

GREEN MANURE AS A WAY OF ORGANIC PRODUCED CARROT (*Daucus carota* L. cv. Nantes)

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Summary: During October 2003 to August 2004 has been study with winter common vetch *Vicia sativa* L. cv. NS Sirmium. Early spring plowing of plots and "green manure" practicing enabled soil organic fertilization. On the same plots were set up carrot cv. Nantes compared with control. Soil samples were taken before common vetch sowing, after its decomposition and first carrot gathering. Carrot quality is evaluated through chemical analyzing of carbohydrates, protein and vitamin C content. Resulted of "green manuring" soil humus, nitrogen, light available phosphorous and potassium were larger. Number of carrot plants (39.27), dimensions (20.75 cm×2.07 cm), weight (59.88 g) and extracted sap (22.18 ml per plant) after 1st gathering are an average increased and yield per plant as well yield in total. Except extracted sap all investigated mentioned parameters were continue gained after the 2nd gathering (23.22 cm×2.69-dimensions, 62.44 g-weight, 18.45-extracted sap). Carbohydrate content is higher at organic produced carrot (20.15 %/100 g d.m.-total; 7.48 %/100 g d.m.), protein either less as well (10.56 %/100 g d.m.) and vitamin C significantly 3.41 %/100 g f.m then control 2.47 %/100 g f.m.

Key words: green manure, organic production, carrot

INTRODUCTION

Forage utilization as pre-culture of certain vegetables is more than practical manner of soil fertility improving. Although is well described and known as well, so far is less presented on individuals farms. Organic matters originated from soil and built in forages shall be included in nature circle cycle as important part of nature and environment protection. In process of air nitrogen fixation bacteria of genus *Rhizobium* sp. that are settled in forage root nodules, extracted specific components which are make soluble unused soil potassium and phosphorous compounds (Kratovalieva et al. 2006). Forage sowing in autumn or spring is very

usefull and economic cost effective manner of soil manuring after green mass plowing and leaving for one month to be decomposed. Mineral elements such as nitrogen, potassium, phosphorus and other ones (Lewak 1998, Sawicka & Mikos-Bielak 2002) can be released gradually and be constant source to soil for a long period of one year or more.

MATERIAL AND METHODS

Cropping and Sample Characteristic

Seed of winter common vetch variety Sirmium-NS was sown on soil that is manures with nature manure of animal origin last 30 years by seeding rate 110-kg ha⁻¹. Trial was set up (02. October 2003) accordingly random block system in 4 repetition in rows of 0.15 m between row distance. Mechanical cultivation was used as needed for weed control. Soil is belonged to dusty-clay classification (Scheffer&Schachtschabel), type Alluvial with pH=7.50, organic matter=4.10%, N=0.255 g kg⁻¹, available P=377.9 mg kg⁻¹ and available K=117.3 mg kg⁻¹. After decomposition of plowed green mass of common vetch when are taken soil samples on the identical plots was set up carrot cv.Nantes (14 April 2004) in rows of 0.60 m distance. Parallel control variants were set up by aim of comparison with treated ones. Soil samples are also taken after carrot first gathering (07.July 2004) aiming of following nutrient releasing from organic matter to soil becoming carrot available.

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

Samples for chemical analyzing are taken after the IInd gathering (02. September 2004). Carbohydrates are fractioned according Dubois et al. method (1956), nitrogen content according well established Khjeldal method (% N x 6.25) and ascorbic acid according Tillmans method.

Other examinations

Aiming of better characterization and result justification related to organic produced carrots, were also conducted other examinations on carrots such s number of plants per m², length (cm), diameter (cm), weight (g) and cell content (ml/100 g d.m.) after manual extraction. Listed parameters are examined after the Ist (28. June 2004) and IInd (02. September 2004) carrot gathering.

RESULTS AND DISCUSSION

Pedological analyses

pH-reaction of soil solution is low alcality on depth 0-20cm with tendency of lighter increasing at green manured variants 7.8 (0-20 cm) and moderate alcality 8.00 (20-40 cm). Resulted of green manure with an average yield of 17.84 t/ha green mass, at treated variants humus content is also increased on depth 0-20 cm (4.41 %) and 20-40 cm (4.12 %) as well. Azotofixation realised in simbiotic relation among *Rhizobium leguminosarum* var. *viciae* and common vetch influ-

enced on nitrogen content increasing 0.256 % (0-20 cm) and 0.261 % (20-40 cm). Available phosphorous and potassium content is also 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 (12.9 P₂O₅/100 g soil; 23.28 K₂O/100 g soil) (Table 1).

