

INFLUENCE OF ORGANIC FERTILIZATION ON ORGANOLEPTIC INDICATORS AND NITRATE CONTENT IN GREENHOUSE SALAD

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Abstract

In an experiment with a greenhouse lettuce in the period 2018-2020, the influence of biological fertilization on the visual characteristics, taste indicators and nitrate content were studied. The biological fertilizers were tested: Arcobaleno, Italpolina, Lumbrical and the microbiological fertilizer Ecoprop NX with control of non-fertilized and mineral fertilization (MF) - NPK. The study was conducted with three varieties of salads: 'Maritima' - 'Batavia' type, 'Tuska' variety - 'Lolo rosa' type and 'Winter Butterhead' - 'Butterhead' type. An organoleptic assessment was performed on a five-point scale. A differentiated variety reaction was established. The 'Maritima' variety is the most responsive to the applied organic fertilizer. The variants with organic fertilization have a complex score from 3.52 for Ecoprop NX to 3.62 for Arcobaleno compared to 3.30 for the control of non-fertilized and 3.49 for the control of mineral fertilization. For the variety 'Tuska' only the variant fertilized with Italpolina exceeds the control and has the highest complex score of 3.82. Biological fertilization has improved the quality of the 'Winter ButterHead' variety and the complex assessment is from 3.14 in Italpolina to 3.41 in Lumbrical compared to the control variants non-fertilized 3.07 and MF 3.10. Fertilization with the tested biological fertilizers does not increase the amount of nitrates in lettuce leaves above the maximum permissible amounts set by the European Commission.

Key words: lettuce, greenhouse, organic fertilizers, sensory evaluation, nitrates.

INTRODUCTION

Salad is one of the most grown and marketed vegetables in Bulgaria. Although the production is year-round consumption is mainly in the autumn-winter and winter-spring period. Consumers are interested in both the price and the quality of the product. More and more attention is paid not only to the taste, but also to the health of the food. Interest in organically produced vegetables, including salads, is growing. Visual and taste characteristics are important in the choice of consumers. In this direction, a number of studies have been conducted on salad varieties and growing dates for the selection of those with an attractive appearance and high taste. Thicoipe et al. (2004) performed sensory analysis of 9 varieties of salads of the types: Batavia, Butterhead, Lollo, Romaine, Iceberg. They point out that the varieties: Iceberg and Romaine have the greatest crunchiness, juiciness and sweetness. Evaluation of taste and sensory qualities in 50 varieties of *Lactuca sativa* is conducted by Liu et al. (2016). They found significant differences between the

different groups and different colored varieties. The head lettuce has a better sensory evaluation compared to the leaf lettuce and the lettuces with green coloring than those with purple. The taste qualities are mainly determined by the variety and the variety type (Bunning et al., 2010). This conclusion is the result of the evaluation of sensory qualities and total phenols in 5 varieties of lettuce (Butterhead, Crisphead, Green leaf, Red leaf, Romaine). Harvesting is done at the beginning, middle and end of the season. They found that taste and bitterness had nothing to do with environmental factors (temperature and light) and the content of phenolic compounds. Akand et al. (2010) set up an experiment with 6 genotypes of lettuce to study the organoleptic characteristics 15, 30, 45 days after planting. After the analysis with the most points (1027) is the genotype Green waves on day 30 and with the least (927) Okayama salad 45 days after planting. Fertilization and the applied cultivation technology have a significant influence on the taste and visual characteristics. Great interest is shown in organically produced salads and their organoleptic and visual evaluation. Some

