

GREEN MANURE AS A TOOL OF ORGANIC PRODUCED POTATO (*Solanum tuberosum* L. cv. Amorosa)

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Summary: During September 2003 to August 2004 has been done study with winter common vetch *Vicia sativa* L. cv. NS Sirmium as pre-culture of followed vegetables. After "green manure" practicing on the same plots were set up potato cv. Amorosa. Soil samples were taken before common vetch sowing. after its decomposition and carrot. Carrot quality was established through chemical analyzing of total and soluble carbohydrates. vitamin C and proteins compared with control. Resulted by "green manure" soil humus. soil nitrogen. light available soil phosphorous and potassium are larger. After 1st gathering potato dimensions are characterized with increased average dimensions. yield per plant and yield in total as well. Total carbohydrate content at manure plots is amounted 17.02 %/100 mg d.m. that means 33.45 %/100 g d.m. increasing compared with control ones. while soluble content is 3.24 %/100 g d.m. and recorded 11.72%/100 g d.m. even. Protein content is increased for 4.22 %/100 g d.m. at green manure plots. differs of vitamin C content that is not higher compared with control and corresponded with literature data. Analyzed parameters are increased as result of potato tendency of soil potassium using.

Key words: green manure, organic production, potato, cv. Amorosa.

INTRODUCTION

Organic production represents a crucial segment of agricultural in Balkan region within. As faster growing segment is based on soil husbandry practices that built reservoirs of plant nutrients. increase level of decomposed organic matter. forced soil biological activity and improves its structure. A key role in organic farming beside crop rotation is turn off green mass of some forages into soil green manures that built its fertility. Legumes have received considerable attention as an important component of sustainable cropping system because they supply biologically fixed nitrogen to subsequent crops. such as potato

(Ojala et al. 1990). Organic potatoes may bring a higher price, because many consumers understand that organic practices not only produce safe, high-quality food, but they preserve top soil and reduce pollution (Bullock 1992, Honeycutt et al. 1995, Smith et al. 1987).

So far researches are very few and present initiative phase (Kratovalieva et al. 2006) of similar way of potato production through the nutrition facts presentation. Regarding green manure using and forage ability of nitrogen fixation as well and organic practicing in Republic of Macedonia and Serbia, these researching is conducted, with hope to move NGO's and others subject became of interest.

MATERIAL AND METHODS

Cropping and Sample Characteristic

Winter common vetch variety Sirmium-NS was sown on soil under control managed last 30 years by seeding rate 110-kg ha^{-1} . In beginning of October 02, 2003 was establishing a trial as random block system in 4 repetitions in rows by 0.15 m distance within. Accordingly Scheffer&Schachtschabel classification, soil is belonged to dusty-clay, type Alluvial with $\text{pH}=7.50$, organic matter=4.10%, $\text{N}=0.255\text{ g kg}^{-1}$, available $\text{P}=377.9\text{ mg kg}^{-1}$ and available $\text{K}=117.3\text{ mg kg}^{-1}$. Before common vetch starting to bud forming, green mass was plowed and leaved it for one month to be mineralized. Soil samples are taken to the end of mass mineralization and potato seed (cv. Amorosa) dimensions 50-kg dca-1 was sown on identical plots (14 April 2004) in rows of 0.65 m wide. Control variants were set up parallel by aim of comparison with green manure ones.

Chemical analyses (Methods of Fractionation of Carbohydrates, Nitrogen and Ascorbic Acid)

Samples for chemical analyzing are taken after the IInd gathering (02. September 2004). Fractioning of total and soluble carbohydrates is conducted according Dubois et al. method (1956), nitrogen content on the base of total nitrogen percent according Kjeldal method ($\% \text{N} \times 6.25$) and vitamin C according Tillmans method. Obtained results are statistically analyzed (\bar{x} , S_x , Ω , CV, min-max).

RESULTS AND DISCUSSION

Pedological analyses

Mechanical soil composition and separate soil fractions are listed bellow in Table 1.

