NO_3 – 250; P – 300; K – 400; Mg – 150; Ca 2000, while pH 6.5. Microelements were supplied to the soil once before plant setting. Half of phosphorus rate was applied before planting, whereas the remaining quantity – at the sixth vegetation week. Nitrogen, potassium, and magnesium amounts were divided into 10 doses in order to prevent from excessive salt accumulation and to maintain constant levels of nutrients for the whole vegetation period. One-tenth rate was applied just before vegetation, subsequent doses – as top-dressing, while the last portion – 3 weeks before planned complete of the experiment.

Studies included the influence of two following factors:

1. Type of calcium preparation;
2. Calcium rates.

Calcium was applied as foliar feeding in mineral form as $Ca(NO_3)_2$ – 19% Ca, 15.5% N; in chelated form EDTA – Librel Ca – 9.5% Ca, as well as as Wapnowit – 11.9% Ca, 10% N, 0.48% Mg, 0.05% B, 0.02% Cu, and 0.02% Zn. The control comprised of plants that were sprayed only with distilled water at appropriate dates. Foliar feeding using calcium was started from the moment, when the first-level pepper fruits attained size of a walnut (mid of June). Working concentrations of particular calcium agents amounted to (% by weight): $Ca(NO_3)_2$, – 0.5%; Librel Ca – 1.05%; Wapnowit – 0.8%, which corresponded to the quantity of 1000 mg Ca · dm^{-3}.

The calcium foliar feeding was performed every 10 and 20 days, thus carrying out 10 and 5 operations during the vegetation season, respectively. Amount of used liquid was recorded after each feeding operation, which allowed for calculating that 0.4 g Ca during 10 and 0.2 g Ca during 5 treatments were applied per a single plant.

Sweet pepper fruits were harvested from each plant at their utility ripeness stage, when they were completely red colored, every 7 days. Following yielding parameters were determined: total weight of fruits, weight of commercial fruits, total number of fruits, number of healthy fruits, and number of fruits manifesting the symptoms of apical dry-rot.

The fruit samples for chemical analyses were collected in the mid of August (beginning of fruiting stage) as well as at the end of September (just before experiment complete).

Following items were determined in raw fruits: dry matter – drier method – PN-90/A-75101/03, vitamin C – Tilman's method – [PN-A-04019 1998], and sugars [Rutkowska 1981]. All above analyses were performed in 3 replicates.

Achieved results were statistically processed applying variance analysis. The significance of differences was verified by means of multiple Tukey confidence intervals. Values of LSD were assumed at the significance level of $\alpha = 0.05$.

RESULTS AND DISCUSSION

Achieved results related to the total and commercial yields of sweet pepper fruits indicated the lack of significant influence of diverse calcium rates nor Ca preparations on the yield size. On average, 1431 g of total fruits, 1317 g of commercial fruits, as well as 114 g fruits with apical dry-rot symptoms, were harvested from a single plant. At density of 4 plants per m^2, the mean total yield amounted to 5.72 kg·m^{-2}, commercial yield – 5.27 kg·m^{-2}, while 456 g ·m^{-2} of fruits with symptoms of apical blossom-end rot (BER); the average percentage of commercial in total yield was 91.6% (tab. 1). Substantial differences were recorded in total and commercial yields between particular years of study. Considerably lower fruit yield was harvested in the second experimental year (2008) as compared to other years. Similar dependence referring to the lack of calcium feeding influence on sweet pepper fruit yield was reported in experiments carried out by Flores et al. [2004] as well as Michałojć and Horodko [2006]. Kobryń and Zielony [2001], and Nurzyński et al. [2001] found comparable sweet pepper fruit yields, whereas Golcz [1999], Szafirowska and Elkner [2008] – slightly higher.