studies indicate that there are no significant differences in appearance and taste after treatment with organic and non-organic fertilizers (Masarirambi et al., 2010). They use three organic fertilizers: 1. bounce back compost; 2. cattle manure; 3. chicken manure; 2 and 3 40 t/ha, 1 - 2.5 t/ha, control - mineral fertilizer 1055 kg/ha. The best results in growth, development and yield are obtained after fertilization with chicken manure, followed by beef and compost, and the last is inorganic manure. Similar results were obtained by Sajjad et al. (2020) in a study of the influence of organic fertilizers on the morphological characteristics and organoleptic characteristics of Iceberg and Batavia type salads. The best results are obtained after fertilizing with chicken manure. The highest value for flavor 4.5 was found in leaf lettuce. From a practical and scientific point of view, it is of interest to determine whether there is an organoleptic difference between organically and conventionally grown vegetables. Zhao et al. (2007) conducted experiments with organically and conventionally grown salads (red and green), spinach, tomatoes, cucumbers and onions. The consumer test does not show significant differences in liking and perception of sensory quality. However, consumers believe that organic products are healthier (72%) and more environmentally friendly (51%), and 28% consider organic vegetables to be tastier. Similar study for salads grown organically, conventionally, and hydroponically was conducted by Murphy et al. (2011). They analyzed 5 varieties of types: Romaine, Green leaf, Red leaf, Butter and Common lettuce. They used 5 and 3 degree scales to assess taste, smell, visual quality and texture. The obtained results did not show a significant difference in the sensory evaluation of hydroponic, conventionally and organically produced salads. The content of nitrates also has a significant impact on the quality assessment of salads. In a field experiment conducted in Greece, the influence of the date of sowing and fertilization on the growth and development of Great Lake and Nabuco lettuce varieties was studied. The effect on physical and organoleptic characteristics has been determined. They found that the heads had a lower content of nitrates than the leaves. The

values of the sensory parameters are inversely proportional to the amount of fertilizers used (Khah & Arvanitoyannis, 2003). In another experiment, Boros et al. (2020) investigated the influence of technology and the term (season) of cultivation on the content of nitrates in variety types salads Batavia, Butterhead, Lollo, Oak leaf. They found that when Oak Leaf lettuce was harvested in the fall, they accumulated less nitrate than the red ones and the Lollo type. During spring harvest, Batavia accumulates more nitrates than Butterhead.

In summary, it can be stated that the results of the studies are not one-way. They vary depending on the variety and type, as well as the fertilizers used. The specific consumer requirements, tastes and preferences have a significant influence. Based on this, we set ourselves the goal of conducting an experiment to assess the visual and organoleptic characteristics after application of different organic fertilizers in salad varieties of different types for the conditions of Bulgaria.

MATERIALS AND METHODS

The experiment was conducted in the period 2018/2020 in an unheated polyethylene greenhouse of the Agricultural University - Plovdiv. The influence of biological fertilization on the visual characteristics, taste indicators and nitrate content of lettuce was studied. The biological fertilizers were tested: Arcobaleno, Italpolina, Lumbrical and the microbial fertilizer Ecoprop NX. The following variants were set: 1. Unfertilized; 2. Mineral fertilization; 3. Italpolina; 4. Arcobaleno; 5. Lumbrical; 6. Ecoprop NX. The study was conducted with three varieties of lettuce: variety 'Maritima' (type 'Batavia'), variety 'Tuska' (type 'Lollo rosa') and variety 'Winter Butterhead' (type 'Butterhead'). The experiment was based on 4 repetitions of 28 plants in a plot. Fertilizers were applied during the last soil preparation in the following norms: Italpollina - 250 kg/ha, Arkobaleno - 1000 kg/ha, and Lumbricompost - 4000 L/ha. Soluble microbial fertilizer Ekoprop NX was applied twice at a dose of 1 kg/ha before planting in phase 4-5 leaf seedlings and 10 days after planting. Mineral fertilization was done with potassium sulfate, triple super phosphate and ammonium nitrate N- 125 kg/ha,

P₂O₅- 12.5 kg/ha, K₂O - 47.5 kg/ha. The lettuce was planted in phase 4-5 leaves at the beginning of November according to the scheme 70 + 30 + 30 + 30/30 cm. During the vegetation the appropriate care was taken, as the watering was done with a drip system.

