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YIELDING OF RED PEPPER (*Capsicum annuum* L.) UNDER THE INFLUENCE OF VARIED POTASSIUM FERTILIZATION

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Abstract. The type of the applied nitrogen fertiliser plays a significant role in plant nutrition. Supplying plants with potassium in the form of chloride, sulphate or salpetre significantly modifies the chemical composition of plants, as anions accompanying potassium serve different functions. The vegetation experiment on the cultivation of red pepper cv. 'Cyklon' was conducted in 2005 and 2006 in a plastic tunnel in rings (V = 5 dm^3) filled with mineral soil and highmoor peat (3:2). The response of plants to three potassium salts KCl, K_2SO_4 and KNO_3 was determined at two levels of nitrogen-potassium fertilization of 250 mg N and NH_4NO_3 and 300 mg K, as well as 350 mg N and 400 mg K·dm^{-3} substrate, at constant levels of the other macro- and microelements. Biometric measurements of plants were taken and the volume of fruit yield was determined. It was found that the type of potassium fertilizer at the two levels of nitrogen and potassium fertilization did not have a significant effect on total and marketable yields of fruits in red pepper cv. 'Cyklon', plant height, total and marketable fruit numbers as well as fresh weight of a single fruit. It was shown that a higher level of nitrogen and potassium fertilization (350 N and 400 K mg dm^{-3} substrate) had a positive effect on the analyzed biometric parameters of fruits, except for fresh weight of a single fruit. Results of these investigations, confirmed by other authors, critically refer to the division of vegetable crops developed by Th. Geissler and Buchner into chloride- and sulfate-loving vegetable crops.

Key words: N and K dose, fertilizer KCl, K_2SO_4, KNO_3, yield, biometric measurements

INTRODUCTION

Red pepper is a cultivated form of pepper (*Capsicum annuum* L.). A Polish cultivar 'Cyklon' with pungent taste is valued by the pharmaceutical and processing industries as well as consumers among other things for its antioxidant properties. Continuous consumption of red pepper provides higher resistance to thrombi and embolism, while capsaicin

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alone effectively reduces blood cholesterol and triglyceride levels thanks to reduced cholesterol production in the liver. It protects against cardiovascular diseases and apoplexy.

Successful growing of red pepper depends on many factors, such as e.g. mineral fertilization, especially with potassium and nitrogen. Golcz et al. [1970] stated that chilli pepper has the greatest requirement for potassium (40%) and nitrogen (31%), lower for calcium (20%) and phosphorus (11%) in relation to the total amount of absorbed nutrients. Similar results were reported by Hoffmann and Lenz [1974], Hoffmann et al. [1984] and Nurzyński [1986]. According to Mecs [1974], chilli pepper cultivars absorb more nitrogen and phosphorus than sweet cultivars. In turn, for potassium uptake certain trends were observed for its increased uptake in red peppers. Maximum uptake of these macronutrients occurs at different development phases, i.e. nitrogen – from anthesis to full fruiting, while for potassium – from the beginning of fruit colouration until physiological maturity is reached.

In horticultural production KCl, K_2SO_4, KNO_3 and KH_2PO_4 fertilisers are potassium sources for plants in case of mineral fertilisation. They contain potassium in the form of a univalent cation, while they differ in the type of the accompanying anion, i.e. Cl^-, SO_4^{2-}, NO_3^- or H_2PO_4. In pepper nutrition with potassium it is recommended to apply chloride-free potassium fertilisers, such as potassium sulphate or salpetre [Nowosielski 1988]. The division of plants into chloride-, sulphate-loving and neutral for the the Cl^- and SO_4^{2-} ions was considered binding after studies by Geissler [1953] and Buchner [1958]. Opinions on the subject presented in literature are varied. At present some authors claim that chloride ions have a disadvantageous effect on plant growth and development as well as yielding [Satti and Al-Yahai 1995, Caines and Shennan 1999, Chartzoulakis and Klapaki 2000]. Zekki et al. [1996] and Caines and Shennan [1999] considered chlorine as a burden, which together with sodium causes an increase in salinity in the root medium. Other researchers confirmed the suitability of chloride in crop growing [Nukaya et al. 1996, Borowski et al. 1998, 2000, Nurzyński and Michałojć 1998, Nukaya and Hashimoto 2000]. Nurzyński [1994] did not record significant differences in the yielding of tomato, peppers, cucumber, lettuce or kale when applying fertilisation with potassium chloride or potassium sulphate.

