The promising variety of European radish Ophelia grown in protected and open ground conditions

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Abstract. Among the existing variety of vegetables, table root crops are very popular both in the Russian Federation and abroad: carrots, beets, radishes, turnips and parsnips. These crops are sources of natural vitamins; due to low prices for marketable products and seeds, they have been cultivated in Russia. Among all vegetables, radish ranks first by the content of potassium, magnesium and calcium salts; it also contains iron and phosphorus. When growing new varieties and hybrids of radish suitable for the mechanized harvesting, one should pay attention to the strength of leaves, the erectness of leaf rosettes, the uniformity of immersion in the soil and the easy pull-out of root crops. The collection of root crops Raphanus sativus L. VIR is annually replenished with numerous samples of the latest selection, primarily from China, Japan, and the Netherlands, as well as samples collected in Central Asia and the Caucasus. The main task of greenhouse vegetable growing is year-round or off-season production of high-quality vegetables (daikon, radish and turnip). As a result of the research, a new variety of European summer radish Ophelia was created for growing in protected and open ground conditions. It is an early ripening variety: it takes 33-38 days from full germination to the beginning of economic ripeness. Leaf rosettes are of medium size, light green. The vegetable has white elliptical roots. The Base is rounded. The pulp is white and opaque.

1. Introduction
Among the existing variety of vegetables, table root crops are very popular both in the Russian Federation and abroad. These are carrots, beets, radishes, turnips, parsnips. These crops are sources of natural vitamins; due to low prices for marketable products and seeds, they are cultivated everywhere in Russia [1].

Among all vegetables, radish ranks first by the content of potassium, magnesium and calcium salts; it also contains iron and phosphorus [2].

In Russia, European and Chinese radish and European summer and winter radish are of the greatest economic importance. It is profitable to grow European radish in winter and spring and Chinese radish - in autumn. In recent years, daikon has been gaining more and more popularity due to its higher yield, nutritional value and new varieties selected for various regions of Russia. Many local varieties are donors of valuable traits. For example, winter radish (white and black, round) has a high yield, a high content of sugars and ascorbic acid, and can be stored for a long time (the best variety is Graivoronskaya). Summer radish (grade Odessa 5) has early maturity [3].
More than 30 varieties and hybrids of F1 root crops have been selected by the Federal Research Center (Queen Margo, Feya, Aria, Sonata, Myth and Moor). They are early ripening and can be cultivated in low light conditions in winter glazed greenhouses (January-February), film greenhouses, under small-sized shelters and in fields in all zones [4]. Supporting selection technologies were developed in the primary seed production of vegetable roots [5].

The collection of Raphanus sativus L. VIR is annually replenished with numerous samples of the latest selection, primarily from China, Japan, and the Netherlands, as well as samples collected in Central Asia and the Caucasus [6].

When selecting new varieties and hybrids of radish suitable for mechanized harvesting, one should pay attention to the strength of leaves, the erectness of leaf rosettes, the uniformity of immersion in the soil and the easy pull-out of root crops [7].

The main task of greenhouse vegetable growing is year-round or off-season production of high-quality vegetables (daikon, radish and turnip). Optimal conditions are created for the growth and development of plants, with the help of which an artificial microclimate can be created [8].

In the Non-Chernozem zone of Russia, summer radish seeds are obtained during one year with the transplantation of mother plants in film greenhouse, but only to obtain original and elite seeds of a particular variety [9].

2. **Problem Statement**

Currently, the State Register includes 8 varieties of European summer radish. In Russia, there is a shortage of summer radish varieties for cultivation in greenhouses which could be resistant to flowering and produce high yields.

3. **Research Questions**

To solve the goal, the following tasks were set:

1. To evaluate samples in the nursery of source materials;
2. To evaluate the samples by their main morphological economically valuable traits. To identify the best sample.
3. To submit documents for including a new variety in the State Register of Selection Achievements Permitted for Use

4. **Purpose of the Study**

The aim of the research is to create an early ripening variety of European summer radish with a yield of more than 4.0 kg / m², resistant to flowering and flabbiness.

5. **Research Methods**

The selection of European summer radish was carried out in protected and open ground conditions by the branch of the Federal Research Center. Seeds were sown in greenhouses since 20 to 25 March. The plot area was 10 m² (with a 10x10 cm sowing scheme). The Mayskaya variety was used as a standard.

When conducting the research, we were guided by the method of field experiments (Litvinov, 2011).

6. **Findings**

In the selection from Russian varieties, a collection of selection numbers was obtained. The selection was carried out on the basis of resistance to stalking, high marketability and productivity, and shape uniformity. After testing in the control and competitive nurseries, sample 20 (Ophelia) was transferred to the State Tax Inspection.

During the growing season, phenological observations were carried out. The following phases of growth and development were observed: the sowing date - emergence of seedlings, appearance of the first true leaf, bunch ripeness.

The emergence of mass shoots appeared on the 9-14th day. According to the duration of the growing season, all samples were early ripening (40–46 days).
The length of the growing season was determined by the hereditary characteristics of the variety, the place and growing conditions.

The sample isolated differs from the original variety by its uniformity in shape, length, diameter of the root crop, a compact leaf rosette, which forms a root crop under the conditions of short and long daylight hours (Table 1).