The harvesting took place from the second decade of March to the end of March. In the middle of the harvest period, an organoleptic evaluation was performed by an 11-member jury on a five-point scale using the following methodology. The visual indicators of the rosette were evaluated: 1. Coloring - separately for the green and red colored varieties with application of 5 degree scale according to the color intensity; 2. Habitus type - on a three-point scale (dense, semi-loose, loose); 3. Size - on a three-point scale (very large, large, medium); 4. General appearance - on a five-point scale (highly attractive, attractive, impressive, normal, unattractive). A tasting evaluation of the indicators was conducted: 1. Taste - on a five-point scale (sweet, neutral, sweet bitter, slightly bitter, bitter); 2. Consistency - on a five-point scale (tender, brittle, juicy, coarse, fibrous); 3. Aroma - on a five-point scale (strong pleasant, moderately pleasant, weakly pleasant, typical, unpleasant). An overall organoleptic assessment was made as a sum of the values of all indicators divided by their number.

During the harvest, the amount of nitrates was determined in an average sample of 4 plants from each variant (1 plant from each replication) in all three varieties. The analysis was performed by VVL (internal laboratory methodology), created and verified on the basis of BDS EN 12014-3: 2005

A one-way analysis of variance and an LSD test were performed to assess the differences in

each of the traits resulting from the application of the tested fertilizers. The mathematical processing of the experimental data was performed using the software product IBM SPSS Statistics 24 (Ganeva, 2016).

RESULTS AND DISCUSSIONS

1. Sensory evaluation of 'Maritima' lettuce.

The Maritima variety has reacted positively to the applied fertilization with the used organic fertilizers. The values for most indicators are higher than the mineral fertilization and significantly exceed the unfertilized control.

1.1. Visual indicators (Table 1)

After fertilization with organic fertilizers, the color, density and size are improved. Coloring becomes more intensive, with values in all bio-variants exceeding unfertilized control and mineral fertilization. The highest score of 2.73 was given to variants 4, 5 and 6 (with biological fertilizer). Density has improved in all variants with bio-fertilization and is superior to mineral fertilization and non-fertilization control. The highest values for this indicator have the variants 4 Arkobaleno and 5 Lumbrical, respectively 2.64 and 2.82 at 1.91 for mineral fertilization. Biological fertilization had the strongest effect on the size of the rosette. Variants 3, 4 and 6 are superior to mineral fertilization and unfertilized control. The highest score of 4.20 was given to option 4 Arkobaleno. The differences in the visual indicators of the indicated variants are statistically significant both in the control of non-fertilization (Table 2) and in the control of mineral fertilization (Table 3).

Table 1. Sensory analysis in lettuce variety 'Maritima'

Variant	Visual indicators				Tasting evaluation			Overall assessment
	Leaf rosette				Taste	Consistence	Aroma	
	Appearance	Coloring	Density	Size				
1	4.18	2.55	2.27	3.18	4.36	3.00	3.55	3.30
2	4.18	2.55	1.91	3.73	4.18	4.09	3.82	3.49
3	3.82	2.60	2.45	4.09	4.64	3.82	3.91	3.62
4	4.09	2.73	2.64	4.20	4.09	3.45	3.91	3.59
5	4.18	2.73	2.82	3.55	4.27	3.45	3.82	3.55
6	3.91	2.73	2.45	3.91	3.91	4.00	3.73	3.52

Table 2. Proof of the differences in the variety 'Maritima' after fertilization with biofertilizers compared to control 1 (unfertilized) with a significance level \leq of 0.5

Variant	Appearance	Coloring	Density	Size	Taste	Consistence	Aroma
3	*.	n.s.	n.s	*	*	*	*
4	n.s.	*	*	*	n.s.	*	*
5	n.s.	*	*	*	n.s.	*	*
6	n.s.	*	n.s	*	*	*	n.s.

Table 3. Proof of the differences in the variety 'Maritima' after fertilization with biofertilizers compared to control 2 (mineral fertilization) with a significance level \leq of 0.5

Variant	Appearance	Coloring	Density	Size	Taste	Consistence	Aroma
3	*	n.s.	*	*	*	n.s	*
4	n.s.	*	*	*	*	*	*
5	n.s.	*	*	n.s.	n.s.	*	n.s.
6	n.s.	*	*	n.s.	*	n.s	n.s.