Table 1. The effect of Ca foliar feeding on yield (g · plant^{-1}) of sweet pepper fruits cv. Red Knight F_1
Tabela 1. Wpływ dokarmiania pozakorzeniowego Ca na plon (g ·roślinę$^{-1}$) owoców papryki słodkiej odm. Red Knight F_1

Dose Ca g · plant^{-1} Dawka Ca g·rośl.$^{-1}$ (A)	Kind of Ca fertilizer Rodzaj preparatu Ca (B)	Total yield Plon ogółem Years – Lata (C)			Mean Średnio	Marketabel yield Plon handlowy Yaers – Lata (C)			Mean Średnio	Share of marketable yield in total yield (%) Udział plonu handlowego w plonie ogółem (%) Years – Lata (C)			Mean Średnio %
		2008	2009	2010		2008	2009	2010		2008	2009	2010	
0.4	control – kontrola	1589	1017	1533	1380	1377	994	1382	1251	86.6	97.7	91.5	91.9
	Ca (NO3)2	1884	1035	1452	1457	1707	1021	1324	1351	90.6	98.6	93.4	93.2
	Librel Ca	1713	978	1635	1442	1490	978	1590	1353	87.0	100.0	94.9	94.0
	Wapnowit	1949	967	1740	1552	1661	951	1702	1438	85.2	98.3	93.8	92.4
Mean for 0.4 Ca Średnia dla 0.4 Ca		1784	999	1590	1458	1559	986	1500	1348	87.4	98.7	93.4	93.1
0.2	control – kontrola	1567	1175	1655	1466	1339	1042	1517	1299	85.4	88.7	88.6	87.6
	Ca(NO3)2	1523	1141	1305	1323	1340	1080	1305	1242	88.0	94.7	93.8	92.2
	Librel Ca	1593	1144	1444	1394	1358	1082	1393	1278	85.2	94.6	91.7	90.5
	Wapnowit	1607	1033	1671	1437	1377	952	1644	1324	85.7	92.2	92.1	90.0
Mean for 0.2 Ca Średnia dla 0.2 Ca		1573	1123	1519	1405	1354	1039	1465	1286	86.1	92.6	91.6	90.1
Mean for Ca fertilizer Średnio dla preparatu Ca	control – kontrola	1578	1096	1594	1423	1358	1018	1450	1275	86.1	92.9	90.0	89.7
	Ca(NO3)2	1704	1088	1378	1390	1524	1051	1314	1296	89.4	96.6	93.8	93.3
	Librel Ca	1653	1061	1539	1418	1424	1030	1491	1315	86.1	97.1	93.4	92.2
	Wapnowit	1778	1000	1705	1494	1519	951	1673	1381	85.4	95.1	92.9	91.1
Mean – Średnia		1678	1061	1554	1431	1456	1013	1482	1317	86.8	95.4	92.5	91.6
$NIR_{0,05}$													
dla dawki Ca – for dose Ca (A)					n.s. – n.i.				n.s. – n.i.				
dla preparatu Ca – for Ca fertilizer (B)					n.s. – n.i.				n.s. – n.i.				
dla lat – for yiers (C)					284.44				127.88				
A × B					n.s. – n.i.				n.s. – n.i.				
B × C					231.40				220.19				
A × C					375.16				356.98				
A × B × C					n.s. – n.i.				n.s. – n.i.				

Table 2. The effect of Ca foliar feeding on structure of the yield (No·plant^{-1}) of sweet pepper fruits cv. Red Knight F_1
Tabela 2. Wpływ dokarmiania pozakorzeniowego Ca na liczbę owoców papryki słodkiej (sztuk · roślinę$^{-1}$) odm. Red Knight F_1