In this study next to the K^+ cation, also the accompanying anion of SO_4^{-2} was applied in fertilization, along with Cl^- and NO_3^- anions, at the same time differentiating nitrogen-potassium fertilization into two levels in order to determine the total and marketable yields, collecting biometric measurements of red pepper.

MATERIAL AND METHODS

The vegetation experiment was conducted in 2005 and 2006 in a plastic tunnel, growing red pepper (*Capsicum annuum* L.) cv. ‘Cyklon’ at a private horticultural farm in Nowa Wieś near Kutno (latitude 52.28°N; longitude19.36°E). Plants were grown in rings filled with 5 dm^3 substrate, composed of a mixture of the black earth arable soil layer and highmoor peat at a v : v = 3 : 2 ratio in the density of 5 plants per 1 m^2 (50 × 40 spacing).

The two-factorial experiment was established in a random block design in the independent statistical system with 5 replications (6 plants per replication).

The assumption of the study was to determine the response of plants to three potassium salts, i.e. KCl, K_2SO_4 and KNO_3, at two nitrogen-potassium fertilization levels of 250 mg N ($N\text{-}NH_4$+ $N\text{-}NO_3$) and 300 mg K, and 350 mg N ($N\text{-}NH_4$+ $N\text{-}NO_3$) and 400 mg $K{\cdot}dm^{-3}$ and at constant levels of the other macro- and microelements. Plants were fertilized before vegetation and as top-dressing, maintaining constant levels of N and K in the substrate based on chemical analyses performed every 4–5 weeks.

In the vegetation period of peppers in a plastic tunnel measurements were taken for temperature and humidity using a Hobo temperature/rh recorder and light intensity using a Hobo Pendant temperature/light recorder. Fluctuations of microclimate conditions in the tunnel in successive years of the experiments are presented in Figs. 1, 2 and 3.

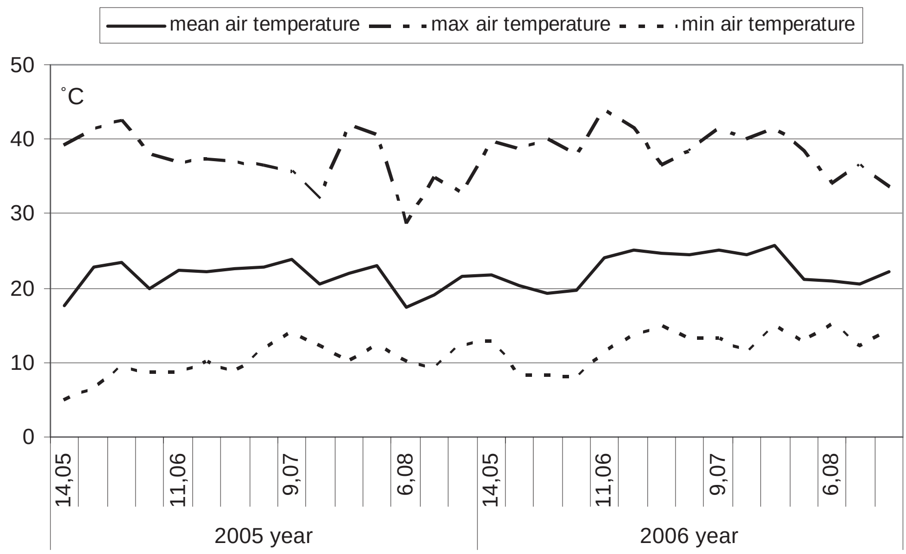


Fig. 1. Air temperature in a plastic tunel in growing season pepper (14.05.–31.08.2005 and 2006)
Ryc. 1. Temperatura powietrza w tunelu foliowym w okresie uprawy papryki (14.05.–31.08. 2005 i 2006)

The scope of taken biometric measurements included dynamics of plant growth as well as the total and marketable yields, yield structure, the number of fruits and the weight of a single marketable fruit. Marketable yield comprised fruits harvested each time at the physiological maturity phase, fully grown and coloured, of typical size and shape characteristic of the cultivar, with no visible symptoms of damage.