1.2. Organoleptic indicators (Table 1)

The performed tasting evaluation also gives an advantage to most variants with biological fertilization. The taste of the 3 Itapolina and 5 Lumbrical variants is 4.64 and 4.27, respectively, superior to the mineral fertilizer 4.18 as the mathematical differences for variant 3 are proved in the non-fertilized and fertilized controls (Tables 2 and 3). The consistency was less affected by the application of organic fertilizer. All variants have higher scores than the control - unfertilized with proof of differences, but inferior to mineral fertilization. Only the variant fertilized with Ecoprop NX has a score of 4.00 close to mineral fertilization - 4.09.

The fertilizers used have enhanced the aroma of the salads. All salads fertilized with organic fertilizers exceed the control - unfertilized with proof of differences, as options 3, 4 and 5, respectively, with scores of 3.91; 3.91 and 3.82 are equalized and exceed the mineral fertilization by 3.82.

The complex assessment from the sensory analysis gives, although a slight advantage of the variants with biological fertilization over the mineral fertilization 3.49 and the control - non-fertilization 3.30. With the highest scores of 3.62 and 3.59 are options 3 and 4 fertilizers with Itapolina and Arkobaleno.

2. Sensory evaluation of 'Tuska' leaf lettuce (Table 4)

The 'Tuska' variety reacted less well to fertilization with organic fertilizers. The effect is insignificant in the visual indicators of the leaf rosette: color, density, size. There is a more

pronounced positive effect on the indicators of the tasting evaluation: taste and consistency.

2.1. Visual indicators (Table 4)

After the application of the tested biological fertilizers, the salads have a more intense red color compared to the control - unfertilized, but are inferior to the mineral fertilization with a score of 4.70. Only option 5 fertilization with Lumbrical is equal to mineral fertilization. Statistically, differences were shown in the coloration compared to the control - not fertilized for variants 3, 4 and 5 (Table 5) and in comparison with the mineral fertilization for variants 4 and 5 (Table 6). The same trend is observed in the density of the leaf rosette. Only variant 5 with 3.14 approaches the mineral fertilization 3.18. This trend is maintained in terms of rosette size. Only the Itapolina variant has a higher value of 3.40 than the mineral fertilizer 3.20. In terms of density and size, only option 4 has a proven difference in terms of mineral fertilization (Table 6).

2.2. Organoleptic indicators (Table 4)

The taste has improved and all variants with organic fertilization exceed the control - unfertilized. The highest score of 4.14 was given to the fertilizer variant with Arkobaleno. The fertilizer variant with Lumbrical has a score of 3.00 and slightly exceeds the mineral fertilizer 2.82. The differences were proved for variants 3, 4 and 5 compared to unfertilized (Table 5) and for variants 3 and 5 compared to mineral fertilization (Table 6). The consistency has improved only after the application of the organic fertilizers Arkobaleno and Itapolina

with a value of 4.09 and 4.64 and exceeds the mineral fertilizer with a score of 3.91 and the differences are mathematically proven. The aroma is best in the variants with mineral fertilization. The applied biological fertilizers in variants 3, 4 and 5 are superior to the control - not fertilized, but inferior to the variants with

mineral fertilization. The complex assessment from the sensory analysis only in variant 3 fertilization with Italtolina 3.82 is superior to the mineral fertilization 3.71. All variants with biological fertilization are superior to the control - non-fertilized.