Qualitative carrot evaluation and yield

Throughout the life of trial no insect or disease problems are occurred and plant health was very good. Carrot quality at harvest both first and second was good at control. but excellent at green manures one. So. treated roots were crisp but tender. with clarify expressed orange color. uniformity shape. nearly none hairiness and very vigorous leaves. Few defects are seen at controlled roots such as ununiformity shape. pale color. poor hairiness. less length and poor leaf vigor. Carrots that are cropped on green manures plots concerning morphological traits (Table 2) after the 1st gathering are characterized with an average dimensions length x diameter 20.75×2.07 cm. an average weight of 59.88 g per plant and average sap of 22.18 ml/100 g d.m. compared with control where an average dimensions are evaluated 14.3×1.22 cm. average weight 17.33 g per plant and average obtained sap of 14.5 ml/100 g d.m.. During the 2nd carrot gathering (Table 2) based on results are considered increased dimensions 23.22×2.69 cm. average weight of 62.44 g per plant and sap content of 18.45 ml/100 g d.m. while at control carrots achieved dimensions of 15.41×1.79 cm. average weight 28.44 g per plant and extracted sap 12.00 ml/100 g d.m. At green manures carrots cortex width an average is amounted 1.0 cm in total diameter. xylem diameter 2.3 cm after the 1st gathering by value increasing after the 2nd (0.74 cm-cortex width; 1.59 cm-xylem diameter). Compared with control carrot is more than obviously that green manure is responsible for very good performances and corresponded with literature data of examinations conducted with cv.Nantes. too (Chiwon et al. 1996). Similar results are obtained through investigations performed with potato cv.Agata (Kratovalieva et al. 2006) that lead down to conclude more qualitative products are obtained using green mass of common vetch as green manure (Kratovalieva et al. 2006).

Table 1. 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 počva)	
					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
11	07.07.2004	C	0-20	/	/	/	0.21	38.28	9.7
12	07.07.2004	C	20-40	/	/	/	0.216	23.35	8.09
13	07.07.2004	GM	0-20	/	/	/	0.229	41.34	9.3
14	07.07.2004	GM	20-40	/	/	/	0.217	24.5	6.87

Legend: C-control; GM-green manured

With refer to obtained carrot yield after the 1st gathering 23.52 t/ha at organic produced and 5.03 t/ha at control. analysis is pointed out on increasing of 78.61 %, while by 11nd for 66.27 %, which shows on organic production as suitable by common vetch utilization (Figure 1).

Table 2. Analyse of morphological carrot traits (*Daucus carota* L. cv. Nantes) -1st gathering (28.06. 2004)

Statistics	No plants/m ²		Carrot length (cm)		Carrot diameter (Ø/cm)		Carrot weight /g/		Sap ml/100g d.m.	
	C	Org.	C	Org.	C	Org.	C	Org.	C	Org.
x	29.1	39.27	14.3	20.75	1.22	2.07	17.33	59.88	14.5	22.18
Sx	0.16	0.05	0.16	0.1	0.2	0.19	0.2	0.21	0.16	0.15
Ω	4.71	2.02	3.25	2.19	0.18	0.03	1.85	3.81	2.12	4.95
CV	15.76	4.93	15.97	9.66	20.14	18.79	20.11	20.75	16.55	14.84
min	24	26	9.5	19.2	0.65	1.85	10.54	40.32	10	17
max	38	31	16.6	27.8	1.65	3.3	24.26	91.41	16	27

-11nd gathering (02.09. 2004)

	Carrot length (cm)		Carrot diameter (Ø)		Carrot weight /g/		Sap ml/100g d.m.	
	C	Org.	C	Org.	C	Org.	C	Org.
x	15.41	23.22	1.79	2.69	28.44	62.44	12	18.45
Sx	0.12	0.08	0.19	0.2	0.24	0.23	0.16	0.14
Ω	0.49	1.06	1.05	0.49	17.52	9.45	1.41	0.71
CV	12.52	8.18	18.88	19.83	24.01	22.59	16.21	13.78
min	10.4	19.5	0.71	1.95	11.08	89.28	11	14
max	18.9	28.1	2.3	3.65	39.69	125.3	18	22

