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PHYTOSANITARY CONDITION OF RAPESEED IN THE REGION OF KAVARNA

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Abstract

Rapeseed is grown because of the seeds which are rich in fat (30-49%). This makes it the most important plant rich in oil and protein in temperate climate zone. Thanks to this, in the last few decades rapeseed has taken the honorable third place in the world production of vegetable oils. The aim of the present study is to establish the phytosanitary condition of the cultivated rapeseed in the area of the Kavarna town. The present study includes four cultivars of rapeseed grown in the area. As a result of the study it was found that the studied cultivars are characterized by high winter hardiness - 90.5% and good productivity 359.8 kg/da. The rapeseed oil reaches an average content of 47.8%. The low content of glucosinolates in the seeds of rapeseed cultivars 13.3 µmol/g allows quality oil production. The average erucic acid content is 1.31%. Economically important fungal diseases in the autumn for the area of Kavarna town are Phoma (Leptosphaeria maculans), Alternaria (Alternaria brassicae) and Powdery mildew.

Key words*: rapeseed, productivity, seeds, cultivars, oil.*

INTRODUCTION

Rapeseed (*Brassica napus L.)* belongs to the family *Brassicaceae*, genus *Brassica*. It is grown for seeds that are rich in fat (30-49%). This makes it the most important plant rich in oil and protein in the temperate zone. Thanks to this, in the last few decades rapeseed has taken an honorable third place in the world's vegetable oils. The waste products, - in this production – cake and meal - contain about 33 % protein and 10 % fat and are valuable feed for farm animals. Meal from eruicless cultivars is close to soybean meal in terms of forage value.

In recent years, rapeseed oil is no longer used only for food, but also as fuel. The reduction of the content of glucosinolates in rapeseed from 80 µmol/g. to the limit below 10 µmol/g, allows the use of waste products (cake, meal) for feed. These cultivars are marked with 00 (two - zero, canola) with a very low content of eruic acid.

The local production is facing reconstruction. Increased demand for alternative energy sources has created a stable market. Europe's need for rapeseed is growing dynamically. Along with the supply of renewed cultivars and hybrids, the production technology is becoming more and more intensive. In recent years, between 1.3 and 1.8 million decares of rapeseed are harvested annually in Bulgaria (Raykov et al., 2009).

The growth cycle of winter oilseed rape takes place in autumn and spring and goes through the following few characteristic phases. The first two phases of development take place in autumn. Spring growth is evident in the months of February - March, when the air temperature is permanent + 5°C or more (Kyuchukova, 1983).

Winter oilseed rape has a good regenerative ability and can relatively well restore the loss of leaf mass from winter. When growing winter oilseed rape, there are certain climatic requirements and requirements for the type and condition of the soil (Tonev, 2000; Tonev, 2006). Climatic requirements: these requirements include the needs of the crop for heat, light and moisture. Rapeseed requires a temperate climate. Rapeseed frost hardyness sometimes helps in the successful weed control (some of the main weeds accompanying this crop do not tolerate such low temperatures) (Fetvadjieva et al., 1988).

Rapeseed develops a large mass and needs a lot of water, especially during budding and flowering, as well as the growth of pods. The seeds germinate when absorbing 80-90% of water from their mass, and during flowering

this crop requires high atmospheric humidity, nearly 80 %. Average annual rainfall of 550-700 mm is favorable for achieving optimal yields In our country rapeseed is attacked by many diseases, mainly fungal. In the past, rapeseed was considered a crop that did not need fungicidal protection and almost no attention was paid to rapeseed diseases. Currently, in rapeseed crops, due attention should be paid to fungal diseases, especially Foma and White rot (Nankov, et al., 1994; Nakov et al., 1999; Shindrova, 2015).

Some rapeseed pathogens are polyphagous, respectively, they can be transmitted to it from other crops (*Sclerotinia sclerotiorum, Botrytis cinerea,* soil pathogens), but most of the rapeseed pathogens are specific to plants of the cruciferous family - *Brassicaceae* (Bobev, 2009b).

The purpose of this study is to establish the phytosanitary condition of cultivated rapeseed in the region of Kavarna.