Soil belongs to dusty clay soil type with low alkalinity pH reaction on 0-20 cm depth, but with tendency to increase 7.8 on plots under green manure, differ of more depth 20-40 cm moderate alkalinity 8.00. After one month organic mass decomposing, humus content is moderate increased on 0-20 cm 4.41 % and lightly less deeper 20-40 cm 4.12 %. Biological soil activity realised throughout the simbiotic relations among bacteria belongs to *Rhizobium leguminosarum* var. *viciae* and legume roots, is reflected on nitrogen content gain (Meek et al. 1994) 0.256 % (0-20 cm) and more deeply 0.261 % (20-40 cm). Light available

soil form of phosphorous and potassium is increased on depth both 0-20 cm (11.73 mg P₂O₅/100 g soil; 43.89 mg K₂O/100 g soil) and 20-40 cm (12.90 P₂O₅/100 g soil; 23.28 K₂O/100 g soil). Potato as "potassium crop" during its development is used a large quantity that is recorded as decreased value 14.55 mg/100 g soil (0-20 cm) and more less deeply 11.72 mg/100 g soil (20-40 cm), (Table 2).

Table 1. Soil mechanical composition and high moisture (loc.: Jurumleri, Skopje surroundings)

No of soil sample	Variants	Depth (cm)	Large sand (0.2-2.0 mm)	Small sand (0.02-0.2 mm)	Large+small sand (0.2-2.0 mm)	Dust+clay (< 0.02 mm)	Dust (0.002-0.02 mm)	Clay (< 0.002 mm)	Hygroscopic moisture (%)
1	C	0-20	0.3	32.6	32.9	67.1	48.4	18.7	1.03
2	C	20-40	0.0	26.3	26.3	73.7	51	22.7	1.07
3	GM	0-20	0.0	34.6	34.6	65.4	45.7	19.7	1.03
4	GM	20-40	0.0	33.3	33.3	66.7	45.7	21	1.04

Legend: C-control; GM-green manure

Table 2. Soil chemical properties (loc. v. Jurumleri, Skopje surroundings)

No	Date of soil sampling	Variants	Depth (cm)	Humus (%)	Ph-reaction of soil soluble		Total nitrogen (%)	Available (mg/100 g soil)	
					H ₂ O	nKCl		K ₂ O	P ₂ O ₅
1	02.10.2003		0-20	/	/	/	0.262	55.43	14.81
2	02.10.2003		20-40	/	/	/	0.235	24.02	16.12
3	14.04.2004	C	0-20	4.10	7.50	6.70	0.255	37.79	11.73
4	14.04.2004	C	20-40	3.92	7.80	6.80	0.251	21.37	8.6
5	14.04.2004	GM.	0-20	4.41	7.80	6.70	0.256	43.89	11.73
6	14.04.2004	GM	20-40	4.12	8.00	6.80	0.261	23.28	12.9
7	07.07.2004	Kk	0-20	/	/	/	0.288	45.94	17.79
8	07.07.2004	Kk	20-40	/	/	/	0.272	45.94	20.62
9	07.07.2004	Org.k	0-20	/	/	/	0.245	42.11	14.55
10	07.07.2004	Org.k	20-40	/	/	/	0.23	38.28	11.72

Legend: C-control; GM-green manured

Qualitative tuber evaluation and potato yield

Potato tubers cropping on the same plots treated with green manure achieved an average dimensions after 1st gathering 9.28×5.44 cm by yield per plant 1.86 kg and total yield 29.12 t/ha compared with control 19.16 t/ha. After that until 2nd gathering, tubers are increased its dimensions 11.34×8.04 cm with average yield per plant of 2.18 kg and total yield 34.05 t/ha. Variety Amorosa is characterized as significant yielder that after the 1st gathering is recorded increased yield for 33.87 % and 35.00 %-2nd gathering (Table 3).

Generally considered is needed to stress the point soil potassium and phosphorous on plots cropped under potato cv.Amorosa as subsequent culture

is strong decreased (K_2O -16.67 %; P_2O_5 -43.16 %). that means this variety is capable to used available soil form of these mineral elements (Leszczynski & Lisinska 1985. Leszczynski & Lisinska 1986) essential for potato development by decisive role for tuber quality evaluation.

