



Evaluation of Morphological Manifestations of New Bulgarian Kohlrabi Variety Grown in The Conditions of Organic Crop Production

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Abstract

A new Bulgarian kohlrabi variety Niki was studied in two systems of organic crop production: organic system without fertilizer and without pesticide treatment of the plants and organic system by use of biological fertilizer and plant protection with biological insecticides and biofungicides. The morphological characteristics: size of leaf rosette, number and weight of rosette leaves and weight, height and diameter of the kohlrabi (knob) were investigated. It was established that the new kohlrabi variety demonstrates relatively good biological potential for realization in organic crop production systems although the values recorded for almost all studied characters of the morphological characteristics were lower compared to those recorded in the conditions of conventional crop production. The phenotypical manifestations of the variety were better in organic system production with use of bioproducts for fertilization and plant protection where the values of the characters from the morphological characteristics were with 6 % to 23 % lower than those recorded in conventional production system. The values of the studied characters of kohlrabi grown in organic production without application of products for fertilization and plant protection were with 15 % to 34 % lower compared to the recorded in the conventional production. The average weight of the kohlrabi (knob) was 1.110 kg in organic system production with use of bioproducts for fertilization and 0.897 kg by growing in organic production without application of products for fertilization and plant protection which were smaller compared to the registered knob weight in conventional production 1.256 kg.

Keywords: Kohlrabi, Organic Production, Morphological Characters

Introduction

The initiation and development of the organic agriculture as a part of the strategy for ecological integration is a main factor for stable development of the modern farm economy (Carlier, 2001; Bencheva and Dzhabarova, 2006). In this aspect a special attention is devoted of vegetable organic production (Jordanova, 2003; Cholakov et al., 2006). It was established that cole crops in comparison with the remaining vegetable crops are described with high adaptability to the organic production systems and in view of that they cover considerable part in the organic sector for vegetable production in many countries (Guerena, 2006; Kaniszewski et al., 2012). With

regard to this the increase of the diversity of species and cultivars of cole crops is of great importance (Kaniszewski et al., 2012). The organic production of cabbage in Bulgaria is still limited as the studies were performed mainly with head cabbage and broccoli (Antonova et al., 2007; Mihov et al., 2012; Antonova, 2013). In the cole crops range the kohlrabi is absent as one of the reasons is also the insufficient variety assortment in Bulgaria. By the development of a new Bulgarian kohlrabi variety "Niki", suitable for conventional production, a good possibility is given for identification of the biological possibilities for new realization of the genotype in the conditions of organic production that are

different compared to those of the conventional production. It is considered in the organic production that the local varieties could be integrated very good to the specific unconventional conditions of production (Varghese, 2000; Maghirang et al., 2002). This determines the necessity to perform studies concerning the estimation of the adaptability of new local genotypes to the condition of organic production in the regions where these varieties are developed.

The purpose of the study was to establish the phenotypic manifestations of the main characters from the morphological characteristics of new Bulgarian kohlrabi variety Niki grown in the conditions of organic production.

Materials and Methods

In the period of 2011 – 2013 a new Bulgarian kohlrabi variety “Niki” grown in two systems of organic production and control – standard conventional production system was studied in the Maritsa Vegetable Crops Research Institute – Plovdiv. The new kohlrabi variety (recognized by The Experts Commission to Executive Agency for Variety Testing, Field Inspection and Seed Control /EAVTFISC/ in 2011) was cultivated by the late field production technology with sowing date 17 – 20 of June and transplanting – 27 – 30 of July on high flat bed by 90+70/60 cm scheme. The experiments were set by block method. The studying was done in the following systems: 1 – control: conventional production system with use of standard mineral fertilization (up to $N_{200}P_{150}K_{120}$ kg ha⁻¹) and plant protection based on pesticides with chemical origin; 2 - organic system without fertilizer and without pesticides treatment of the plants; 3 - organic system by use of biological fertilizer and plant protection with biopesticides. (In organic system 3 the fertilization was done by use of bio-fertilizer lumbrical produced by *Lumbricus rubelis* in rate of 3000 L ha⁻¹ and for plant protection were used biological insecticides and biofungicides permitted for application in the organic production in Bulgaria). All variants of study were set in 4 replications (22 plants/ replication).

