Analele Universităţii din Craiova, seria Agricultură – Montanologie – Cadastru (Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series) Vol. XLII 2012/2

RESEARCHES REGARDING THE BEHAVIOR OF SOME LETTUCE GENOTYPES IN THE PROTECTIVE CROP SYSTEM TECHNOLOGY

SOARE RODICA[1], DINU MARIA[1], BICĂ M.[1]
[1]University of Craiova, Faculty of Agriculture and Horticulture

Key words: greenhouses, soil mulching, protection with agril, quality

ABSTRACT

The existence of a growing assortment of garden lettuce, constantly renewing, required to carry out research in order to determine the most valuable crops in protected areas of Oltenia. The aim of this experiment was to investigate the quality and quantity of the lettuce in greenhousesby applying some important techological sequences. Mulching the soil and plant protection with Agryl canvas have greatly improved the thermal and hydric soil proprieties with beneficial effects on earliness and yields of the lettuce grown in greenhouse.

The biological material was represented by six genotypes of lettuce: Larisa, Sommer Kragner, Gratia, Attraction, Nadege and Május Királya. From the experimental results on the behavior of growing lettuce in protected crop conditions, the highest yield was recorded at the Kragner Sommer, genotype, 40.5t/ ha, and from the biochemical aspect, the genotypes showed optimum values, but concerning the nitrates concentration, the values were higher on Gratia and Elsa cultivars.

INTRODUCTION

Vegetable crops in protected areas constitute a profitable investment for the future because of the high demand for fresh vegetables throughout the year, higher yields per unit area and the possibility of controlling climatic factors. To increase the efficiency of these construction types, usually before thermophilic vegetable crops (tomatoes, peppers, eggplants, cucumbers) are established crops with short vegetation period (Adriana Duta, 2005). On the other hand, by improving crop technology, we can increase the efficiency of these facilities without increasing too much the costs. Soil mulching positively influence crop earliness, prevents crust formation and maintain a constant soil moisture, combat weeds and pests, improves commercial quality of lettuce heads, etc. (Fritz D., W. Stoltz, 1989, Castoldi and co., 2006, Adriana Duta, 2007). Also, the use of protective materials against their unfavorable factors (type canvas Agryl) occupies an important role in modern technologies (Apahidean Al. S. Maria Apahidean, F. Pacurar, 2008). Protected crops should be considered as the best and cheapest insurance against climate damagen (Lăcătuş V., 2012). Leafy vegetables occupy a very important place in the human diet, but unfortunately constitute a group of foods which contributes maximally to nitrate consumption by living beings (Shahid Umar Anjana and co., 2007). Lettuce *(Lactuca sativa*) is an acclaimed worldwide vegetable because of their nutritional, therapeutic and economically issues. Short vegetation and low temperatures make it possible to cultivate lettuce in extra season in protected areas, ensuring the supply of the population in these periods (Rodica Sima, 2007). Regarding lettuce, the marketable and nutritional quality depends heavily on the agronomic strategy used (Sabine Rattler, 2005). Also, the content of dry matter, sugars and vitamin C decreased with increasing level of nitrogen, and the content of nitrate increased (N. Poulsen, 1995).

MATERIAL AND METHOD

The research was conducted in year 2010, on the Banu-Maracine R.D.S of the University of Craiova, Roumania.

The biological material was represented by six genotypes of lettuce: Larisa, Sommer Kragner, Gratia, Elsa, Nadege and Május Királya, which were grown in greenhouses.

Study's objectives were:

- Determining the behavior of an assortment of lettuce genotypes in terms of elements of precocity, yield and commercial quality;

- Determining the biochemical composition, including the accumulation of nitrates and nitrites in lettuce heads.

Experience was placed after 3 repetitions in randomized blocks method. In the experiment were applied the specifically technological sequences of the lettuce crop. The technology used was that recommended in the literature. In addition, soil mulching was made with special film, and the plants were covered with Agryl canvas in order to increase the temperature on the interior with 4-5^{0}C towards the exterior for preventing from frozen.