Table 3. Analyze of morphological potato characteristics (n=30)

	- I st gathering (28.06. 2004)						- II nd gathering (02.09. 2004)					
	28. 06. 2004 god.						02. 09. 2004 god.					
	Length (cm)		Width (cm)		Yield/plant (kg)		Length (cm)		Width (cm)		Yield/plant (kg)	
	C	GM.	C	GM.	C	GM.	C	GM.	C	GM.	C	GM.
x	5.99	9.28	4.2	5.44	1.23	1.86	7.74	11.34	4.42	8.04	1.43	2.18
Sx	0.18	0.17	0.13	0.17	0.1	0.04	0.13	0.1	0.12	0.1	0.12	0.09
Ω	0.57	1.2	0.21	1.13	0.03	0.06	1.41	0.28	0.64	1.77	0.19	0.13
CV	18.0	17.7	13.1	16.6	9.7	3.6	13.1	9.74	11.8	9.65	12.3	8.95
min	4.8	7.4	3.6	4.0	0.98	1.79	6.0	10.0	3.7	6.6	1.12	1.93
max	8.0	11.8	5.2	6.6	1.36	1.95	8.9	13.6	5.1	9.1	1.69	2.56

Quantitative tuber evaluation

Potato quality as essential nutrient product and energy source is evaluated through the analyze of synthesized total carbohydrates and light digestible and adsorbed as well. Tubers originated from treated with green manure plots have more quantity of sugars 17.0 %/100 g d.m. than control 15.2 %/100 g d.m. (Kratovalieva et al. 2006). During summer period when air temperatures are going over 40°C. treated plants are more adaptable on drying conditions; actually sugar hydrolysis is more intensive that is reflected on increased soluble carbohydrate content 3.24 %/100 g d.m. (Table 4).

Protein content at tubers picked from green manure plots are significantly increased 1.66 % compared with control ones 1.59 %. This value is probably corresponded with decomposing and mineralization of legume organic mass (Smith et al. 1987) (Table 4).

Table 4. Total and soluble carbohydrate (%/100 g d.m.), protein (%/100 g d.m.) and vitamin C (mg/100 g f.m.) content (n=3)

	Carbohydrates (%/100 g d.m.)				Protein content (% N x 6.25) (%/100 g d.m.)		Vitamin C mg/100 g f.m.	
	Total		Soluble		C	GM.	C	GM.
	C	GM.	C	GM.				
x	15.2	17.0	2.43	3.24	1.59	1.66	14	13.7
Sx	0.02	0.03	0.08	0.04	0.06	0.07	0.13	0.17
Ω	0.49	0.25	0.27	0.19	0.04	0.06	2.54	1.84
CV	2.32	2.7	8.54	4.32	6.17	7.11	13.18	16.65
min	14.9	16.3	2.24	3.1	1.53	1.58	12.2	12.4
max	15.6	17.2	2.63	3.38	1.73	1.82	15.8	15

Vitamin C as ant oxidative matter powerful against free radicals is very variable at investigated tuber samples. An average concentration of this vitamin at

treated tuber is lower (13.7 %) than control (14.0 %). But. this finding is ordinary and corresponded with too many literature data (Marecek 2001) of other investigations related to organic produced vegetables (Table 4).

CONCLUSION

Multidiscipline research team aiming of popularization of organic produced potato is reached the followed conclusions:

1. An average dimensions at potato tuber cropped on green manure plots are amounted 9.28×5.44 cm with average yield per plant 1.86 kg (1st gathering). after that intensive increased of tuber dimensions 11.34×8.04 cm and average .yield of 2.18 kg/plant is recorded (IInd gathering).
2. Content of total carbohydrate is increased at treated plots 17.02 %/100 g d.m. than control 11.72 %.
3. Vitamin C average concentration is less low at treated than control variants; either few particular samples are reached higher concentrations than control.
4. Less decreasing is recorded at tuber protein content at treated variants 1.66 % than control 1.59 %.

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