In the experimental period were studied 6 main morphological characters: size of leaf rosette (cm), rosette leaves (number), weight of rosette leaves (kg), weight (kg), height (cm) and diameter

(cm) of the kohlrabi (knob). The analysis of the characters is carried out by biometrical measurement of 10 plants per replication.

Data obtained were mathematically processed by analysis of variance (Lakin, 1990). The significance of differences by comparison with the control was determined by the LSD test using Student's *t* – test.

Results and Discussion

In the conditions of organic production the new kohlrabi variety “Niki”, demonstrates different phenotypic expression of the studied characters from the morphological characteristics as the recorded values for predominant part of the characters are lower than those registered for the control variant of growing in conventional system (Table 1). In organic system of production without fertilizer and pesticides treatment of the plants the values of the studied characters are lower than those in the control variant and the ones recorded for variant of production by use of biological fertilizer and plant protection with biological pesticides. The rosette is with 68.5 cm diameter, formed by 22 leaves, with weight 0.497 kg. The knob of the kohlrabi is with 10 cm diameter, 11.5 cm height, 0.897 kg weight, that is with 0.359 kg less compared to the weight registered in the conventional production.

The parameters of the technological characters of the new kohlrabi variety in production system with use of biological fertilizer and plant protection with biological pesticides are closer to the recorded for production in conventional conditions. Plants form 22 leaves rosette being with 80 cm diameter and 0.527 kg weight. The knob weight gets to 1.110 kg and it is with 0.146 kg less compared to that registered in conventional production. The knob size – height and diameter are 10.5 cm и 12.7 cm, respectively. These results could be an indication that the potential for realization of the new genotype is better in organic production system where biological fertilizer and plant protection with biological insecticides and biofungicides have been used. It is observed that the number of the rosette leaves keeps the same regardless of the kind of the production systems and it is identical to the recorded in the conventional production system.

Table 1. Morphological characteristics of kohlrabi variety Niki

System	Size of leaf rosette	Rosette leaves	Weight of rosette leaves	Knob		
				Weight	Height	Diameter
	cm	number	kg	kg	cm	cm
1	103.8	22.0	0.674	1.256	11.9	13.5
2	68.5***	22.0 ^{ns}	0.497***	0.897***	10.0***	11.5***
3	80.0***	22.0 ^{ns}	0.527***	1.110**	10.5***	12.7 ^{ns}
<i>LSD 0.05</i>	3.20	1.14	0.026	0.082	0.70	0.91
<i>LSD 0.01</i>	4.32	1.54	0.036	0.111	0.94	1.24
<i>LSD 0.001</i>	5.76	2.06	0.048	0.148	1.26	1.65

*, **, *** significant at level of $p \leq 0.05$, $p \leq 0.01$, $p \leq 0.001$; ^{ns} – non significant

The two organic systems have a different effect on the phenotypic expression of the studied kohlrabi variety (Figure 1). The values of the characters from the morphological characteristics in organic system production with use of bioproducts for fertilization and plant protection where with 6 % to 23 % lower than those recorded in conventional production system. The values of the studied characters of kohlrabi grown in organic production without application of

products for fertilization and plant protection were with 15 % to 34 % lower compared to the recorded in the conventional production. The conditions of the two systems for organic production influence in the greatest degree on the leaf rosette diameter and weight while a stronger negative effect on kohlrabi knob weight is observed in organic system growing without application of products for fertilization and plant protection.