Table 4. Sensory analysis in lettuce variety 'Tuska'

Variant	Visual indicators				Tasting evaluation			Overall assessment
	Leaf Rosette				Taste	Consistence	Aroma	
	Appearance	Coloring	Density	Size				
1	4.70	4.55	3.00	3.00	2.00	3.64	3.09	3.42
2	4.50	4.70	3.18	3.20	2.82	3.91	3.64	3.71
3	4.80	4.64	3.00	2.82	4.14	4.09	3.27	3.82
4	4.60	3.80	2.82	3.40	2.73	4.64	3.45	3.63
5	4.94	4.70	3.14	3.00	3.00	3.55	3.00	3.62
6	4.88	4.55	2.82	2.82	2.40	3.82	3.18	3.49

Table 5. Proof of differences in the variety 'Tuska' after fertilization with biofertilizers suspended control 1 (unfertilized) with a significance level \leq of 0.5

Variant	Appearance	Coloring	Density	Size	Taste	Consistence	Aroma
3	*	*	n.s.	n.s.	*	*	*
4	n.s.	*	n.s.	*	*	*	*
5	*	*	*	n.s.	*	*	n.s.
6	*	n.s.	n.s.	n.s.	n.s.	*	n.s.

Table 6. Proof of the differences in the variety 'Tuska' after fertilization with biofertilizers compared to control 2 (mineral fertilization) with a significance level \leq of 0.5

Variant	Appearance	Coloring	Density	Size	Taste	Consistence	Aroma
3	*	n.s.	n.s.	n.s.	*	*	n.s.
4	n.s.	*	n.s.	*	n.s.	*	n.s.
5	*	n.s.	n.s.	n.s.	*	n.s.	*
6	*	*	n.s.	n.s.	n.s.	n.s.	*

3. Sensory evaluation of head lettuce 'Winter Butterhead'

The 'Winter Butterhead' variety, like the 'Tuska' variety, was less affected by the applied organic fertilizers. From the visual indicators the coloring and the size of the leaf rosette were more strongly influenced.

In the indicators of the tasting evaluation, the strongest positive effect was given by the used biological fertilizers in terms of consistency.

3.1. Visual indicators (Table 7)

Coloring only in variant 5 with Lumrical has a score of 2.79, which exceeds the mineral fertilization 2.36 and the control - non-fertilization 2.55 with proven differences in both controls (Tables 8 and 9).

The density of the leaf rosette is also slightly affected, as options 4 and 5 are equal to the

mineral fertilizer 2.82, and only option 6 exceeds it by 3.00 and the difference is proven (Table 9).

The size of the leaf rosette is better in all variants with biofertilization and significantly exceeds the mineral fertilizer 1.73. The highest score of 3.18 is the fertilizer variant with Lumrical.

3.2. Tasting evaluation (Table 7)

The taste did not improve after the biofertilizers were used. Only variant 5 with Lumrical has a score of 4.40, equal to the mineral fertilizer 4.40 and surpasses the control - unfertilized. The consistency is most strongly influenced by the biofertilizers used. All variants are superior to mineral fertilization 3.73 and control - unfertilized 3.25. Option 6 with Ecoprop NX received the highest score - 4.36. Statistical

differences were proved in all variants compared to the control not fertilized (Table 8) and for variants 4 and 6 compared to mineral fertilization (Table 9).

In terms of flavor, option 4 is equal to mineral fertilizer 3.45, and options 5 Lumrical and Ecoprop NX 6 surpass it with grades of 3.55 and 3.65, respectively.

In general, however, the complex assessment from the sensory analysis gives preference to the variants fertilized with biofertilizers. The highest score of 3.41 is in the variant fertilization with Lumrical, which is superior to mineral fertilization with a score of 3.10.

Table 7. Sensory analysis in lettuce variety 'Winter Butterhead'

Variant	Visual indicators				Tasting evaluation			Overall assessment
	Leaf Rosette				Taste	Consistence	Aroma	
	Appearance	Coloring	Density	Size				
1	3.22	2.55	3.00	1.55	4.30	3.25	3.64	3.07
2	3.22	2.36	2.82	1.73	4.40	3.73	3.45	3.10
3	3.44	2.36	2.09	2.82	4.10	3.91	3.27	3.14
4	3.67	2.36	2.82	1.91	4.00	4.27	3.45	3.21
5	3.11	2.79	2.82	3.18	4.40	4.00	3.55	3.41
6	3.44	2.45	3.00	2.82	3.90	4.36	3.64	3.37

