

Fertilization Influence on the Vitamin C Content and the Yield of Sweet Pepper¹

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Abstract: The vitamin C content and the yield of sweet pepper was investigated by planting in the soil with a rich content of all minerals except the nitrogen and with the following variants of fertilisation: organic fertilisation (farmyard manure, AgorminT), mineral fertilisation (N) and the combination of organic and mineral fertilisation (N). The control variant was not fertilised at all. The highest fruit yield and the earliest harvest were achieved in the variant where the nitrogen fertilisation eked out the desired standard of nitrogen content in the soil. The variants with organic and mineral fertilisation and with the organic fertilisation only succeeded and the lowest total yield and the first yield value were both found out with the control variant without fertilisation. No confirmative difference was determined in the vitamin C content between the variants but the lowest vitamin C content was determined with the not fertilised variant.

Key words: farmyard manure, Agormin T, nitrogen, fertilization, vitamin C, fruit yield, harvest.

Introduction

Sweet pepper (*Capsicum annuum* L) is popular with staple food for its various use and content of valuable substances, above all ascorbic acid. Its consumption, increasing yearly, reaches at present 4,3 kg per head and year on average. Sweet pepper can be successfully grown in the mild to the hot southern Moravia region. The Employment of modern horticultural technology is based

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on optimum supply of nutrients and water (drip irrigation with additional fertilisation, mulching, using efficient variety ,etc.) According to the situation and perspective report of Ministry of Agriculture, the Czech Republic (2002), average yield of sweet pepper is 27 t per hectare. The soil with organic manure SOMOS (1984), VOGEL (1996) and others is considered a condition for good yield. However, there is a lack of these at present. The objective of the present investigation was to study the influence of organic and mineral fertilisation on fruit yield and content of vitamin C in sweet pepper.

Material and Methods

Sweet pepper, variety 'Zorka', was cultivated in the field of Horticultural Faculty, Mendel University of Agriculture and Forestry in Lednice, in the year 2001-2002. The soil type is sandy-loam. The previous crop on the same field was pickling cucumber. Before transplanting, the soil was analysed on nutrient content (N, P, K, Ca, Mg). Very high content of phosphorus, potassium, magnesium and calcium was found during both years. The N_{min} level was oscillating between 20 - 40 kg . ha⁻¹, which meant low necessity of manure N. The experiment design consists of the following variants:

- farmyard manure with application rate 30 t per ha ,represented by - CH;
- Agormin T fertilisation with application rate 2,1 t per ha - A;
- N mineral. fertiliser (based on nutrient content in soil, taking sustenance 1 ton performance - HLUSEK 1996 - and supposed yield 65 t . ha-1 only N manure was needed) basic rate N =180 kg . ha-1 in 3 split application - M;
- farmyard manure with application rate 30 t . ha-1 and A- mineral. fertiliser (basic rate N - correction on farmyard manure) - CH + M;
- Agormin T fertilisation 2,1 t per ha and N mineral fertiliser (basic rate N - correction on AgorminT) - A + M;
- control variant - without fertilisation - C.

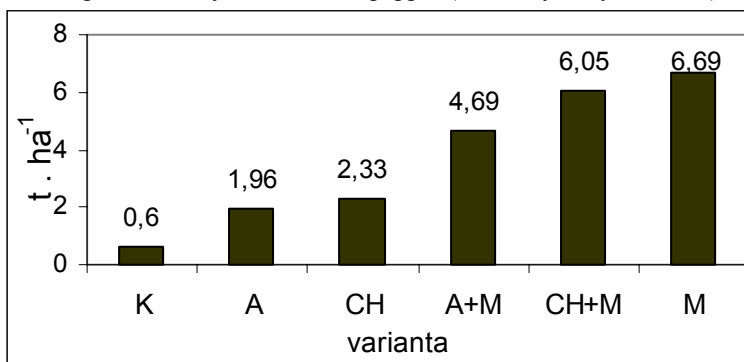
Agormin T (producer Agro CS Ceska Skalice) is a registered organo-mineral fertiliser recommended for fundamental fertilisation and additional fertilisation of sweet pepper and tomato. It contains 3,7% total N, 1,6 % P, 7,1 % K, further Mg and Ca.