Dose Ca g·plant^{-1} Dawka Ca g·rośl.$^{-1}$ (A)	Kind of fertilizer Ca Rodzaj preparatu Ca (B)	Total number fruits Liczba owoców ogółem No·plant^{-1} – sztuk·rośl.$^{-1}$ Years – Lata (C)			Mean Średnio	Markertable number fruits Liczba owoców handlowych No·plant^{-1} – sztuk·rośl.$^{-1}$ Years – Lata (C)			Średnio Mean	Fruit number with BER* Liczba owoców z objawami SZW* No·plant^{-1} – sztuk·rośl.$^{-1}$ Years – Lata (C)			Mean Średnio
		2008	2009	2010		2008	2009	2010		2008	2009	2010	
0.4	control – kontrola	13.9	10.2	7.5	10.5	10.8	9.9	6.1	8.9	3.1	0.3	1.4	1.6
	Ca $(NO_3)_2$	16.4	9.5	11.9	12.6	13.3	9.4	1.9	11.2	3.1	0.1	1.0	1.4
	Librel Ca	15.4	9.1	14.2	12.9	13.1	9.1	13.8	12.0	2.3	0.0	0.4	0.9
	Wapnowit	17.4	10.7	16.2	14.8	13.9	10.6	15.8	13.4	3.5	0.1	0.4	1.3
Mean for 0.4 Ca Średnia dla Ca 0.4		15.8	9.9	12.5	12.7	12.8	9.8	11.6	11.4	3.0	0.1	0.8	1.3
0.2	control – kontrola	17.0	13.1	9.4	13.2	13.5	11.8	8.5	11.3	3.5	1.3	0.9	1.9
	$Ca(NO_3)_2$	15.1	12.1	20.5	15.9	11.6	11.6	20.5	14.6	3.5	0.5	0.0	1.3
	Librel Ca	18.4	12.7	10.4	13.8	14.1	11.9	10.0	12.0	4.3	0.8	0.4	1.8
	Wapnowit	19.4	12.5	28.3	20.1	15,3	11.5	27.9	18.2	4.1	1.0	0.4	1.8
Mean for 0.2 Ca Średnia dla dawki Ca 0.2		17.5	12.6	17.2	15.8	13,6	11.7	16.7	14.0	3.8	0.9	0.4	1.7
Mean for fertilizer Ca Średnio dla preparatu Ca	control – kontrola	15.5	11.7	8.5	11.9	12,5	11.0	7.5	10.1	3.5	1.0	1.0	1.8
	$Ca(NO_3)_2$	15.8	10.8	16.2	14.3	12,5	10.5	16.0	12.9	3.5	1.0	1.0	1.8
	Librel Ca	16.9	10.9	12.3	13.4	13,5	10.5	12.0	12.0	3.0	1.0	0.0	1.3
	Wapnowit	18.4	11.6	22.3	17.4	14,5	11.5	22.0	15.8	4.0	1.0	0.0	1.7
Total mean – Średnia ogółem		16.7	11.3	14.8	14.3	13.0	11.0	14.0	12.6	3.5	1.0	0.5	1.7
$NIR_{0,05}$													
dla dawki Ca – for Ca dose (A)					1.039				1.0				0.234
dla preparatu Ca – for Ca fertilizer (B)					1.926				1.8				0.434
dla lat – for yiers (C)					1.521				1.4				0.343
A × B					n.s. – n.i.				3.1				0.726
A × C					4.247				4.0				n.s. – n.i.
B × C					n.s. – n.i.				n.s – n.i.				0.59
A × B × C					n.s. – n.i.				n.s – n.i.				n.s. – n.i.

BER – SZW* – Blossom-end rot – sucha zgnilizna wierzchołkowa

Table 3. The content of dry matter, monosaccharides and total sugars, vitamin C in sweet pepper fruits depending on Ca foliar feeding – mean for year 2008–2010

Tabela 3. Zawartość suchej masy, cukrów redukujących i ogółem oraz witaminy C w owocach papryki słodkiej w zależności od dokarmiania Ca – średnia z lat 2008–2010