MATERIALS AND METHODS

In the last few years, in the region of Kavarna, cultivars of Rapul (a German company with a representative in Bulgaria) have been sown. Our study included four cultivars grown in the area, namely Sherpa, Dalton, Edimax and Shrek. The company's portfolio presented cultivars with the following selection indicators. Sherpa cultivar is characterized by very good frost hardiness and rapid recovery of spring growth. This is a universal hybrid, suitable for late sowing, with the application of minimum tillage technologies, as well as for growing in less favorable conditions. This is due to its adaptability and the powerful strong root system of the hybrid, which reaches a depth of 2 m. as a total length of the roots, and the lateral branches and active root pappus, absorb nutrients and water to the maximum efficient way. The Dalton cultivar is a representative of a new generation of Rapul hybrids. It is selected especially for the conditions of Southern Europe and combines many advantages necessary for the successful production of rapeseed in Bulgaria. One of them is disease resistance in particular to Foma, thanks to the gene Rlm 7, thus preventing the negative effects on the yield due to infection with the fungus *Foma Lingam.* Another extremely important advantage of the cultivar is the strong growth in the autumn, thanks to which the hybrid is extremely suitable for late sowing, and even then it guarantees optimal development for overwintering.

Edimax cultivar is suitable for all soil types and different production systems – either extensive or intensive. It has an extremely fast initial start in autumn, as a result of which the hybrid is suitable for medium late and late sowing dates. This cultivar is selected for cultivation in continental conditions. Its excellent frost hardiness and drought and stress tolerance makes it suitable for growing in all regions of the country.

Cultivar Shrek is very suitable for later sowing dates. Thanks to the quick start, we observe a very good autumn development, without the risk of stem outgrowth. Its genetics makes it extremely suitable for the "golden" autumn conditions of Bulgaria. The pods are significantly longer and over 20% heavier than those of other hybrids. This is of great importance in regions with severe droughts or in cases of late spring frosts, because the seeds in the other pods reach a higher absolute mass and thus we get a high yield, regardless of adverse conditions.

Kavarna municipality has flat to - hilly terrain, with slightly vertical and horizontal dissection, the predominant slopes are from 3 to 5 degrees. The municipality covers the eastern part of Danube plain - the southern parts of the Dobrudzha plateau, and parts of the Black Sea coast – coasts and shelf. The territory's coast, has clearly expressed old and modern abrasion and accumulation processes. From Cape Shabla to Cape Kaliakra, the abrasion has formed numerous caves, underwater and surface clips. Kavarna municipality belongs to the area of the temperate – continental climate, which is formed under the direct influence of the Black Sea. The region is relatively cold for its latitude with average temperatures of + 0.8 °C in January and 22.3°C in July. The annual temperature amplitude is 21.7-21.9°C. The average annual air temperature is +11.8°C. The region belongs to the driest regions of Bulgaria. The total average annual rainfall is in the range of 411-480 mm. The maximum precipitation amounts for the region of Kavarna municipality

are marked in autumn, the minimum in spring and summer. (www. goverment.bg.net, www. Meteoshum. bg.net).

The area is completely occupied by chernozem soils with their varieties - carbonaceous, residual - forest and typical. Chernozem soils have strong humus horizon, fertility, with a slightly alkaline to neutral soil reaction.

In our study, the examined cultivars were located in the land of Kavarna town. The area of the individual cultivars was within 150-180 da. The crops are grown using the traditional technology. Sowing was carried out on 25 August. The sown hybrids are grown for the first time by the company. The inspection of the cultivars was carried out three times, in the autumn after the germination of the crop (October - 15), in the month of April (April 20) and along with the ripening of the crops (June 20). To determine the frost hardiness of the cultivars we used the meters, which were placed by the agricultural company. Reporting took place in the autumn, when we determined the disease attack, and also in the spring. Reporting to disease attack was done through an individual assessment of 100-150 plants. We analyzed symptomatic picture of randomly selected plants. A five-point scale was used to score from zero to 100%.