Seedlings were raised in multi-cell pots JP3040/54H ,transplanting on 16.5. in the field with spacing 0,6 x 0,3 m. The plot size of one variant is 27 m² with 3 replications. In 2001 with spray irrigation, which was not suitable for even dosage irrigation in single replication, so that evident differences were found between them. In 2002 replaced by drop irrigation, which ensured even dosage irrigation. Hand cultivation was performed during the plants growth period. The harvest was carried out as soon as the fruits achieved the recommended norm indicator CSN 46 31 56. The first harvest started on 16.7. 2002 and total fruit harvest of pickling 6 times. Fruits were weighed and sorted into biennial qualitative classes according to the above specification. The vitamin C content in the fruit was determined using capillary chromatograph HPLC .

Results and Discussion

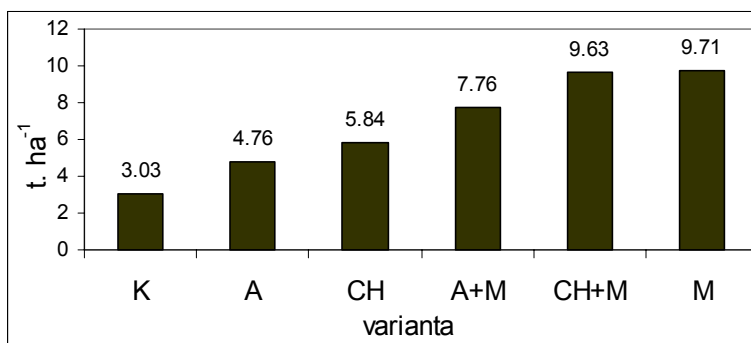
The earliest harvest was achieved by the variant with mineral fertiliser (N), followed by variant, where there was mineral fertilisation combined with organic fertilisation (AgorminT, farmyard manure). This analogous sequence of variants was also the same for the second harvest. (Graph 1,2, Tab.1,2).

Graph 1. Fruit yield of sweet pepper (the first yield year, 2002)



C = control variant; A = Agormin T; CH = farmyard manure; A+M = Agormin + mine. fertilisation (N); CH+M = farmyard manure + mineral fertilisation (N); M = mineral fertilisation (N)

Graph 2. Fruit yield of sweet pepper (second yield year, 2002)



The highest fruit yield ,49,46 t · ha-1 was also obtained by the variant with mineral fertilisation, followed by the variant, where the mineral fertilisation was combined with the organic one. The lowest yield was recorded in the variant not-fertilised at all (graph 3, Tab.3). As already mentioned before, nutrient content in soil before cultivation sweet pepper was high, except for nitrogen. According to our record, nitrogen became a limiting factor for fruit yield. Higher fruit yield mineral fertilisation in comparison with organic in celery and carrot is presented by LECLERC et al. (1991), SCHUPHAN (1974). The findings

concerning all our experimental variants indicate very low nitrate content in fruit (max. 20 mg NO₃ . kg⁻¹).

In the case of the vitamin C content there wasn't statistically meaningful difference among the variants . The determined content of ascorbic acid in sweet pepper is higher (1380-1730 mg per kg) than the results indicated in literature Kopec, 1996. The lowest content of vitamin C was found in the variant not fertilised at all (Tab. 4). Higher content of vitamin C owing to organic fertilisation is stated in LECLERC et. al. (1991). SORENSEN et al. (1994), POULSEN (1995) found, testing lettuce, that high N application rate lower the content of vitamin C.