To achieve the objectives in the comparative study of genotypes assortment of lettuce crops in greenhouses during the growing season were conducted following records, tests and analyzes:

- vegetation period genotypes was determined taking into account the number of days from emergence until the complete formation of the head;
- biometric measurements at lettuce heads were made at harvest, recording diameter, average weight, features and color of the leaves;
- it has been also recorded yield efficiency of lettuce varieties, yield results were statistically processed and interpreted according to the method of variance analysis (Fisher's exact test);
- it were analyzed the main biochemical components, which makes nutritional value of lettuce, or content TDS, SDS, total sugar, C vitamin, nitrate and nitrite.

The percentage of soluble solids content was determined with portable refractometer. Determination of titratable acidity is performed by titrimetric method and expressed as g malic acid. Extraction of vitamin C from plant material was performed by iodometric method.

To determine nitrates concentration in lettuce leaves extraction, it was done by grinding freshly harvested plant material and transfer it into 2% CH_3COOH solution of the NO_3 and NO_2 ions. After filtration unit, it was dosed with refractometer, model RQ flex plus (Merck).

RESULTS AND NTERPRETATION

The studied lettuce genotypes in order to expand the assortment grown in the greenhouses, were analyzed in terms of precocity, morphological characteristics, as well as productive potential. Regarding the precocity, it was found that genotypes Elsa, Nadege and Kiralya Majus, with a period of 45-50 days, are early and Larisa, Sommer Kragner and Gratia, where the vegetation was by 52-60 days, were semiearly.

Regarding the phenotypic and yield characteristics, cultivars have the following characteristics:

•Larisa: leaves are curled, light green, forming a spherical head with a diameter of 18.4 cm and average weight 227.2 g;

•Sommer Kragner: leaves are slightly wavy green-flattened head is spherical with a diameter of 28.6 cm and an average weight of 275.6 g;

• Graţia: curled leaves, yellowish green, the heads are spherical with average diameter of 24.2 cm and a weight of 255.6 g;

• Elsa: The leaves are slightly wavy, the heads are globular-flattened, with a diameter of 25.5 cm and average weight 240.2 g;

•Nadege: leaves dark green, wavy, globular-flattened head, stuffed with a diameter of 19.3 cm and an average weight of 247.3 g (Table, Graphic1,);

Morphological characteristics of lettuce genotypes studied

Table 1.

Variety	Precocity (nr. zile)	Leaves characteristics	Heads form
Larisa (Mt)	50-52 **	curled/ light green	Spherical
Sommer Kragner	58-60**	slightly curled/ green	globular-flattened
Graţia	56-58**	curled / yellowish-green	Spherical
Elsa	48-50*	slightly wavy /green	globular-flattened
Nadege	48-50*	wavy / dark green	globular-flattened
Május Királya	45-47*	medium wavy /green	Spherically slightly elongated

*early genotypes = 45-50 days; ** semiearly genotypes = 52-60 days

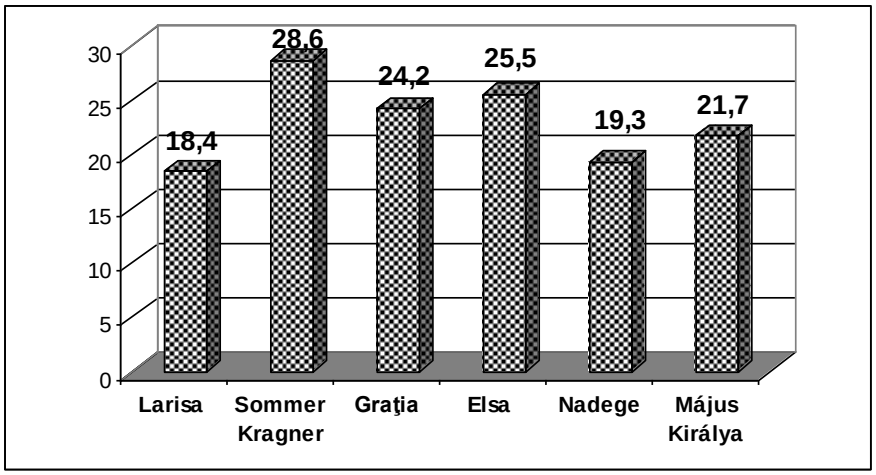

Fig. 1 Diameter of the heads (cm) genotypes of lettuce

•Majus Kiralya: green leaves, medium wavy, slightly elongated heads are spherical with a diameter of 21.7 cm and an average weight of 235.2 g

The yields of the six genotypes of lettuce, obtained from solar culture were between 32.9 t/ha and 40.5 t/ha (Table 2., Fig. 2.).