Dose Ca g·plant^{-1} Dawka Ca g·rośl.$^{-1}$	Kind of Ca fertilizer Rodzaj nawozu Ca	Dry matter Sucha masa %			Monosaccharides Cukry redukujące, % f.m. – św.m.			Total sugars Cukry ogółem % f.m. – św.m.			Vitamin C, mg·100 g^{-1} Witamina C, f.m. – św.m.		
		I*	II**	mean średnio	I*	II**	mean średnio	I*	II**	mean średnio	I*	II**	mean średnio
0.4	control – kontrola	10.37	11.12	10.75	4.59	4.76	4.68	4.71	5.24	4.98	175.3	167.8	171.6
	Ca $(NO_3)_2$	10.04	10.61	10.33	4.59	4.85	4.72	4.85	5.10	4.98	194.7	173.4	184.1
	Librel Ca	10.31	10.82	10.57	4.68	4.78	4.73	4.85	5.08	4.97	190.1	182.7	186.4
	Wapnowit	10.27	11.06	10.67	5.04	5.23	5.14	5.43	5.49	5.46	191.4	182.2	186.8
Mean for 0.4 Ca Średnio dla 0.4 Ca		10.25	10.90	10.58	4.73	4.91	4.82	4.96	5.23	5.09	187.9	176.5	182.2
0.2	control – kontrola	10.03	11.25	10.64	4.89	4.87	4.88	5.20	5.34	5.27	182.7	163.5	173.1
	Ca $(NO_3)_2$	9.67	11.03	10.35	4.88	4.90	4.89	5.14	5.48	5.31	194.7	169.0	181.9
	Librel Ca	9.94	11.36	10.65	4.92	5.11	5.02	5.41	5.72	5.57	187.4	166.7	177.1
	Wapnowit	10.30	11.65	10.97	5.07	5.09	5.08	5.65	5.56	5.61	188.1	172.4	180.3
Mean for 0.2 Ca Średnio dla 0.2 Ca		9.99	11.32	10.65	4.94	4.99	4.97	5.35	5.53	5.44	188.2	167.9	178.1
Mean for Ca fertilizer Średnio dla nawozu Ca	control – kontrola	10.20	11.19	10.70	4.74	4.82	4.78	4.95	5.29	5.12	179.0	165.6	173.2
	Ca $(NO_3)_2$	9.86	10.82	10.34	4.73	4.87	4.80	4.99	5.29	5.14	194.7	171.2	183.0
	Librel Ca	10.13	10.09	10.11	4.80	4.95	4.88	5.40	5.40	5.27	188.8	174.7	181.8
	Wapnowit	10.28	11.36	10.82	5.05	5.16	5.11	5.54	5.52	5.53	189.7	177.3	183.6
Total mean – Średnia ogólna		10.12	10.87	10.49	4.83	4.95	4.89	5.22	5.38	5.27	188.1	172.2	180.2
$NIR_{0.05}$													
for dose Ca – dla dawki Ca (A)			n.s. – n.i.			n.s. – n.i.			0.223			n.s. – n.i.	
for Ca fertilizer – dla nawozu Ca (B)			n.s. – n.i.			0.198			0.251			11.099	
for date haverst – dla terminu zbioru (C)			n.s. – n.i.			0.103			0.154			12.048	
A × B			n.s. – n.i.			0.110			0.201			4.319	
B × C			n.s. – n.i.			0.191			n.s. – n.i.			16.203	
A × C			n.s. – n.i.			n.s. – n.i.			0.211			9.004	
A × B × C			n.s. – n.i.			n.s. – n.i.			n.s.– n.i.			n.s. – n.i.	

I* – date haverst 2 dekad August – data zbiotu 2 dekada sierpnia; II** – date haverst 3 dekad September – data zbioru 3 dekada września

Results on the number of sweet pepper fruits harvested from a single plant univocally indicate some significant effect of both studied factors on that feature (tab. 2). Considerably higher number of total and commercial fruits was recorded when lower (0.2 g Ca·plant^{-1}) unlike higher calcium level (0.4 g Ca·plant^{-1}) was applied. The impact of used calcium preparations on fruit number appeared to be quite interesting. Considerably more fruits from plants fed with calcium (as compared to the control and Wapnowit application) was recorded (tab. 2). Moreover, considerably lower weight and number of fruits during the second experimental year (2008) as compared to other years, was prominent. These facts can be elucidated by high air temperatures in the greenhouse during sweet pepper flowering, which contributed to falling the flowers from 2nd and 3rd levels. High temperatures (27–32°C) reduce fruit setting, because sweet pepper flowers and produces a lot of flowers, but the flowers fall of [Dobrzańska and Dobrzański 2001].