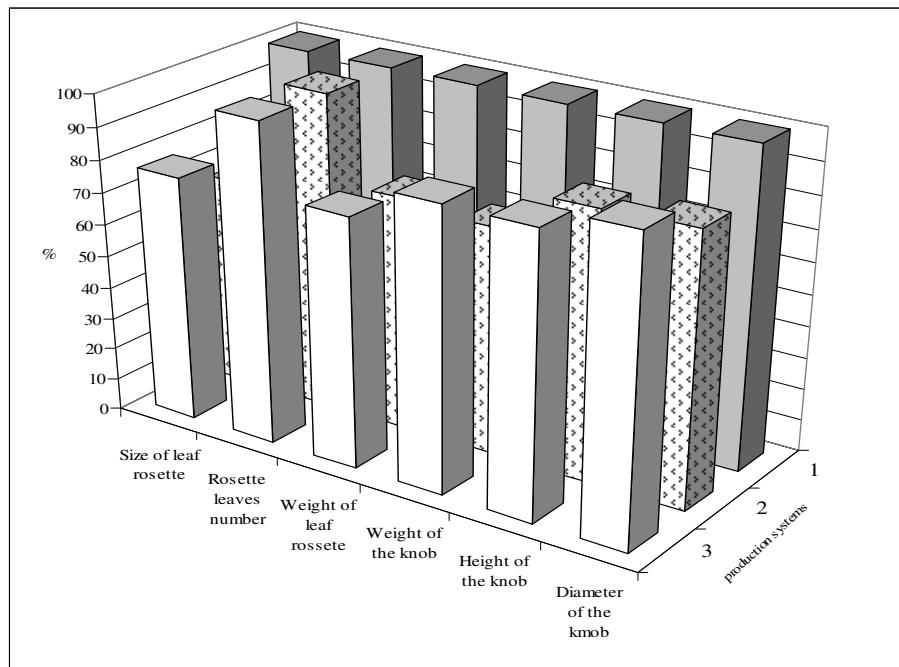


Figure 1. Influence of organic crop production on morphological characteristics of kohlrabi variety Niki

According to the results from the analysis of variance it was established that the variation of

almost of the studied characters is due to the proven differences between the three production

systems, the years of investigation and specific interaction year x production system (Table 2).

The sources of variability have a different effect on the studied characters (Table3).

Table 2. Two factor analysis of variance

Sources of variation	df	Variance					
		Leaf rosette			Knob of kohlrabi		
		Size	Number of leaves	Weight	Weight	Height	Diameter
Systems	2	3665 ^{***}	2.9 [*]	77304.86 ^{***}	373019.4 ^{***}	19.44 ^{***}	36.86 ^{***}
Years	2	91.2 ^{***}	8.69 ^{***}	5969.44 ^{***}	76252.78 ^{***}	3.69 ^{***}	0.36 ^{ns}
Systems x Years	4	26.5 ^{**}	3.11 ^{**}	2804.86 ^{***}	12444.44 [*]	0.94 [*]	0.78 ^{ns}
Residual	27	4.87	0.62	344.91	3222.22	0.23	0.39

df – degree of freedom; *, **, *** significant at level of $p \leq 0.05$, $p \leq 0.01$, $p \leq 0.001$; ^{ns} – non significant

Table 3. Effect of variation factors on morphological characteristics

Sources of variation	Leaf rosette			Knob of kohlrabi		
	Size	Number of leaves	Weight	Weight	Height	Diameter
	(%)	(%)	(%)	(%)	(%)	(%)
Systems	94.58	10.94	82.64	72.06	69.07	83.49
Years	2.35	33.24	6.38	14.73	13.12	-
Systems x Years	1.37	23.80	6.00	4.81	6.71	-

Dominant effect 69.07 % - 94.58 % on the variability of the size of leaf rosette, weight of rosette leaves, weight, height and diameter of the kohlrabi has the proven differences between the production systems. The remaining sources of variability have weaker influence on the studied characters from 1.37 % to 33.24 %.

The comparative analysis of the studied results demonstrates that the new Bulgarian kohlrabi variety Niki shows relatively good biological potential for realization in the studied organic production systems although the recorded values of almost of the tested characters from the morphological characteristics are lower than those registered in conventional production.

These results are similar to some of the reported by other researchers who also reported diversity of phenotypic manifestations of the studied characters in test of new genotypes of vegetable crops and potato (Kalapchieva et al., 2011; Todorova et al., 2013; Nacheva et al., 2013). In this study the values of the morphological characters decrease with up to 34 % compare to recorded parameters in conventional production

systems. However such a reduction is considered to be an optimal in organic production where the conventional varieties usually demonstrate slower potential for realization. In this aspect it is found that the new Bulgarian kohlrabi variety Niki could be grown in condition of organic production as a production system with use of bioproducts for fertilization and plant protection is advisable.