0 - no disease
\+ - 0% to 25% - weak disease attack
\+ + - 26% to 50% - average disease attack
+++ - 51% to 75% - severe disease attack
++++ - 76% to 100% - very strong disease attack.

We made visual diagnosis based on the symptoms of the disease. For specific studies, visual diagnostics was supported by the use of specialized guides and reference books (Bobev, 2002; Bobev, 2009a; Stancheva, 2002; Stancheva, 2006).

The average yields were reported after the harvest, the data was kindly provided by the producer. The technological markers of the raw material quality are checked by the companies that bought the rapeseed. The aim of the present study is to establish the phytosanitary condition of the cultivated rapeseed in the area of Kavarna town.

RESULTS AND DISCUSSIONS

Rapeseed is a risky crop for our country. It is mainly due to the fact that the critical temperature at which rapeseed freezes is minus 17 degrees. Each year the frost leads to lighter losses in different regions. Large losses are typical for long winters with severe cold and temperature fluctuations, especially after a warm autumn. Figure 1 presents the results of the examination of the cultivars for their frost hardiness. In the spring, while reporting the diseases, we counted the overwintering plants and from the difference in the autumn we calculated the percentage of frost hardiness. The results of our study show that the highest percentage (93.6%) overwintered plants is in Edimax cultivar, which was confirmed by the portfolio of the cultivar. The other cultivars show values close to the average for the group, which is 90.5%. This data gives us reasons to conclude that the cultivated cultivars of rapeseed in Kavarna region show good frost hardiness.

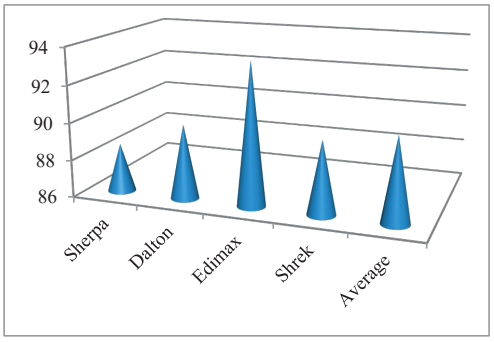

Figure 1. Frost hardiness of rapeseed cultivars in %

To determine the productive potential of rapeseed cultivars we take into account the obtained average yields in kg/da, grain (Figure 2). For the studied period the average yield of seeds from the studied cultivars reached 359.8 kg/da. The highest average seed yield per decare was obtained by the Sherpa cultivar - 388.1 kg/da. The superiority over the average for the group is 7.7%. Edimax cultivar (361 kg/da) has a relatively lower yield.

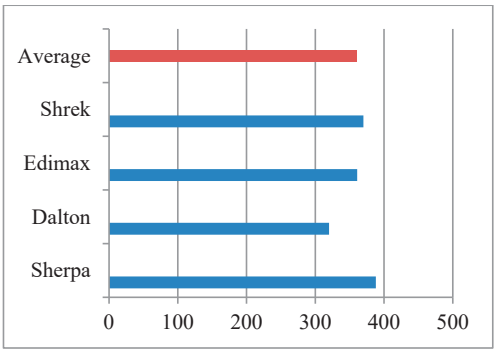

Figure 2. Average rapeseed yields in kg/da

The technological qualities of modern cultivars are evaluated by the content of rapeseed oil in the seeds. Figure 3 presents graphically the studied cultivars data on the oil content in percentage.

For the studied hybrids, the average oil content in the seeds is 47.9%. The highest oil content in the seeds (49.0%) was found in Edimax cultivar where the excess is 10.1 % over the average for the group.