Applied rates and types of calcium preparations exerted significant influence of the number of fruits infected by apical blossom-end rot (BER). Among studied preparations, the smallest number of fruits with the disease symptoms was found after applying 0.4 g Ca · plant^{-1} in a form of Librel Ca, that contained chelated calcium. At the same time, considerably larger number of fruits with apical blossom-end rot (BER) symptoms in the first experimental year as compared to remaining years of study, was prominent. The studies were carried out in the greenhouse and atmosphere inside was not regulated. Literature ascertains that besides calcium deficit, also limited activity of gibberellins within a plant, water deficit, excessive concentrations of salts, and lack of oxygen in a subsoil are main causes of apical blossom-end rot (BER) [Saure 2000, Starck 2003, Cabanero et al. 2005, Aktas et al. 2005, Sonnenveld and Voogt 2009]. These parameters were not under control in present experiment.

Influence of studied experimental factors on biological value of sweet pepper fruits was evaluated on a base of dry matter, reducing sugars, total sugars, and vitamin C contents at the initial stage of full fruiting (mid of August) as well as just before experiment complete (end of September). Due to the fact that levels of dry matter, sugars, and vitamin C were similar over experimental years, table 3 presents mean values for 2008–2010.

Proportion of dry matter in sweet pepper fruits amounted from 9.67% to 11.65%, with average 10.43% (tab. 3). No significant influence of studied factors on dry matter content was observed, although its lower level in fruits harvested at the initial fruiting stage was prominent. Achieved results related to this item in here examined pepper fruits exceeded or were similar to those reported for sweet pepper fruits determined by other authors (7.30–10.29%) [Gajc-Wolska and Skąpski 2002, Gajc-Wolska at. el. 2005], (10.10–11.59%) [Buczkowska and Najda 2002 as well as Michałojć and Horodko 2006].

Mean concentration of reducing sugars in the first date was 4.83%, in the second – 4.95%, while that of total sugars: 5.22% and 5.38%, respectively, which suggests that sugars content increased along with the vegetation season by 0.12% and by 0.16% (tab. 3). Considerably more sugars was determined in fruits of pepper fed with lower calcium rate (0.2 g Ca·plant^{-1}) and when Wapnowit was applied, as compared to the control and other Ca preparations (tab. 3). Higher calcium dose (0.4 g Ca·plant^{-1}) reduced reducing and total sugars contents in pepper fruits. Michałojć and Horodko [2006] did not report any univocal influence of foliar feeding using calcium on sugars concentration in sweet pepper fruits. Results referring to the sugars content found in present experiment involving pepper fruits are comparable with those achieved for other pepper cultivars – 3.80–5.26% [Gajc-Wolska et. al. 2005] or they are higher than those reported by Buczkowska and Najda [2002] – 3.86–4.44%.

Summing up, a positive influence of foliar feeding with calcium on reducing and total sugars was recorded after applying 0.2 g Ca·plant^{-1} (5 treatments) in a form of Wapnowit.