Conclusion

Bulgarian kohlrabi variety Niki demonstrates relatively good biological potential for realization in organic crop production systems although the values recorded for almost all studied characters of the morphological characteristics were lower compared to those recorded in the conditions of conventional crop production.

The phenotypical manifestations of the variety were better in organic system production with use of bioproducts for fertilization and plant protection where the values of the characters

from the morphological characteristics were with 6 % to 23 % lower than those recorded in conventional production system. The values of the studied characters of kohlrabi grown in organic production without application of products for fertilization and plant protection were with 15 % to 34 % lower compared to the recorded in the conventional production.

The average weight of the kohlrabi (knob) was 1.110 kg in organic system production with use of bioproducts for fertilization and 0.897 kg by growing in organic production without application of products for fertilization and plant protection which were smaller compared to the registered knob weight in conventional production 1.256 kg.

References

- Antonova, G., Yankova, V., Masheva, S., Boteva, H., Dimov, I. and Kanazirska, V., 2007. Evaluation of productivity manifestations in bulgarian varieties of late head cabbage grown in organic production systems. International Symposium "Durable agriculture – agriculture of the future", *Annales of the University of Craiova – Romania*, vol. XXXVII/A, 448-454.
- Antonova, G., 2013. Phenotypic variability of a new broccoli genotype in growing in organic production systems. *Proceedings of the International scientific and practical conference "Scientific support of potato, vegetable and melon growing: Achievements and Prospects"*, 11-12 december 2013, Kazahstan, 87-92.
- Bencheva, N. and Dzhaharova, Y., 2006. State of art trends and challenges of the organic development. Association "Regional science and technology unions-Plovdiv, *Proceedings of Sixth National Scientific Conference with international participation*, 97-102, (in Bulgarian)
- Carlier, L., 2001. Organic farming: Back to the past or solution for a sustainable agriculture - Chance and challenge for Bulgarian agriculture. *Bulgarian Journal of Agricultural Sciences*, 7, 1-5.
- Cholakov, T., Masheva, S., Mikhov, M., Boteva, H., Yankova, V., Dincheva, T., Arnaudov, B. and Tringovska, I., 2006. Ecological Elements in Vegetable Production. *Proceedings of Ist International Symposium "Ecological approaches towards the production of safety food"*, Plovdiv-Bulgaria, 33-40, (in Bulgarian)
- Guerena, M., 2006. Cole Crops and Other Brassicas: Organic production. <http://www.attar-publ/cole.html>
- Jordanova, M., 2003. State of organic farming and problems of organic vegetable gardening. *Proceeding of International scientific conference "50 Years University of Forestry"*, Session Agriculture, 61-63, (in Bulgarian)
- Kalapchieva, Sl., Masheva, St. and Yankova, V., 2011. Identification of initial material for organic breeding in garden pea. *Bulletin of the Transilvania University of Brasov*, 4, 53, 2, 81-88.
- Kaniszewski, S., Babik, I. and Babik, J., 2012. The usefulness of cole crops species and cultivars for organic production. *Journal of Research and Applications in Agricultural Engineering*, 57, 3, 190-193.
- Lakin, G., 1990. Biometria. Vishaja Shcola, Moskva, p. 395, (in Russian)
- Maghirang, R.A., Miranda, M.B., Guevarra, M.L.D., Rodulfo, G.S., Taylo, L.D., Sison, L.M.J., Opino, N.I. and Dolores, L.M., 2002. Varietal screening in vegetables under organic conditions. *Philippine Journal of Crop Science*, 27 (1), 33.
- Mihov, M., Antonova, G., Masheva, S. and Yankova, V., 2012. Energy Assessment of Conventional and Organic Production of Head Cabbage. *Bulgarian Journal of Agricultural Science*, 18 (3), 320-324.
- Nacheva, E., Masheva, S. and Yankova, V., 2013. Characterization of agrobiological response of mid-early potato breeding lines and varieties in biological production. *Plant Science*, 50, 80-85. (in Bulgarian)
- Todorova, V., Yankova, V. and Masheva, S., 2013. Manifestations of bulgarian pepper varieties grown in condition of organic production. *Plant Science*, 50, 34-37. (in Bulgarian)
- Varghese, L., 2000. Organic vegetables issues and strategies – a review. *Agricultural Reviews*, 21 (4), 211 – 222