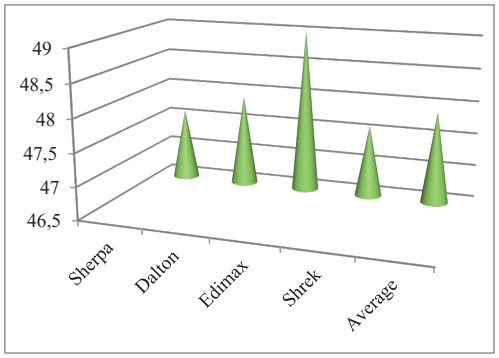

Figure 3. Oil content in rapeseed in %

With the progress of rapeseed selection and the establishment of new high standards in the quality of rapeseed, which is marked with "00'', the content of erucic acid in the oil must be below 2 % and 25 µmol/g glucosinolates in the grain. It is believed that the lower the content of glucosinolates (below 15-25 µmol/g) in rapeseed, the better the quality of the oil and meal obtained. Our study of these indicators is presented in figures 4 and 5. The content of glucosinolates in rapeseed for the four cultivars is 13.1 µmol/g. The lowest content of glucosinolates in the seed was reported in cultivar Edimax 11.8 µmol/g. In the case of Sherpa hybrid, this content is 13.8 µmol/g. Approximately the same values were found for Shrek hybrids - 13.6 µmol/g (Figure 4).

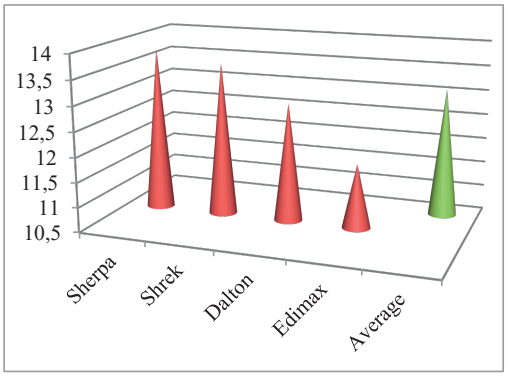

Figure 4. Content of glucosinolates in rapeseed in µmol/g

Figure 5 presents the results of the content of erucic acid in the oil of the studied rapeseed cultivars. It is known from the literature that rapeseed oil contains erucic acid, which is toxic to humans and animals.

Modern selection using the method of genetic engineering creates cultivars, including genetically modified ones, in which the content of erucic acid is about and below 2%.

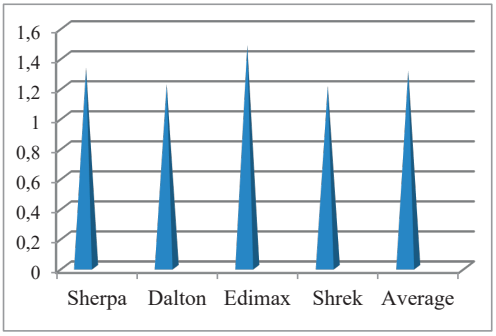

Figure 5. Erucic acid content of rapeseed, %

The oil from these cultivars is almost harmless for humans and is mainly used for margarine production. We could obtain results through chemical analysis for the studied rapeseed hybrids and they show that the highest erucic acid content of 1.48% is found in Edimax cultivar. Dalton (1.22%) and Shrek hybrids (1.21%) have approximately similar content.

The average erucic acid content for the group was 1.31%.

The obtained results for the productive and quality indicators of the studied cultivars show that they are characterized by good productivity as the average seed yield is 359.8 kg/da. The low content of glucosinolates in rapeseed - 13.1 μmol/g, allows the production of quality oil. The highest content of erucic acid was found in Edimax cultivar - 1.48%. The average erucic acid content is 1.31%. In our country, rapeseed is attacked by a number of diseases - some of them with economic influence are: sclerotic rot, dry stem rot (phomosis), black leaf spots (black spots or alternaria), mold, light leaf spots, powdery mildew and others.

We tried to make a tabular outline of the main diseases of rapeseed crops in late autumn, spring and the end of the growing season.

Table 1 shows the estimates of the rapeseed disease attacks on the studied rapeseed cultivars in autumn. Timely sowing and good pre-sowing soil preparation allowed the rapeseed crop to develop normally, which is a prerequisite for good overwintering of the crop. The data show that a relatively higher attack was reported by the diseases Foma, Alternaria and Powdery mildew. Analyzing the results, we found that the Dalton cultivar showed very high resistance to Foma and Shrek has resistance to Powdery mildew. In the autumn there was no attack of Sclerotinia and very weak attack of fungal diseases Gray rot and White rust.

