

THE STUDY OF KALE CULTIVARS BY SOWING AND SEEDLING IN AUTUMN CROP

STUDIUL UNOR CULTIVARURI DE VARZĂ KALE PRIN SEMĂNAT DIRECT ȘI RĂSAD ÎN CULTURĂ DE TOAMNĂ

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Abstract. *The Nero di Toscana variety had very good suitability for sowing under drip irrigation conditions, followed by the varieties Dwarf Green Curled S, Larkezungen and Westlander Halbhoher. Under sprinkling irrigation conditions, the emergence of plants was reduced at Larkezungen variety at 50%, Westlander Halbhoher at 12.5% The feature leaf/plant production varied as follows: Larkezungen - 542 g, Westlander Halbhoher - 347 g, Reflex F1 - 336 g, Black magic - 332 g, Dwarf Green Curled S - 322 g and Dwarf Green Curled - 312 g. Total yield (leaves + strains) was 825 g - Larkezungen, 434 g - Westlander Halbhoher, 422 g - Reflex F1, 380 g - Black magic, 372 g - Dwarf Green Curled S, - Fizz, 332 g - Nero di Toscana, 321 g - Pentland Brigg. Other varieties had a yield of less than 300 g / plant.*

Key words: thrips, attack, pepper, biological control, *Amblyseius swirskii*

Rezumat. *Soiul Nero di Toscana a avut o foarte bună pretabilitate la semănatul direct în condiții de irigare prin picurare, fiind urmat de soiurile: Dwarf Green Curled S, Larkezungen și Westlander Halbhoher. În condiții de irigare prin aspersie răsărirea a fost redusă la Larkezungen 50%, Westlander Halbhoher 12,5%. Producție de frunze/plantă a variat astfel: Larkezungen – 542 g, Westlander Halbhoher - 347 g, Reflex F1 - 336 g, Black magic - 332 g, Dwarf Green Curled S – 322 g și Dwarf Green Curled - 312 g. Producția totală (frunze + tulpini) a fost de 825 g – Larkezungen, 434 g - Westlander Halbhoher, 422 g – Reflex F1, 380 g - Black magic, 372 g - Dwarf Green Curled S, 361 g - Dwarf Green Curled, 342 g - Fizz, 332 g - Nero di Toscana, 321 g - Pentland Brigg. Restul soiurilor au avut o producție mai mică de 300 g /plantă.*

Cuvinte cheie: trips, atac, ardei, combatere biologică, *Amblyseius swieskii*

INTRODUCTION

Kale or leaf cabbage (*Brassica oleracea* convar *acephala* (D.C.) Alef.), is cultivated for leaves and it is related to wild cabbage (Chrysopoulos, 2015).

The name comes from "kåle" in Danish, Swedish and Norwegian, "Khal" in German and "khal" or "kall" in Scottish-Welsh (Douglas, 2016).

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The colors of kale cabbage leaves alternate between bright and dark green to green purple or green brown. Kale cabbage has a sweet and slightly pungent flavor, with an astringent flavor due to its high iron content. In countries with a tradition for kale cabbage consumption, the red varieties are used for salads because of their fine taste. The curly kale has a pungent taste, and palm kale has a sweet taste. Smaller leaves are generally finer and sweeter than large ones (Tomar, 2018; Perry, 2018).

The kale cabbage, although almost unknown in Romania, is a high-quality vegetable with the composition: dietary fiber, vitamins: K, C, B1, B2, B3, B5, B6, B9, lutein; mineral elements: iron (more than beef), calcium, magnesium, phosphorus, potassium, manganese, sodium, zinc and glucosinolates with anti-carcinogenic effect. It has a low calories content and can also be used in diets. Consumption of kale kale, strengthens the immune system, protects the body against cancer, lowers cholesterol and blood sugar, slows the aging process of the brain and the whole body, protects against cancerous tumors and sclerosis.

MATERIAL AND METHOD

During 2017 – 2018 period, Kale autumn crop experiments were performed in Vegetable Research-Development Station Bacau - Romania, in order to characterization and evaluate the suitability of kale cultivars by direct sowing and seedling with 11 varieties and hybrids: V1 - Larkezungen, V2 - Westlander Halbhoher, V3 – Scarlet, V4 - Nero di Toscana, V5 - Dwarf Green Curled, V6 - Curly Scarlet, V7 - Fizz, V8 - Dwarf Green Curled S, V9 – Reflex – F1; V10 - Black magic, V11 - Pentland Brigg. Determinations regarding: height of plant, plant diameter, no. leaves on the plant, production leaves / plant and total production (leaves and stem) /plant were made.

During the seedling period the tolerance of the varieties and hybrids for the soil pathogens was studied. The observations were accomplished every 10 days in May and June. The attack estimation was determined using the following indicators:

- Frequency of attack (F%),
- Intensity of attack (I%),
- Degree of attack (DA%).

The obtained results will be used in integrated pest management control in sustainable agriculture in order to increase the biological pest control practices in vegetables.