Significant differences in yield (ANOVA)

Tab. 1 Assessment demonstrativeness difference in yield method ANOVA

Variant	t.ha ⁻¹	C	A	CH	A+M	CH+M	M
C	0,60	x			*	**	**
A	1,96		x			*	**
CH	2,33			x		*	**
A+M	4,69		*		x		
CH+M	6,05		**	*	*	x	
M	6,69		**	**	**		x

Note: * significant at $P = 0,05$

** significant at $P = 0,01$

Significant differences in yield (ANOVA)

Tab. 2. Assessment demonstrativeness difference in yield statistical method ANOVA

Variant	t.ha ⁻¹	C	CH	A	A+M	CH+M	M
C	3,03	x			*	**	**
CH	4,76		x			*	*
A	5,84			x			
A+M	7,76	*			x		
CH+M	9,63	**	*			x	
M	9,71	**	*				x

Note: * significant at $P = 0,05$

** significant at $P = 0,01$

Significant differences in yield (ANOVA)

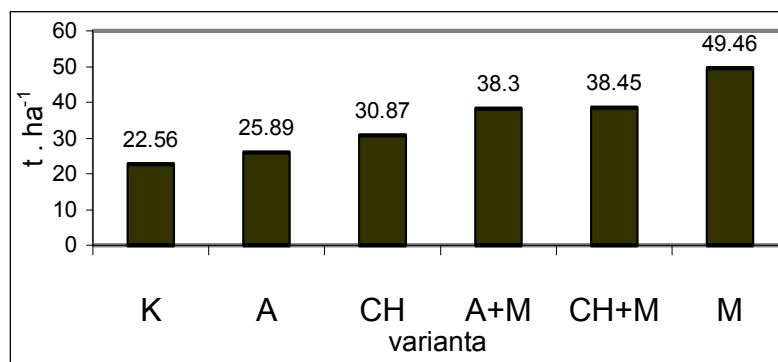
Tab. 3. Assessment demonstrativeness difference in yield statistical method ANOVA

Variant	t.ha ⁻¹	C	CH	A	CH+M	A+M	M
C	22,56	x			**	**	**
CH	25,89		x		*	*	**
A	30,87			x			**
CH+M	38,30	**	*		x		*
A+M	38,45	**	*			x	*
M	49,46	**	**	**	*	*	x

Note: * significant at $P = 0,05$

** significant at $P = 0,01$

Graph 3. Total yield in sweet pepper



Tab. 4. Vitamin C content in fruit sweet pepper

Variant	mg . kg ⁻¹
C	1380 ± 207
CH+M	1520 ± 157
M	1550 ± 125
A	1640 ± 172
CH	1690 ± 156
A+M	1730 ± 75

Conclusions

The cultivation of sweet pepper on soil with high content of all nutrients with the exception of N proves that the lowest total yield and also the least yield from the first harvest was with the variant without fertilisation (control variant). On the contrary, the highest yield and also the earliest harvest was achieved with the variant with mineral N-fertilisation according to the directive taking nutrient by supposed yield. This variant was followed by those, where organic fertilisation was combined with nitrogen fertilisation and then by the variants with organic fertilisation (farmyard manure, AgorminT). Based on the finding of the vitamin C content there, wasn't conclusive difference among the variants. The lowest content of vitamin C was, however, determined in the variant without fertilisation – control variant.

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UTICAJ ĐUBRENJA NA SADRŽAJ VITAMINA C I PRINOS PAPRIKE

- originalni naučni rad -

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Rezime

Sadržaj vitamina C i prinos paprike su ispitivani putem gajenja na zemljištu sa povoljnim sadržajem svih minerala osim azota. U ogledu su bile uključene sledeće varijante đubrenja: organsko đubrenje (stajsko đubrivo, AgorminT), mineralno đubrenje (N) + organsko, kao i samo azotno đubrivo. Kontrolna varijanta nije bila đubrena. Najveći prinos ploda i najranija berba su postignute u varijanti gde je primenjeno samo azotno đubrivo. Varijante sa organskim i mineralnim đubrenjem i samo sa organskim đubrenjem su takođe dale pozitivan efekat. Najniži ukupni prinos i vrednost prvog roda utvrđeni su u kontrolnoj varijanti, bez đubrenja. Nije utvrđena razlika u sadržaju vitamina C između varijanti, dok je najniži sadržaj vitamina C utvrđen u varijanti bez đubrenja.