In order to evaluate the effect of the type of potassium fertilizer (A) at two levels of nitrogen and potassium fertilization (B) on yield of red pepper the results were analyzed statistically. The obtained results were statistically elaborated by the STAT program of

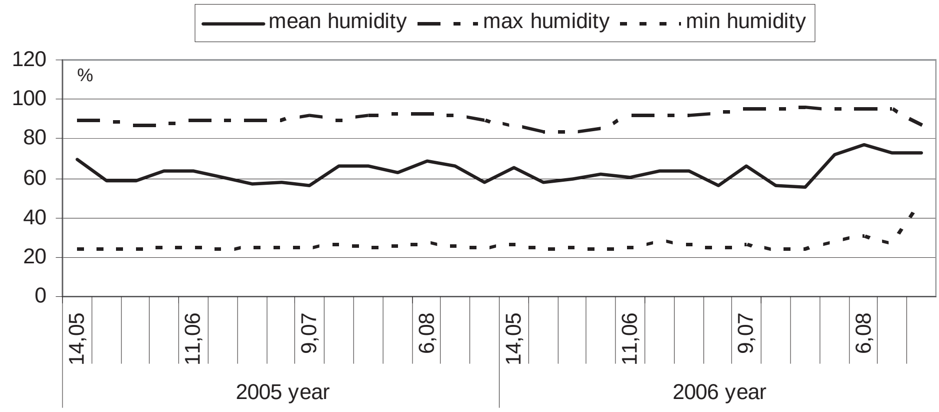


Fig. 2. Diurnal fluctuactions of relative humidity in a plastic tunel
Ryc. 2. Dobowy przebieg wilgotności względnej powietrza w tunelu foliowym

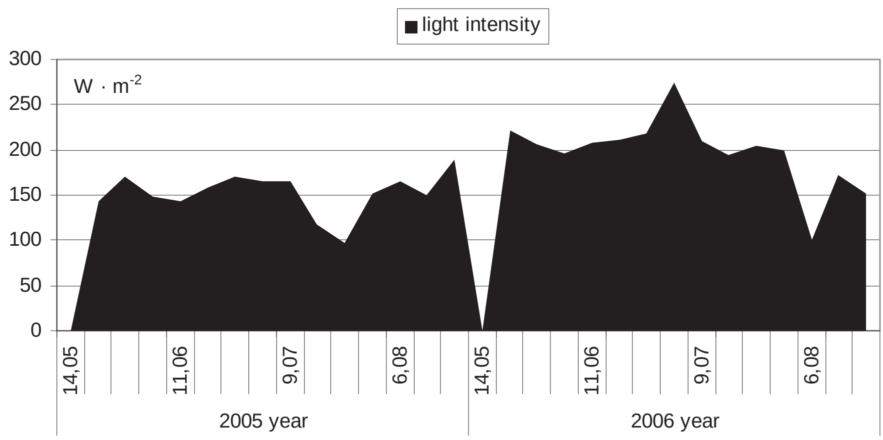
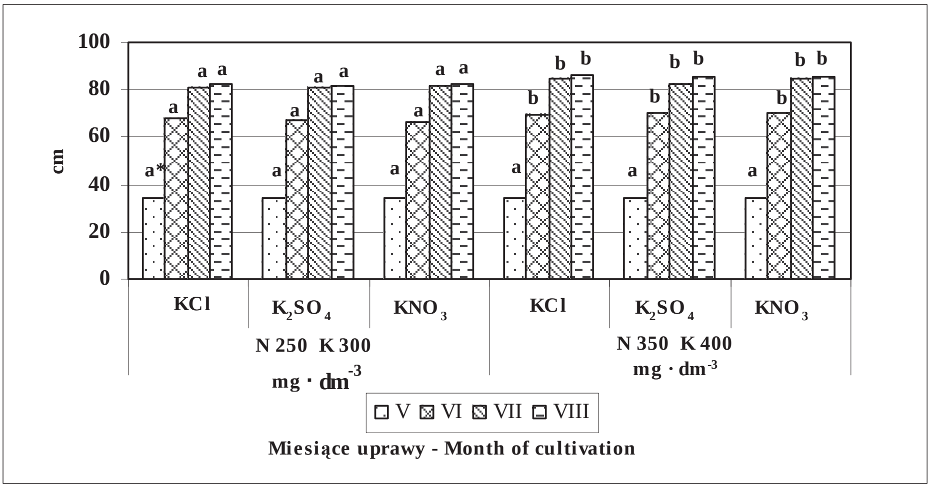