Table 1. Rapeseed disease attacks in autumn

Diseases	Sherpa	Dalton	Edimax	Shrek
White rot (*Sclerotinia sclerotiorum*)	0	0	0	0
Foma (*Phoma lingam)*	+	0	++	++
Black spots or Alternaria (*Alternaria brassicae*)	++	++	++	++
Mold (*Peronospora parasitica*)	0	0	+	+
Gray rot *(Botryotinia fuckeliana*)	0	0	0	+
White rust (*Albugo candida)*	0	+	0	0
Powdery mildew (*Erysiphe cruceferarum*)	+	++	+	0
Cilindrosporiosis (*Pyrenopeziza brassicae)*	0	0	+	+

In the spring we reported the attack of fungal diseases on the studied hybrids (Table 2).

From the presented data it is evident that in the spring the cultivars were attacked mainly by the diseases foma (*Phoma lingam*), gray rot (*Botryotinia fuckeliana*) and cilindrosporiosis (*Pyrenopeziza brassicae)*.

Table 2. Rapeseed disease attacks in April

Diseases	Sherpa	Dalton	Edimax	Shrek
White rot *(Sclerotinia sclerotiorum)*	+	0	0	0
Foma (*Phoma lingam)*	+	0	+	++
Altarnaria, black spots (*Alternaria brassicae*)	0	+	0	+
Mold (*Peronospora parasitica*)	0	0	0	+
Gray rot (*Botryotinia fuckeliana*)	++	+	++	+
White rust (*Albugo candida)*	0	+	0	0
Powdery mildew (*Erysiphe cruceferarum*)	+	+	+	0
Cilindrosporiosis (*Pyrenopeziza brassicae)*	+	++	+	+

The strongest attack was made by the fungal disease foma. The second place in terms of damage is gray rot. This disease was found at the base of the young stems and parts of the leaves where there were rotten areas as well as gray sticker. Dalton cultivar also showed complete resistance to Foma in the spring.

The last disease report was taken at the end of the growing season. Reporting coincided with the end of flowering with over 60% of the pods already formed.

Table 3. Rapeseed disease attacks in June

Diseases	Sherpa	Dalton	Edimax	Shrek
White rot (*Sclerotinia sclerotiorum*)	++	++	+	++
Foma (*Phoma lingam)*	+	0	+	+
Black spots or Alternaria (*Alternaria brassicae*)	++	++	++	++
Mold (*Peronospora parasitica*)	++	++	++	+
Gray rot *(Botryotinia fuckeliana*)	0	0	0	0
White rust (*Albugo candida)*	0	0	0	0
Powdery mildew (*Erysiphe cruceferaru*)	+	0	+	0
Cilindrosporiosis (*Pyrenopeziza brassicae)*	0	0	0	0

White rot, Mold and Alternaria showed the highest degree of development. Estimates of Alternaria attacks show that all the cultivars were almost equally affected by the disease. The highest harmful effect of the disease was observed in young pods, which were deformed, wrinkled, cracked, so that it leaded to immature seeds fall. The studied cultivars showed very good resistance to fungal diseases such as Gray rot, White rust, and Cilindrosporiosis at the end of the growing season.

CONCLUSIONS

The studied cultivars are characterized by high frost hardiness - 90.5% regarding the questioned year and the region's climatic conditions.

The studied cultivars have relatively good productivity, on average 359.8 kg/da. Sherpa cultivar is characterized by the highest yield (388 kg/da) compared to the others.

The rapeseed oil content reached an average of 47.9% for the group. The low content of glucosinolates in the seeds of rapeseed cultivars - 13.3µmol/g, allows the production of quality oil.

The highest content of erucic acid was found cultivar Edimax cultivar - 1.48%. The average erucic acid content for the group was 1.31%.

Economically important fungal diseases in the autumn for the area Kavarna town are Foma, Alternaria and Powdery mildew. At the end of the growing season, the highest level of development is found for diseases, White rot, Alternaria and Mold.

It was found that the studied cultivars showed very good resistance to fungal diseases, such as Gray rot, White rust and Cylindrosporiosis at the end of the growing season.

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