Level of vitamin C in pepper fruits ranged from 163.4 to 194.7 mg · 100 g^{-1} FW and it was significantly differentiated by calcium rate, applied Ca preparation types, and harvest date. On average, 188.1 mg · 100 g^{-1} FW in the first, while 172.2 mg · 100 g^{-1} FW in the second date were determined (tab. 3). No effect of calcium dose on vitamin C concentration in sweet pepper fruits was recorded in the first harvest date, although its level depended the most positively on the item accumulation due to calcium nitrate. In the second date, substantially more vitamin C was found in pepper fruits when applying 0.4 g Ca · plant^{-1} rather than 0.2 g · Ca plant^{-1}; Wapnowit appeared to have the most positive influence on the compound synthesis. It is worth underlining that pepper fruits are abundant source of vitamin C and calcium feeding stimulates the compound synthesis. Perucka and Materska [2004], as well as Michałojć and Horodko [2006] reported positive effects of calcium feeding on vitamin C concentration, while Flores et al. [2004] could not confirm such dependence. Some other authors also found similar contents of vitamin C in sweet pepper of hybrid cultivars: Lee and Kadar [2000], Buczkowska and Najda [2002] – 168.7–202.5 mg · 100 g^{-1}, Gajc-Wolska and Skąpski [2002] – 176.3–197.3 mg · 100 g^{-1}, whereas little less in 2005–2006: Gajc-Wolska et al. [2005] – 70.39–137.46 mg · 100 g^{-1} FW. All quoted results indicate that foliar feeding using calcium had positive influence of vitamin C content in sweet pepper fruits.

CONCLUSIONS

1. Applying the calcium foliar feeding to sweet pepper of Red Knight F_1 cultivar had no significant influence on the yield size, while it reduced the weight and number of fruits manifesting the symptoms of apical blossom-end rot (BER) as compared to the control.

2. No significant effect of studied factors on dry matter content was found, although its lower level in pepper fruits harvested at the initial stage of fruiting was prominent.

3. The influence of calcium feeding on reducing and total sugars concentrations was positive when 0.2 g Ca · plant^{-1} (5 treatments) in a form of Wapnowit was applied.

4. Considerably higher vitamin C concentration in calcium foliar-fed pepper fruits as compared to the control was recorded.

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PLONOWANIE I WARTOŚĆ BIOLOGICZNA OWOCÓW PAPRYKI SŁODKIEJ W ZALEŻNOŚCI OD DOKARMIANIA POZAKORZENIOWEGO WAPNIEM

Streszczenie. Badania z papryką słodką odmiany Red Knight F_1 przeprowadzono w szklarni w latach 2008–2010. Miały one na celu określenie wpływu zróżnicowanych preparatów wapniowych oraz dawek wapnia, które zastosowano pozakorzeniowo, na plonowanie, zawartość suchej masy, cukrów i witaminy C w owocach papryki. W badaniach do dokarmiania wykorzystano $Ca(NO_3)_2$, Librel Ca oraz Wapnowit. Wapń zastosowano w ilości 0,4 g Ca · roślinę$^{-1}$ (10 zabiegów) oraz 0,2 g Ca · roślinę$^{-1}$ (5 zabiegów). Stwierdzono brak istotnego wpływu zastosowanego dokarmiania wapniem na wielkość plonu owoców papryki, natomiast wykazano istotnie mniej owoców porażonych suchą zgnilizną wierzchołkową u roślin dokarmianych wapniem w postaci Librelu Ca w porównaniu z kontrolą. Nie stwierdzono istotnego wpływu badanych czynników na zawartość suchej masy, aczkolwiek zwraca uwagę mniejszy jej udział w owocach papryki zebranej w początkowym okresie owocowania. Wykazano korzystny wpływ dokarmiania Ca na zawartość cukrów redukujących i ogółem po zastosowaniu 0,2 g Ca · roślinę$^{-1}$ (5 zabiegów) w postaci Wapnowitu. Odnotowano istotnie większą zawartość witaminy C w owocach papryki dokarmianych pozakorzeniowo wapniem w porównaniu z kontroląi oraz nie wykazano jednoznacznego wpływu zastosowanych preparatów Ca na jej gromadzenie w owocach.

Słowa kluczowe: dokarmianie pozakorzeniowe, wapń, plon, witamina C, cukry, papryka słodka

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