RESULTS AND DISCUSSIONS

Characterization of kale cultivars

1 – Larkezungen. Variety is from northern Germany, with an average height of 42 cm, with finely curved leaves. The leaves are very resistant to frost and have a very good taste. It can be sown for the autumn culture of the decade of May to the third decade of July. In Bacau climatic condition has very good vegetation and the biggest production (tab. 1).

The behaviour of kale cultivars in autumn culture

No. Var.	Cultivar	Height of plant (cm)	Plant diameter (cm)	No. leaves/plant	Production of leaves / plant (g)	Total production (g)
1	Larkezungen	42	46	51	542	825
2	Westlander Halbhoher	24	51	30	347	434
3	Scarlet	13	12	6	7	8
4	Nero di Toscana	51	37	49	186	332
5	Dwarf Green Curled	28	54	36	312	361
6	Curly Scarlet	27	37	24	76	95
7	Fizz	44	80	35	269	342
8	Dwarf Green Curled S	30	50	20	322	375
9	Reflex F1	38	61	35	336	422
10	Black magic	34	40	28	332	380
11	Pentland Brigg	28	90	24	260	321

2 - Westlander Halbhoher. Variety of German origin, with a lower height, can reach up to 24 cm. The leaves of this variety are very corrugated, their taste improving after the first frost. They can be sown early spring, continuing sowing until the end of July, to have fresh leaves until late in the winter. Height of plant, plant diameter, no. leaves on the plant, production leaf / plant and total production (leaves and stem) /plant are presented in table 1.

3 – Scarlet. The Scarlet variety is not suitable for autumn crops in the Bacău area, having a slow growth, the height being 13 cm, at 100 days after planting (table 1). It has good weather resistance in the field. It produces very decorative, greyish leaves, the color intensifying as the cold weather approaches.

4 - Nero di Toscana. It is a vigorous variety with rich, tasty, succulent, dark green leaves, even in cold days up to minus 6°C. It is harvested when young and tender. It is a very popular vegetable in Italian cuisine and is also known as "Palm Cabbage". It had a medium production – 186 g leaves / plant (tab. 1).

5 - Dwarf Green Curled. It is a compact variety with a height of 28 cm. It has an excellent low temperature tolerance and is one of the best varieties of kale cabbage with free pollination. This variety, due to wintering resistance, can also be used as a winter animal feed.

In our climatic condition the variety had a good growth and medium production– 312 g leaves/plant (tab. 1).

6 - Curly Scarlet. It is a late-mature sort, reaching up to 27 cm tall. The leaves are violet and very creamy. Freezing temperatures intensify the color in a very decorative blue-violet. It can also be used as an ornamental plant. It is a selection of decorative varieties in the French gardens of King Sun, and today it is

more and more common in park design. The production of leaves was low – 76 g leaves/ plant (tab. 1).

7 – Fizz. Leaves grow upright, reaching up to 44 cm high. The variety is ideal for salad, if cultivated at greater distances, will be more productive, larger leaves can be used for cooking. Mature plants are very resistant to low temperatures. The production was medium – 269 g leaves/plant.

8 - Dwarf Green Curled S. The variety has dark green, strongly curved leaves. The plants are compact, with a height of 30 cm. The leaves are very nourishing, their nutritional value being reconsidered in recent years. This has led to a strong expansion in culture lately, due to very high nutritional values. The variety is easy to cultivate, very productive, with a multitude of leaf shapes and colors. In our experimental condition has a medium production – 322 g leaves/plant (tab. 1).

9 - Reflex - F1. The hybrid obtained lately, Reflex F1 has intense, juicy and nutritious green leaves, which maintain their color for a long time, without yellowing. It reaches the height of 38 cm. Can be used for food preparation or as a salad ingredient. Resistance to wintering causes the plant to recover its vegetation in the spring. In our climatic condition the production of Reflex F1 was 336 g/plant (tab. 1).

10 - Black magic There is a selection of "Nero di Toscana" kale cabbage. The leaves are dark green, narrow, well textured. Both the very young, light leaves, but also the long leaves, deeply blanched, dark green, with a rich flavor can be used. Very nourishing, Black Magic Kale (also known as Dinosaur Kale, Tuscan Kale and even Black Flat Cabbage is a particularly valuable gastronomic choice, especially during the winter period. The leaves can be harvested both small (only 6 centimeters or less) or larger, for chips and other dishes. Their flavor is strong and full of vitamins and nutrients. Black magic had a good vegetation with 34 cm height of plant, 40 cm plant diameter, 28 leaves/plant, 332 g leaves/plant, 380 g total production (tab. 1).

11 - Pentland Brigy The leaves are less curly and lighter than the rest of Kale cabbage varieties. The taste is sweet and aromatic, the variety being specially created for texture and aroma, Pentland Brigy produces leaves until November and shoots like broccoli in spring. Variety is a selection resulting from the crosses between Scotch and Thousand Headed being much finer, sweeter and more succulent. It also produces shoots that can be harvested staggered throughout the growing season. Leaves can be harvested in a young phase, when the plant is only 5 cm high. The new leaves will form continuously. In October, the leaves from the top of the plant can be removed in order to form shoots that will be harvested from February to May, when shoots of 10-15 cm long and tender can be chosen. The mature plants survive at -12°C, green shoots can be found under the snow.