Fig. 3. Diurnal fluctuactions of light intensity in a plastic tunel
Ryc. 3. Dzienny przebieg natężenia światła w tunelu foliowym

variance analysis for two-factorial experiments. After the identification of significant differences, the mean values were grouped according to Duncana test at the significance level of $\alpha = 0.05$

RESULTS AND DISCUSSION

When analyzing the height of red pepper plants at successive dates of measurements conducted at monthly intervals during the two years of the experiments no significant effect was observed for potassium chloride, potassium sulfate or potassium nitrate at the two levels of nitrogen and potassium fertilization (fig. 4). In turn, it was found that an increase in the level of nitrogen from 250 to 350 mg N·dm^{-3} substrate and potassium from 300 to 400 mg K·dm^{-3} substrate had a significant effect on plant height. On average for the two years of the analyses in the combination with higher fertilization plants were by 2.7 cm higher in June, by 3.55 cm in July and by 3.7 cm in August.



* Means indicated by the same letters are not significantly different α = 0.05
* Średnie oznaczone tymi samymi literami nie różnią się istotnie między sobą na poziomie α = 0,05

Fig. 4. Effect of potassium fertilizer type and two levels nitrogen and potassium fertilization on height plants in vegetation period

Ryc. 4. Wysokość roślin papryki w okresie wegetacji w zależności od rodzaju nawozu potasowego i poziomu nawożenia azotem i potasem

Pepper is a vegetable with high climatic requirements. This regularity has been confirmed both in this study and in studies conducted by other authors [Buczkowska 1997, Buczkowska et al. 2001]. Optimal temperature for pepper growth and development is 21–27°C during the day and 16–20°C at night [Dobrzańska and Dobrzański 2001]. In the conducted experiment in the successive years of analyses a high variability was observed in terms of microclimatic conditions in the plastic tunnel, particularly temperature and light intensity (figs. 1–3). Mean daily temperature in the vegetation period was 21.3°C in 2005 and 22.3°C in 2006. A greater variation in temperature was found in individual months of cultivation. In 2006 in comparison to the previous year air temperature in June was higher by 1.6°C, in July by 1.7°C and in August by 1.9°C, respectively.

Mean light intensity in the vegetation period in 2005 was lower than in 2006 and amounted to 153 W·m^{-2}, while in 2006 it was 198 W·m^{-2}. As it was reported by Dobrzańska and Dobrzański [2001], optimal light intensity for peppers is 80–120 W·m^{-2}.

Variation in microclimatic conditions in individual years of the study influenced yielding and quality of peppers. In 2006 high air temperature as well as high light intensity had a significant effect on an increase in the number of set fruits per plant and an increase in marketable yield of peppers on average by 0.45 kg·m^{-2} in comparison to 2005. Also Buczkowska et al. [2001] showed an advantageous effect of higher temperatures on the yield of chilli pepper.

It was shown that in 2005 the type of potassium fertilizer had a significant effect on total yield (tab. 1). At a lower level of nitrogen and potassium fertilization the highest total yield of fruits was obtained from the combination with KNO_3 (1.90 kg·m^{-2}), which differed significantly from the yield with KCl (1.74 kg·m^{-2}). In contrast, no significant differences were found in the total yield of fruits between KCl and K_2SO_4. In the combination with the higher level of nitrogen and potassium fertilization the highest total yield was obtained after the application of KCl or KNO_3 (2.25 and 2.29 kg·m^{-2}, respectively) and it differed significantly from the yield harvested when K_2SO_4 was applied (2.11 kg·m^{-2}).