Table 8. Proof of the differences in the variety 'Winter oil head' after fertilization with biofertilizers compared to control (unfertilized) with significance level \leq of 0.5

Variant	Appearance	Coloring	Density	Size	Taste	Consistence	Aroma
3	n.s.	n.s.	*	*	*	*	n.s.
4	*	n.s.	n.s.	*	n.s.	*	n.s.
5	n.s.	*	n.s.	*	*	*	n.s.
6	n.s.	n.s.	n.s.	*	*	*	n.s.

Table 9. Proof of differences in the variety 'Winter oil head' after fertilization with biofertilizers compared to control 2 (mineral fertilization) with significance level \leq of 0.5

Variant	Appearance	Coloring	Density	Size	Taste	Consistence	Aroma
3	n.s.	n.s.	*	*	n.s.	n.s.	*
4	*	n.s.	n.s.	n.s.	*	*	n.s.
5	n.s.	*	n.s.	*	n.s.	n.s.	n.s.
6	n.s.	n.s.	n.s.	*	*	*	*

4. Content of nitrates in salad varieties fertilized with mineral and biofertilizers

4.1. Nitrate content in 'Maritima' variety (Table 10)

The values measured in the individual variants by years vary from 945 mg/kg in the control - not fertilized to and 2450 mg/kg in mineral fertilization. These are levels below the maximum levels established by Regulation (EU) № 1258/2011 as regards maximum levels for nitrates in foodstuffs. For salads (*Lactuca sativa*) greenhouses they are for the period

from 1.X. to 31.III. up to 5000 mg/kg, and for the period from 1.IV to 30.IX to 4000 mg/kg.

The lowest amount of nitrates was measured after fertilization with organic fertilizers Lumrical and Arkobaleno, respectively for 2019 - 1615 mg/kg and 1775 mg/kg, and for 2020 are 1449 mg/kg and 1382 mg/kg. These values are significantly lower than the variants with mineral fertilization, but higher than the control - non-fertilized.

Nitrates are the highest in variant 3 - fertilization with Italpolina and are close to mineral fertilization.

Table 10. Nitrate content in salad variety ‘Maritima’ fertilized with mineral and biofertilizers

Variant	Nitrates				
	2019	%	2020	%	average
1. Control-unfertilized	1265	51.6	945	60.3	1105
2. Control-MF (mineral fertilization)	2450	100	1582	100	2016
3. Italpolina	2320	94.7	1519	96.0	1919.5
4. Arkobaleno	1775	74.4	1382	87.4	1578.5
5. Lumrical	1615	65.9	1449	91.6	1532
6. Ekoprop NX	2235	91.2	1414	89.5	1824.5

The applied fertilization with the studied organic fertilizers in Maritima variety does not form nitrates above the maximum allowable concentration and is lower in value than the mineral fertilization.

4.2. Nitrate content in ‘Tuska’ variety (Table 11) This variety (representative of the ‘Lollo rosa’ type) tends to accumulate more nitrates. A similar finding was made in his study Boros et al. (2020).

Minimum values were measured during the control - unfertilized 1180 mg/kg.

4.3. Nitrate content in the ‘Winter oil head’ variety (Table 12)

maximum for mineral fertilization 2800 mg/kg. In 2019, the variants fertilized with biofertilizers have lower values of nitrates than mineral fertilization. This trend continues in the second year. The lowest amount of nitrates in both experimental years was reported in variant 4 - Arkobaleno, 1885 mg/kg and 1300 mg/kg, respectively.

The highest levels were measured after fertilization with Italpolina, but lower than the control - mineral fertilization.