The vegetation of plants was good, with height of plant of 28 cm, plant diameter 90 cm, 24 leaves on the plant, 260 g production leaves / plant and 321 g total production.

Study of the suitability of kale cultivars to direct sowing in the field

The results (fig 1) show that only the Nero di Toscana variety had a very good suitability for sowing directly under drip irrigation (100% emergence), followed by the Dwarf Green Curled S, Larkezungen and Westlander varieties with 69.2% of emergence in the condition of direct sowing in field and drip irrigation. Under sprinkle irrigation conditions the germination was reduced: Larkezungen 50%, Westlander Halbhoher 12.5%, or nonexistent, to all the other cultivars.

Study of the cultivar tolerance at the attack of soil-borne diseases

The tolerance of cabbage cultivars to the attack of soil-borne pathogens is shown in fig. 1. It is noticed that: Nero di Toscana, Reflex F1, Black magic did not show pathogen attack in the seedling phase, the percentage of healthy plants being 100%. The varieties: Dwarf Green

Curled, Curly Scarlet, Fizz, and Dwarf Green Curled S had over 90% of healthy plants, followed by: Larkezungen and Westlander Halbhoher with over 89% of non-pathogen-free plants. Scarlet varieties 50.2% and Pentland Brigg 75% were susceptible in the seedling phase to pathogen attack.

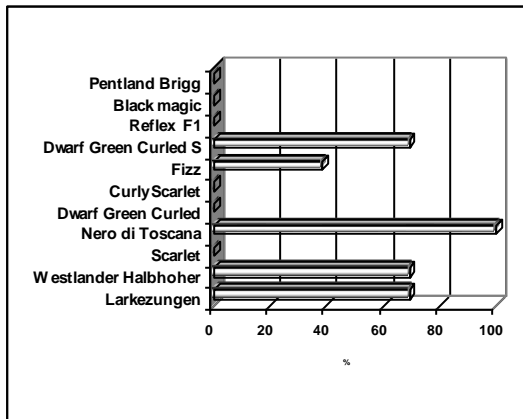


Fig 1 The suitability of kale cultivars to direct sowing in field – drip irrigation

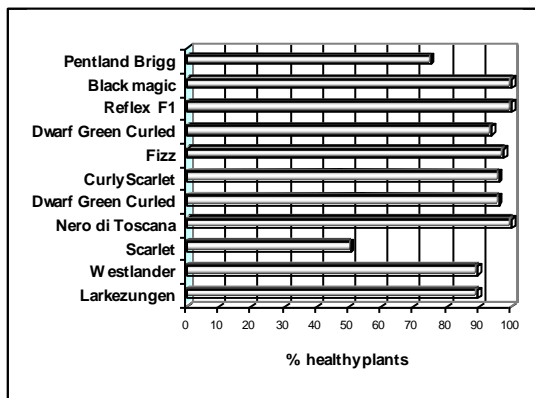


Fig. 2 % of healthy plants

CONCLUSIONS

The tested kale cultivars had different results. Height of the kale plants ranged between 13 cm (Scarlet) and 51 cm (Nero di Toscana). The diameter of the rosette ranged between 12 cm (Scarlet) and 90 cm (Pentland Brigg). The largest leaf / plant production was recorded in the Larkezungen variety - 542 g, followed by Westlander Halbhoher 347 g, Reflex F1 336 g, Black magic - 332 g, Dwarf Green Curled S - 322 g and Dwarf Green Curled - 312 g. The other varieties had a yield of less than 300 g of leaf / plant. The total production was: 825 g - Larkezungen, 434 g - Westlander Halbhoher, 422 g - Reflex F1. The other of the varieties had a total production of less than 400 g / plant.

The suitability of kale cultivars to direct sowing in the field was different. Only the Nero di Toscana variety has a very good suitability for sowing directly under drip irrigation (100% emergence), followed by the Dwarf Green Curled S, Larkezungen and Westlander Halbhoher varieties with 69.2% of emergence in the condition of direct sowing in field and drip irrigation. Under sprinkle irrigation conditions the emergence of plant was reduced: Larkezungen 50%, Westlander Halbhoher 12.5%, or nonexistent, to the other cultivars.

The tolerance at the attack of soil-borne diseases varied in large limits. Nero di Toscana, Reflex F1, Black magic did not show pathogen attack in the seedling phase, the percentage of healthy plants being 100%. The varieties: Dwarf Green Curled, Curly Scarlet, Fizz, and Dwarf Green Curled S had over 90% of healthy plants, followed by: Larkezungen and Westlander Halbhoher with over 89% of non-pathogen-free plants. Scarlet varieties 50.2% and Pentland Brigg 75% were susceptible in the seedling phase to pathogen attack.

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