Table 1. Effect of potassium fertilizer type and two levels of nitrogen and potassium fertilization on total yield of pepper fruit

Tabela 1. Wpływ rodzaju nawozu potasowego i poziomu nawożenia azotem i potasem na plon ogólny owoców papryki

Type of fertilizer Rodzaj nawozu (A)	Year – Rok 2005			Year – Rok 2006		
	Total yield of fruit – Plon ogólny owoców (kg·m^{-2})					
	Level fertilization – Poziom nawożenia (B) (mg·dm^{-3})					
	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)
KCl	1.74	2.25	1.99	2.26	2.66	2.46
K_2SO_4	1.82	2.11	1.96	2.42	2.64	2.53
KNO_3	1.90	2.29	2.09	2.48	2.56	2.52
Mean for (B) Średnia dla (B)	1.82	2.22		2.39	2.63	
$LSD_{0.05}$ $NIR_{0,05}$	(B) 0.070		(A) 0.085	(B) 0.196		(A) n.s. – r.n.
$LSD_{0.05}$ for (A × B) $NIR_{0,05}$ dla (A × B)	0.120			n.s. – r.n.		

n.s. – not significant; r.n. – różnice nieistotne

The higher level of N and K fertilization had a significant effect on an increase in the total yield of fruits of red pepper, on average by 18%, for the type of potassium fertilizer.

In 2006 no significant differences were found in the total yield of red pepper fruits depending on the applied type of potassium fertilizer either at the lower or higher doses of nitrogen and potassium fertilizers (tab. 1). In turn, the level of nitrogen and potassium fertilization had a significant effect on the volume of total yield of red pepper. At the lower level of N and K fertilization the yield was 2.39 kg·m^{-2}, while at the higher doses it was 2.63 kg·m^{-2} (the difference amounting to 9%).

When analyzing the marketable yield of red pepper fruits, similarly as for the total yield of fruits, dependencies were found for the effect of the applied type of potassium fertilizer (tab. 2).

In 2005 the highest marketable yield of red pepper fruits was harvested when applying KNO_3 at the lower level of nitrogen and potassium fertilization. It differed significantly from the yield when KCl were applied. At the higher level of nitrogen and potassium fertilization the highest marketable yield of red pepper fruits was harvested in the combinations with KNO_3 and KCl – not differing significantly from each other. The significantly lowest marketable yield was obtained in the combination with K_2SO_4.

In the following year of the study the type of potassium fertilizer did not have a significant effect on the size of marketable yield of red pepper at the two levels of nitrogen and potassium fertilization (tab. 2). In turn, the higher N and K level resulted in an increase of the marketable yield of fruits on average by 9%.

Table 2. Effect of potassium fertilizer type and two levels of nitrogen and potassium fertilization on marketable yield of pepper fruit

Tabela 2. Wpływ rodzaju nawozu potasowego i poziomu nawożenia azotem i potasem na plon handlowy owoców papryki

Type of fertilizer Rodzaj nawozu (A)	Year – Rok 2005			Year – Rok 2006		
	Marketable yield of fruit – Plon handlowy owoców ($kg \cdot m^{-2}$)					
	Level fertilization – Poziom nawożenia (B) ($mg \cdot dm^{-3}$)					
	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)
KCl	1.67	2.15	1.91	2.11	2.54	2.33
K_2SO_4	1.74	1.99	1.96	2.34	2.53	2.43
KNO_3	1.81	2.18	2.00	2.35	2.42	2.39
Mean for (B) Średnia dla (B)	1.74	2.11		2.27	2.50	
$LSD_{0.05}$ $NIR_{0,05}$	(B) 0.070		(A) 0.085	(B) 0.212		(A) n.s. – r.n.
$LSD_{0.05}$ for (A × B) $NIR_{0,05}$ dla (A × B)	0.120			n.s. – r.n.		

n.s. – not significant; r.n. – różnice nieistotne

Studies conducted by Nurzyński [1986], Nurzyński et al. [2001], Michałojć and Nurzyński [1996] on bell pepper, as well as studies by Borowski et al. [1998], Borowski et al. [2000], Chapagain and Wiesman [2004] and Jarosz [2006 a, b] on tomato, Francke [2010] with pepino (*Solanum muricatum* Ait.) clearly documented the possibility to supply plants with potassium using a chloride fertilizer in order to obtain good quality yields the same refer critically to the division of vegetable crops into chloride- and sulfate-loving plants, developed by Geissler [1953] and Buchner [1958].