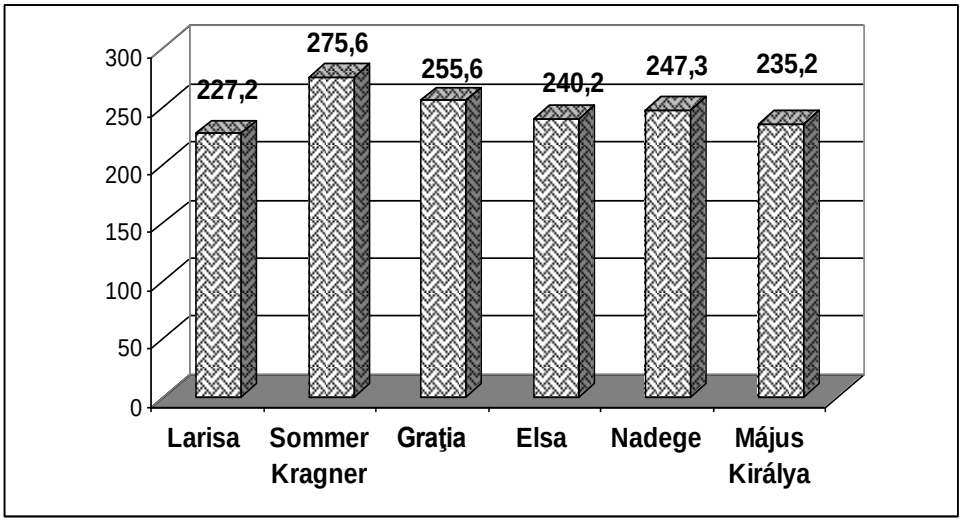

Fig. 2.The weight of the lettuce heads (g) of lettuce varieties

The yeld of lettuce obtained

Table 2.

Nr. crt.	Yield	Yield		± Difference (t/ha)	Signification
		(t/ha)	(%)		
1	Larisa (Control)	32.9	100.00	-	**-**
2	Sommer Kragner	40.5	123.10	+ 7.6	**xx**
3	Graţia	37.8	114.89	+ 4.9	**x**
4	Elsa	35.2	106.99	+ 2.3	**-**
5	Nadege	36.9	112.15	+4.0	**x**
6	Május Királya	34.3	104.25	+ 1.4	**-**

DL 5 % = 3.77 t/ha; DL 1 % = 5.35 t/ha; DL 0,1 % = 7.75 t/ha

According to the analysis of variance, Sommer Kragner variety emerges with the highest average yield of 40.5 t / ha, with a yield difference of 7.6 t / ha, respectivelly 23.10%, compare with Larisa variety, control experience, the ensured statistically significant at distinct levels.

With yield that outperforms the control recorded also Grația variety, by 37.8 t / ha and Nadege, with 36.9 t / ha, increases of 4.9 t / ha (14.89%) and 4.0 t / ha (12.15%) is significant.

Regarding Elsa and Május Királya genotypes, those ones recorded yields level of 35.2 t/ha, or 34.3 t/ha, with yiled differences from variety Larisa (Mt) of only 2.3 t / ha (6.99 %) and 1.4 t / ha (4.25%), not statistically assured of.

Biochemical composition of lettuce is caused by genetic factors, but especially for crops in protected areas, is influenced to a considerable extent, by the specific microclimate conditions and fertilization technology applied. At the lettuce heads harvesting, were determined to highlight the value of the main biochemical and nutritional components of the six genotypes studied (Table 3., Chart 3.).

Table 3.