Legend: C-control; Org.-organic

Table 3. Cortex width and xylem diameter at organic produced carrots compared with control ones (cm) (1st and 11nd gathering)

	Cortex width (cm)		Xylem diameter (Ø/cm)		Cortex width (cm)		Xylem diameter (Ø/cm)	
	C	Org.	C	Org.	C	Org.	C	Org.
x	0.67	1.00	1.51	2.3	0.74	1.01	1.59	2.52
Sx	0.46	0.64	0.81	0.77	0.43	0.64	0.31	0.05
Ω	11.83	0.07	0.12	0.26	2.2	0.13	0.05	0.15
CV	15.19	7.07	3.93	1.44	1.04	3.57	3.57	4.88
min	0.6	0.8	1.30	2.0	0.6	0.8	1.5	2.2
max	0.9	1.0	1.70	2.6	0.8	1.2	1.7	2.6

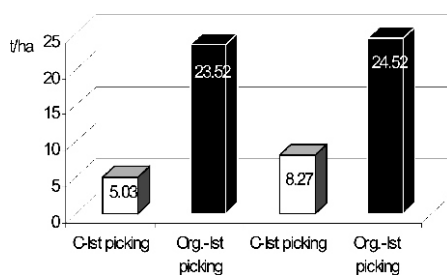


Figure 1. Yield at organic produced carrot compared with control (t/ha)

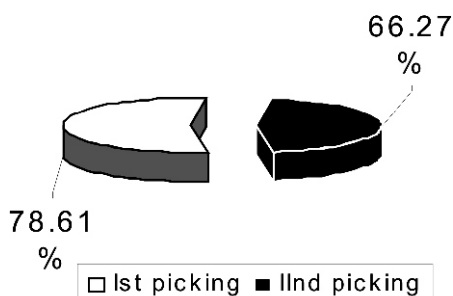


Figure 2. Yield increasing at green manures carrots compared with control (%)

Quantitative evaluation of carrot quality

Carrot quality as important food resource is evaluated on the base of total carbohydrate and ascorbic acid content. This vegetable has a key role in human and animal nutrition as a source of β -carotynoids (and less α - and γ -carotynoides and lutein). Resulted of releasing of banded potassium as available play an important role in synthesizing, transportation and in generally carbohydrate metabolism (Nichols & Baldwin 1983). The sweetness of carrots from this trial field was excellent with an average value of total carbohydrates 20.15 %/100 g d.m with soluble of 7.48 %/100 g d.m. (Chiwon et al. 1993), compared with control 17.81 %/100 g d.m. of total and 6.8 %/100 g d.m of soluble. Ascorbic acid content is also higher at treated variants 3.47 mg/100 g f.m. than control 2.47 mg/100 g f.m. (Table 4). either not at all samples (n=3). but this fact is corresponded with literature data (Marecek 2001) according those at organic produced vegetables ascorbic acid is not always increased.

Table 4. Total-soluble carbohydrate (%/100 g d.m) and ascorbic acid (mg/100 g f.m.) content

	Total-soluble carbohydrate		Ascorbic acid	
	C	Org.	C	Org.
x	17.81-6.8	20.15-7.48	2.47	3.41
Sx	0.024-0.19	0.043-0.13	0.11	0.054
Ω	0.57-1.39	0.42-0.98	0.16	0.25
CV	2.36-8.91	4.27-2.59	10.96	5.45
min	17.41-5.59	18.79-8.17	2.36	3.23
max	18.22-7.78	20.45-9.48	2.93	3.59

Conclusion

"Green manure" presents one of more possible and recommended tool at individual farmers as cost effective applicable manner of soil fertility improvement. Carrots produced on soils treated with green manure are characterised with better qualitative and quantitative traits that play a key role in quality determining. Actually the followed results are riched:

- Carrots cultivated on manure plots after the 1st-11nd gathering achieved higher average dimensions 20.75×2.07-23.22×2.69 cm. weight 59.88-62.44 g/plant and sap 22.18-18.45 ml/100 g d.m.. than control 14.3×1.22-15.41×1.79 cm. weight 17.33-28.44 g/plant and sap 14.5-12.00 ml/100 g d.m.
- Chemical analyses of treated carrot pointed out on higher content of total carbohydrate 20.15 %/100 g d.m. than control 17.81 %/100 g d.m.
- Ascorbic acid content is also higher at carrots produced on green manure variants 3.47 mg/100 g f.m. differs of control 2.47 mg/100 g f.m.

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