Nurzyński [1986], when applying potassium in the form of KCl obtained the highest yield of fruits at the lowest dose of potassium (13 g K per plant), while higher rates of potassium (34 g K per plant) caused a reduction of yields and an increase of dry matter content in fruits. In other studies using different types of potassium fertilisers (KCl, K_2SO_4, KNO_3) Nurzyński et al. [2001] obtained yields of fruits, which did not differ significantly.

Borowski et al. [1998], when comparing the use of KCl and K_2SO_4 in tomato growing in sand, rock wool and peat, did not find significant differences in tomato yielding. However, in other experiments they showed that under the influence of KCl in comparison to K_2SO_4 relative leaf thickness increased and the intensity of transpiration grew [Borowski et al. 2000].

Chapagain and Wiesman [2004], when comparing the application of KCl and KNO_3 in the fertilisation of tomato grown in perlite, did not observe significant differences in plant height, yielding, contents of dry matter and glucose in fruits. Similarly, Jarosz [2006 a] in a greenhouse tomato cv. 'Cunero F_1' growing in rock wool, peat and sand applying a nutrient solution with chlorine (+ KH_2PO_4 + KCl) and a chloride-free nutrient solution (KNO_3 + KH_2PO_4 + K_2SO_4) showed no significant differences in the total yield, marketable yield and classless yield or in the mean number of fruits per plant. The type of potassium fertilisation did not have a significant effect on the chemical composition of tomato fruits [Jarosz 2006 b], while leaves of lettuce fertilised with KCl contained less nitrates in comparison to the application of K_2SO_4 and KNO_3, while the type of potassium fertiliser did not have a significant effect on the weight of lettuce heads [Jarosz and Dzida 2006].

Nurzyńska-Wierdak [2009] proved that garden rocket (*Eruca sativa* Mill.) fed KCl was characterised by a higher concentration of L-ascorbic acid, chlorine and calcium, while it contained less protein, total sugars and sulphates in comparison to plants fed K_2SO_4.

Mean marketable yield of fruits of red pepper grown in a plastic tunnel from the two years of the experiments was 2.15 $kg \cdot m^{-2}$. This yield was higher than that harvested in outdoor cultivation by Orłowski et al. [2003] (1.74 $kg \cdot m^{-2}$), and Buczkowska [2001] and Buczkowska et al. [2001] (1.50 $kg \cdot m^{-2}$).

The red pepper cultivar was characterized by a high proportion of the marketable yield in the total yield. In the following years of the study the marketable yield on average accounted for 95.5% total yield in 2005 and 94.8% in 2006. Differences in the proportions of yields between the combinations were slight and amounted to 0.4–1.6% in 2005 and 0.5–3.4% in 2006.

The type of potassium fertilizer did not have a significant effect on the total number of red pepper fruits (tab. 3). In 2005 the highest number of fruits (75.7 $fruits \cdot m^{-2}$) was harvested from plants fertilized with KNO_3, while the lowest (71.7 $fruits \cdot m^{-2}$) when plants were fertilized with KCl at the lower N and K fertilization doses. In fertilization to the level of 350 N and 400 K $mg \cdot dm^{-3}$ substrate the highest number of fruits (approx. 92 $fruits \cdot m^{-2}$) was harvested from plants in the combination with KCl and KNO_3, while the lowest (85.7 $fruits \cdot m^{-2}$) in case of K_2SO_4. The total number of red pepper fruits in 2006 differed considerably from that from the previous year of the study. However, it did not have an effect on the yield volume. At a higher number of set fruits per plant their individual weight was lower than in 2005. The highest total number of fruits in 2006 (147.5 $fruits \cdot m^{-2}$) was harvested from plants treated with KNO_3 at the lower level of nitrogen and potassium fertilization, and at the higher fertilization dose it was from the combination with K_2SO_4 (161 fruits·m^{-2}). The lowest numbers of fruits (137.7 from 1·m^{-2}), (157.7 from 1·m^{-2}) were harvested from plants at the lower and higher fertilization levels, respectively, in the combination with KCl.