### Table 1. Characteristics of varieties grown in protected ground conditions (2019 and 2020)

| Variety   | Indicator                        | Length of the leaf | number of leaves, pcs. | root crop length, cm | CV% | root crop diameter, cm | CV% | Shape index |
|-----------|-----------------------------------|--------------------|------------------------|----------------------|-----|------------------------|-----|-------------|
| Ophelia   |                                   | 28,4               | 7                      | 5,5                  | 6,5 | 4,0                    | 6,1 | 1,37        |
| Maiskaya  |                                   | 38,1               | 9                      | 5,8                  | 18,5| 5,6                    | 17,0| 1,03        |

The yield was harvested on April 29th. By the leaf rosette, the Maiskaya variety exceeded the Ophelia variety; the leaf length varied from 37.2 to 39.0 cm. The Ophelia variety had a more compact tops, the length varied from 27.4 to 29.5 cm, the leaf width was 6.0 - 8.5 cm.

The parameters of the Ophelia root crop were as follows: the length varied from 4.9 to 5.5 cm, the diameter varied from 4.0 to 4.5 cm, and the shape index varied from 1.29 to 1.37. Root crops had a rounded oval shape.

The coefficient of variation of the length varied within 6.5%. The coefficient of variation of the root crop diameter changed to 6.1%. The coefficient of variation of the shape index ranged up to 5.9%. Thus, the length, diameter and shape index did not change much, which indicates the evenness of the Ophelia variety.

In the Maiskaya variety, the length of the root crop ranged from 5.3 to 6.0 cm, the diameter ranged from 4.7 to 5.8 cm, and the shape index ranged from 0.95 to 1.06. The roots were rounded and rounded-oval.

The coefficient of variation of the length in the Maiskaya variety ranged up to 18.5%. The coefficient of variation of the root crop diameter was up to 17.0%. The variation coefficient of the shape index changed to 20.2%.

The mass of marketable root crops in the Maiskaya variety ranged from 38.0 to 40.0 g, in the Ophelia variety it ranged from 47.0 to 50.0 g. The standard yield was 3.8 - 4.0 kg / m², and in the Ophelia variety it was 4.7-5.0 kg / m² (Table 2).

### Table 2. Economically valuable traits of the European variety Ophelia radish (2019 and 2020)

| Variety   | Economically valuable traits |
|-----------|-----------------------------|
|           | yield, kg / m² | root vegetable weight, g | share of the root crop in the mass of the plant, % | marketability, % |
| Ophelia   | 4,7            | 50                      | 64,5           | 63,1           | 90,8 | 92,5 |
| Maiskaya  | 3,8            | 40                      | 39,4           | 40,7           | 68,4 | 70,9 |

The marketability of Ophelia varied from 90.8 to 92.5%. The percentage of undertraining ranged from 7.5 to 8.2%. The marketability level of the Maiskaya variety varied from 68.4 to 70.9%.

The ratio of the root crop weight in the total plant weight in the Ophelia variety varied from 63.1 to 64.5, while in the Maiskaya variety this indicator varied from 39.4 to 40.7%. On these grounds, Ophelia had significant advantages over the standard.
Table 3 shows data on the chemical composition of root crops of European summer radish varieties. An analysis carried out in 2019 showed that the root vegetables of summer radish contain 4.0 - 4.7% of sugars.

Table 3. Chemical composition of root crops of European summer radish, 2019

| No | Variety      | Dry matter, % | Amount of sugars, % | Ascorbic acid, mg per 100 g of raw material |
|----|--------------|---------------|---------------------|--------------------------------------------|
| 1  | Ophelia      | 7,5           | 4,7                 | 15,5                                       |
| 2  | Maiskaya st  | 7,1           | 4,0                 | 13,0                                       |

By this indicator, Ophelia was better. The dry matter content ranged from 7.1 to 7.5%. Ophelia was better in terms of dry matter. The samples contained vitamin C (13.0-15.5 mg / 100 g).

It was revealed that Ophelia is better than Maiskaya by all the parameters. It is more uniform in shape with a compact leaf rosette.

The yield showed a stable excess of Ophelia over the standard (Table 4).

Table 4. Cost-effectiveness of Ophelia grown in open ground conditions (2020)

| Indicators                        | Measurement unit | Summer radish varieties |
|-----------------------------------|------------------|-------------------------|
| Yield                             | kg/m²            | 5,0                     |
| Sales amount at an average wholesale price of RUB 45 / kg | rub/m² | 225,0 180,0 |
| Production cost                   | rub/m²           | 85,0 85,0               |
| Profit                            | rub/m²           | 140,0 95,0             |
| Additional profit                 | rub/m²           | 45,0 0,0               |
| Profitability level               | %                | 164.7 111.8             |

The European radish Ophelia grown in 2020 showed a profitability of 164.7%. The profitability of the Maiskaya variety was 52.7% -111.8%. Additional profit amounted to 45 rubles / m².

Thus, the Ophelia summer radish is economically viable.

7. Conclusion
A new variety of European summer radish Ophelia was created for growing in protected and open ground conditions. It is an early ripening variety. It takes 33-38 days from full germination to the beginning of economic ripeness. Leaf rosettes are of medium size, light green; the roots are white, elliptical in shape with a rounded base. The pulp is white, opaque. The average weight of the root crop is 47 g, the yield is 4.4-4.7 kg / m². It has good taste properties and is resistant to flowering.

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