The biochemical composition of lettuce genotypes grown in greenhouses

Nr. var.	Cultivarul	TDS	SDS	Sugar	Acidity	Vitamin C mg/100 g f.s.	NO_3^- ppm/s.p.
		(% s.p.)			(%malic acid)		
1	Larisa (Mt)	5,94	5,22	3,89	0,21	12,37	1520
2	Sommer Kragner	5,82	5,31	3,07	0,32	11,71	2045
3	Graţia	5,55	5,43	3,27	0,36	10,90	712
4	Elsa	5,85	5,40	3,42	0,28	12,82	1160
5	Nadege	6,04	5,71	3,78	0,39	12,25	830
6	Május Királya	6,16	5,69	3,92	0,28	11,04	940

MAL (Europe Comision Regulation Nr. 1425/2003) = 4500 ppm/s.p.

Total dry matter show values of 5.55% (Gratia) - 6.16% (Május Királya), soluble dry matter to 5.22% (Larisa) - 5.71% (Nadege), sugar 3.07% (Sommer Kragner) - 3.92% (Május Királya), acidity of 0.21% (Larisa) - 0.39% (Nadege) and 10.90 mg/100 g vitamin C

sp (Gratia) - 12.82 mg/100 g s.p. (Elsa). In terms of greenhouse crop, especially vitamin C accumulates in all genotypes, to a lesser extent compared to culture in the field, according to some authors the ascorbic acid content showed no differences resulting from treatments (D. Frezza et al.).

Knowing that the specific genetic of the lettuce is included in group vegetables high in nitrates (N03) [Zuang H., 1982], we determined their potential accumulation in protected crops. Level of nitrate in lettuce is influenced by both genetic factors (cultivar used), environmental (temperature, light intensity, soil moisture) and technological (nitrogen fertilization, etc.). În Regulation (CE) No Europe. 1425/2003 from Commission of August 11/2003, the maximum content of nitrates (mg NO3/kg) at lettuce cultivated in greenhouses and plastic tunels is of 4500. D. Frezza and co. show that the nitrate content was different by the production system, with lower levels found in the FS plants (2002 = 73%, 2003 = 26%), than in the soil culture plants.

At all six genotypes of lettuce grown in the greenhouse, the amount of nitrate ranged from 830 - 2045 ppm N03/sp The highest accumulating level was recorded in the semi early genotypes Sommer Kragner of 2045 ppm, followed by Larisa with 1520 ppm (Table ...). Regarding the nitrites they were not identified.

CONCLUSIONS

From the experimental results on the behavior of growing lettuce in protected crop conditions, are outlined following conclusions and recommendations:

• Elsa, Nadege and Május Királya lettuce genotypes, show early precocity and Larisa, Gratia and Sommer Kragner, semiearly;

• the average weight of the lettuce head, yield element, on the six varieties ranged from 227.2 g (Larisa) and 275.6 g (Sommer Kragner);

• the lettuce yield obtained in the greenhouse ranged from 32.9 to 40.5 t/ha;

• the highest production yield was recorded on Kragner Sommer genotype, 40.5 t / ha, which distinct significantly surpassed the control, with 23.10%, and 7.6 t / ha;

• high yields obtained Gratia and Nadege varieties, of 37.8 t / ha, or 36.9 t / ha, the yield increases compared to the control, 4.9 t / ha (14.89%) and 4 , 0 t / ha (12.15%) is significant;

• regarding the biochemical aspect, lettuce cultivars had a total solids content (SUT) to 5.55% (Gratia) - 6.16% (Május Királya), the soluble dry matter to 5.22% (Larisa) - 5.71% (Nadege) in sugar 3.07% (Sommer Kragner) - 3.92% (Május Királya) and 10.90 mg/100 g vitamin C sp (Gratia) - 12.82 mg/100 g s.p. (Elsa);

• on the six genotypes of lettuce grown in the greenhouse, the amount of nitrate was the maximum permissible limit of WHO standards, which is 2500 ppm;

• large differences in value between the six varieties that were grown under the same conditions of microclimate and where were applied the same level of fertilization, it is due to the interaction between several factors as the fact of genetic potential in the accumulation of nitrate, which is specific to each cultivar, a possible uneven fertilization on soil preparation or time of year.

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