Table 3. Effect of potassium fertilizer type and two levels of nitrogen and potassium fertilization on total fruit numbers
Tabela 3. Wpływ rodzaju nawozu potasowego i poziomu nawożenia azotem i potasem na ogólną liczbę owoców

Type of fertilizer Rodzaj nawozu (A)	Year – Rok 2005			Year – Rok 2006		
	Total fruit numbers (pcs.· m^{-2}) – Liczba owoców ogółem (szt·m^{-2})					
	Level fertilization – Poziom nawożenia (B) (mg·dm^{-3})					
	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)
KCl	71.7	91.7	81.7	137.7	157.7	147.5
K_2SO_4	73.8	85.7	79.8	139.7	161.0	150.3
KNO_3	75.7	91.8	83.8	147.5	159.5	153.5
Mean for (B) Średnia dla (B)	73.7	89.7		141.6	159.4	
$LSD_{0.05}$ $NIR_{0,05}$	(B) 3.79		(A) n.s. – r.n.	(B) 10.51		(A) n.s. – r.n.
$LSD_{0.05}$ for (A × B) $NIR_{0,05}$ dla (A × B)	n.s. - r.n.			n.s. – r.n.		

n.s. – not significant; r.n. – różnice nieistotne

Table 4. Effect of potassium fertilizer type and two levels of nitrogen and potassium fertilization on marketable fruit numbers
Tabela 4. Wpływ rodzaju nawozu potasowego i poziomu nawożenia azotem i potasem na liczbę owoców handlowych

Type of fertilizer Rodzaj nawozu (A)	Year – Rok 2005			Year – Rok 2006		
	Marketable fruit numbers (pcs.· m^{-2}) – Liczba owoców handlowych (szt·m^{-2})					
	Level fertilization – Poziom nawożenia (B) (mg·dm^{-3})					
	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)
KCl	65.7	84.0	74.8	122.7	144.5	133.5
K_2SO_4	67.3	76.2	71.8	129.3	148.8	139.1
KNO_3	68.5	83.8	76.2	132.5	141.3	136.9
Mean for (B) Średnia dla (B)	67.2	81.3		128.2	144.9	
$LSD_{0.05}$ $NIR_{0,05}$	(B) 3.47		(A) n.s. – r.n.	(B) 12.18		(A) n.s. – r.n.
$LSD_{0.05}$ for (A × B) $NIR_{0,05}$ dla (A × B)	6.01			n.s. – r.n.		

n.s. – not significant; r.n. – różnice nieistotne

A significant effect was found for the nitrogen and potassium fertilization level on the total number of fruits in the two years of the study. The mean difference in the number of harvested fruits from plants fertilized to the level of 350 N and 400 K mg·dm^{-3} substrate in comparison to those fertilized at 250 N and 300 K mg·dm^{-3} substrate amounted to 16 fruits ·m^{-2} in 2005 and 17.8 fruits ·m^{-2} in 2006.

In 2005 significantly the lowest number of marketable fruits from 1 m^2 was harvested at the lower level of nitrogen and potassium fertilization in the substrate in the combination with KCl, while at the higher fertilization it was in the combination with K_2SO_4 (tab. 4). In turn, in 2006 no significant differences were found in either the number of marketable fruits of red pepper or the total number of its fruits depending on the type of the applied potassium fertilizer at the two levels of nitrogen and potassium fertilization.

The yield structure in terms of the number of marketable fruits of red pepper in individual combinations for the type of potassium fertilizer was similar to that of the total number of fruits.

The level of nitrogen and potassium fertilization had a significant effect on the number of marketable fruits of red pepper. In 2005 the mean difference in the number of marketable fruits between the lower and higher levels of N and K fertilization was 16 fruits·m^{-2}, while in 2006 it was 17.8 fruits m^{-2}.

The number of marketable fruits of red pepper in this study (105 fruits·m^{-2}) was considerably higher than the number of fruits (68 fruits·m^{-2}) obtained by Buczkowska [2001].