Table 11. Nitrate content in ‘Tuska’ salad fertilized with mineral and biofertilizers

Variant	Nitrates				
	2019	%	2020	%	average
1. Control-unfertilized	2030	57.3	1790	59.7	1910
2. Control-MF (mineral fertilization)	3545	100	3005	100	3275
3. Italpolina	2985	84.2	2586	86.1	2785.5
4. Arkobaleno	2615	73.8	2303	76.6	2459
5. Lumrical	2325	65.6	1822	60.6	2073.5
6. Ekoprop NX	2875	81.1	2100	69.9	2487.5

The nitrate levels of this ‘Butterhead’ variety are comparable to those of the ‘Maritima’ variety (‘Batavia’ type). Nitrates in both years range from 1180 mg/kg in the control - fertilized to 2800 mg/kg in mineral fertilization and are below the maximum allowable concentration. The applied fertilization with the mentioned biofertilizers has formed plants with lower content of nitrates compared to the mineral fertilization.

The lowest values of 1885 mg/kg and 1300 mg/kg were measured after fertilization with Arkobaleno - option 4. The lowest values are option 5 - fertilizer with Lumrical and option 6 fertilizer with Ekoprop NX, significantly

below the levels of mineral fertilization. The highest values close to mineral fertilization are reported for fertilization with Italpolina.

The varieties included in the experiment reacted differently to the tested biofertilizers. Variety ‘Tuska’ (‘Lollo rosa’ type) accumulates more nitrates than the ‘Maritima’ variety (‘Batavia’ type) and the ‘Winter Butterhead’ variety (‘Butterhead’ type). The applied biofertilizers form plants with a lower amount of nitrates compared to mineral fertilization. The lowest values for all three types of salads (Lollo, Batavia, Butterhead) are obtained after fertilizing with Arkobaleno and Lumrical.

Table 12. Nitrate content in lettuce variety 'Winter Butterhead' fertilized with mineral and biofertilizers

Variant	Nitrates				average
	2019	%	2020	%	
1. Control-unfertilized	1205	43	1180	59.5	1192.5
2. Control-MF (mineral fertilization)	2800	100	1983	100	2391.5
3. Italpolina	2505	89.5	1742	87.8	2123.5
4. Arkobaleno	1885	66.3	1300	65.6	1592.5
5. Lumrical	2270	81.1	1651	83.3	1960.5
6. Ekoprop NX	2295	82	1573	79.3	1934

CONCLUSIONS

The varieties lettuce 'Maritima' (type 'Batavia'), red lettuce 'Tuska' (type 'Lollo rosa') and head lettuce 'Winter oil head' (type 'Butterhead') fertilized with organic fertilizers Italpolina, Arkobaleno, Lumbrikal and Ekoprop NX accumulate less nitrates of 5.3% to 39.4% compared to mineral fertilization. The 'Tuska' variety accumulates more nitrates than the 'Maritima' and 'Winter Butterhead' varieties. Salads fertilized with organic fertilizer Arkobaleno and Lumbrikal have the lowest amount of nitrates, respectively: 'Maritima' 1578.5 mg/kg and 1532 mg/kg; 'Tuska' 2459 mg/kg and 2073 mg/kg and 'Winter oil head' 1592.5 mg/kg.

Highest complex sensory evaluation in the case of the 'Maritima' variety it is obtained after the application of the organic fertilizers Italpolina and Arkobaleno, respectively 3.62 and 3.59, and in the case of the mineral fertilizer it is 3.49. The 'Tuska' variety reacted less to the applied organic fertilizers.

The organoleptic indicators of taste and consistency are improved. After fertilization with Italpolina and Lumbrikal, the estimates are 4.14 and 3.00, respectively, and exceed the mineral fertilization by 2.82.

High scores on the consistency are reported when fertilizing with Italpolina - 4.09 and Arkobaleno - 4.64, exceeding the mineral fertilization - 3.91.

The complex assessment from the sensory analysis in 'Winter Butterhead' gives a slight advantage to the variants with biological fertilization. The highest score of 3.41 is after fertilization with Lumbrikal and exceeds mineral fertilization by 10%.

ACKNOWLEDGEMENTS

This study was conducted with funding provided by the Center for Research, Intellectual Property Protection and Technology Transfer at the Agricultural University - Plovdiv.

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