Table 5. Effect of potassium fertilizer type and two levels of nitrogen and potassium fertilization on weight of marketable fruits
Tabela 5. Wpływ rodzaju nawozu potasowego i poziomu nawożenia azotem i potasem na masę owocu handlowego

Type of fertilizer Rodzaj nawozu (A)	Year – Rok 2005			Year – Rok 2006		
	Weight of marketable fruit – Masa owocu handlowego (g)					
	Level fertilization – Poziom nawożenia (B) (mg·dm^{-3})					
	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)	N 250 K 300	N 350 K 400	mean for (A) średnia dla (A)
KCl	25.4	25.7	25.6	17.1	17.8	17.4
K_2SO_4	25.8	26.2	26.0	18.1	17.0	17.5
KNO_3	26.6	26.1	26.4	17.8	17.2	17.5
Mean for (B) Średnia dla (B)	25.9	26.0		17.7	17.3	
$LSD_{0.05}$ $NIR_{0,05}$	(B) n.s. – r.n.		(A) n.s. – r.n.	(B) n.s. – r.n.		(A) n.s. – r.n.
$LSD_{0.05}$ for (A × B) $NIR_{0,05}$ dla (A × B)	n.s. – r.n.			0.88		

n.s. – not significant; r.n. – różnice nieistotne

Mean fresh weights of individual marketable fruits of red pepper did not differ significantly either depending on the type of potassium fertilizer or the level of nitrogen and potassium fertilization (tab. 5). In contrast, differences were found in the weight of a single marketable fruit in the compared years of the study. Fresh weight of a single fruit obtained in 2006 was on average by 8.5 g lower than that recorded in 2005. However, it did not result in a reduction of yield of fruits, since a greater number of set fruits per plant caused a reduction of weight of an individual fruit.

CONCLUSIONS

1. The type of potassium fertilizer at the two levels of nitrogen and potassium fertilization did not have a significant effect on the total and marketable yields of fruits in red pepper cv. 'Cyklon', plant height, the total and marketable number of fruits or fresh weight of a single fruit.

2. The higher level of nitrogen and potassium fertilization (350 N and 400 K mg · dm^{-3} substrate) had a positive effect on the analyzed biometric parameters of fruits except for the fresh weight of a single fruit.

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PLONOWANIE PAPRYKI ROCZNEJ (*Capsicum annuum* L.) W ZALEŻNOŚCI OD ZRÓŻNICOWANEGO RODZAJU NAWOZU POTASOWEGO

Streszczenie. Rodzaj stosowanego nawozu potasowego odgrywa istotną rolę w żywieniu roślin. Dostarczenie roślinom potasu w postaci chlorkowej, siarczanowej czy saletrzanej modyfikują skład chemiczny roślin, ponieważ aniony towarzyszące potasowi pełnią odmienne funkcje. Doświadczenie wegetacyjne z uprawą papryki rocznej odm. 'Cyklon' przeprowadzono w 2005 i 2006 roku w tunelu foliowym, w pierścieniach (V = 5 dm^3) wypełnionych glebą mineralną i torfem wysokim (3:2). Określono reakcję roślin na trzy sole potasowe KCl, K_2SO_4 i KNO_3 przy dwóch poziomach nawożenia azotowo-potasowego 250 mg N jako NH_4NO_3 i 300 mg K oraz 350 mg N i 400 mg K $\cdot dm^{-3}$ podłoża oraz przy stałych poziomach pozostałych makro- i mikroelementów. Wykonano pomiary biometryczne roślin oraz określono wielkość plonu owoców. Stwierdzono, że rodzaj nawozu potasowego przy dwóch poziomach nawożenia azotem i potasem nie miał istotnego wpływu na plon ogólny i handlowy owoców papryki odm. 'Cyklon', wysokość roślin, ogólną i handlową liczbę owoców oraz świeżą masę pojedynczego owocu. Wykazano, że większy poziom nawożenia azotem i potasem (350 N i 400 K mg dm^{-3} podłoża) dodatnio oddziaływał na analizowane parametry biometryczne owoców z wyjątkiem świeżej masy pojedynczego owocu. Wyniki niniejszych badań, potwierdzone przez innych autorów, krytycznie odnoszą się do podziału roślin warzywnych opracowanego przez Th. Geisslera i Buchnera na chlorko- i siarczanolubne.

Słowa kluczowe: dawka N i K, nawożenie KCl, K_2SO_4, KNO_3, plon, pomiary biometryczne

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