АГРОХИМИЯ, АГРОПОЧВОВЕДЕНИЕ, ЗАЩИТА И КАРАНТИН РАСТЕНИЙ / AGROCHEMISTRY, AGROSOIL SCIENCE, PLANT PROTECTION AND QUARANTINE

DOI: https://doi.org/10.60797/JAE.2024.49.2

DISEASES OF SALAD MUSTARD (*BRASSICA JUNCEA (L.) CZERN*) AND *ERUCA SATIVA MILL.* DURING THE VEGETATION

Research article

Zemyakhin M.S.[1, *], Leunov V.I.[2], Sokolova L.M.[3], Kornev A.V.[4], Bagrov R.A.[5]
[2] ORCID : 0000-0001-9445-5636;
[3] ORCID : 0000-0001-6223-4767;
[4] ORCID : 0000-0003-1373-3302;
[5] ORCID : 0000-0001-5120-5039;
[1, 2] Moscow Timiryazev Agricultural Academy, Zhukovsky, Russian Federation
[3, 4, 5] All-Russian Research Institute of Vegetable Growing - branch of the Federal Scientific Center of Vegetable Growing, Moscow, Russian Federation

* Corresponding author (sun-tci[at]yandex.ru)

Abstract

This article examines the infection of green crops of the cabbage family with mustard lettuce (*Brassica juncea* (L.) Czern) and *Eruca sativa* lettuce (*Eruca sativa* MILL.) with pathogens during their growing cycle. The article consists of an introduction, the purpose and objectives of the study, research materials, description of methods for establishing experience and conducting analysis to identify pathogens, discussion, conclusion and references. The introduction provides a literary overview of the above-mentioned crops, their growing sites for obtaining leaves and pathogens common in these crops. The Goals and objectives section describes the purpose and objectives of the study, respectively. The methodology specifies the scheme and procedure for conducting the experiment within the framework of the study, the place and time of the experiment, the sowing scheme and the preparations used. The method of analysis describes in detail the method of analysis for the detection of pathogenic microorganisms, the methods by which the biochemical analysis was carried out. The Results section presents the results of a phytopathological analysis, during which it was found that pathogens of the genera *Alternaria* and *Fusarium* were found on the organs of agricultural crops. It has also been found that mustard lettuce plants are affected by these pathogens less, unlike *Eruca sativa.* The findings indicate that the pathogens belong to fungal diseases, and the fact that mustard salad plants are more resistant to diseases of a fungal nature than *Eruca sativa.* The novelty of this work lies in the fact that this study can help in understanding the nature of diseases affecting these green crops and help develop measures to protect green crops from them.

Keywords: Eruca sativa, mustard, Alternaria, Fusarium, seeds, vegetative plants, genotype, insecticide.

ЗАБОЛЕВАНИЯ ГОРЧИЦЫ (*BRASSICA JUNCEA (L.) CZERN*) И *ERUCA SATIVA MILL.* В ТЕЧЕНИЕ ВЕГЕТАЦИИ

Научная статья

Земяхин М.С.[1, *], Леунов В.И.[2], Соколова Л.М.[3], Корнев А.В.[4], Багров Р.А.[5]
[2] ORCID : 0000-0001-9445-5636;
[3] ORCID : 0000-0001-6223-4767;
[4] ORCID : 0000-0003-1373-3302;
[5] ORCID : 0000-0001-5120-5039;
[1, 2] Российский государственный аграрный университет — МСХА имени К.А. Тимирязева, Жуковский, Российская Федерация
[3, 4, 5] Всероссийский научно-исследовательский институт овощеводства - филиал Федерального научного центра овощеводства, Москва, Российская Федерация

* Корреспондирующий автор (sun-tci[at]yandex.ru)

Аннотация

В статье рассматривается зараженность зеленых культур семейства капустных – горчицы (*Brassica juncea* (L.) Czern) и руколы (*Eruca sativa* MILL.) – патогенами в течение их вегетационного цикла. Статья состоит из введения, цели и задач исследования, материалов исследования, описания методов постановки опыта и проведения анализа для выявления патогенов, обсуждения, заключения и литературы. Во введении представлен литературный обзор вышеупомянутых культур, мест их выращивания для получения листьев и патогенов, распространенных на этих культурах. В разделе Цели и задачи описаны цель и задачи исследования, соответственно. В методологии указаны схема и порядок проведения эксперимента в рамках исследования, место и время проведения эксперимента, схема посева и используемые препараты. В методе анализа подробно описан метод анализа на выявление патогенных микроорганизмов, методы, с помощью которых проводился биохимический анализ. В разделе Результаты представлены результаты фитопатологического анализа, в ходе которого было установлено, что на органах сельскохозяйственных культур были обнаружены патогенные микроорганизмы родов *Alternaria* и *Fusarium*. Также было обнаружено, что горчица поражается этими патогенами меньше, в отличие от *Eruca sativa*. Полученные данные свидетельствуют о том, что патогены относятся к грибковым заболеваниям, а также о том, что горчица более

устойчива к заболеваниям грибковой природы, чем Eruca sativa. Новизна работы заключается в том, что данное исследование может помочь в понимании природы заболеваний, поражающих эти зеленые культуры, и поможет разработать меры по защите от них.

Ключевые слова: Eruca sativa, горчица, Alternaria, Fusarium, семена, вегетативные растения, генотип, инсектицид.

Introduction

Eruca sativa is an annual herbaceous cross-pollinating plant. The number of leaves in the rosette of plants grown in protected soil reaches 12 pcs., in the open at the time of fruiting – 20-28 pcs. The stem is branched, 40-80 cm high. The inflorescence is racemose, the petals are whitish or gray-yellow with purple veins. The fruit is an unopened pod. About 250 pods are formed on the plant, the duration of the growing season is 75-90 days. The color of the seeds is heterogeneous: greenish-gray, light brown; the root crop is lighter. The number of seeds in the fruit is up to 30 pieces. The weight of 1000 seeds is 2.5 g, they retain germination for 4 years [1], [6]. *Eruca sativa* is cultivated in the Mediterranean, in the countries of the Middle East [9], Southern Europe and India [14] and in Argentina [11].

According to available foreign literature sources, it has become known that *Eruca sativa* can be infected with a number of diseases and pests, such as: turnip mosaic virus (TuMV) and radish (RaMV) (Bianco, 1995), bacterial diseases such as *Xanthomonas campestris* (Crop Profile/PMSP database, 2001) and fungal, caused by omnivorous species of fungi of the genera *Fusarium* [12], [19] *Pythium, Rhizoctonia, Botrytis and Sclerotinia* (Pimpini, Enzo, 1997), leaf spotting (*Alternaria brassicae, A. brassicicola, A. alternata*), powdery mildew (*Erysiphe convolvuli*) and white vesicular disease (*Albugo candida*) (Bianco, 1995).

The incidence of *Eruca sativa* transporosis has been reported [11]. It is not known how often the culture is affected by bacterial diseases when grown to produce leaf products, however, cases of infection with the above-described pathogens have been confirmed [10]. At low temperatures and high humidity, *Eruca sativa* can be affected by phytophagy and cruciferous rot (*Phytophtora brassicae*) (Pimpini, Enzo, 1997). Like other species of the Brassicaceae family, the rocket can potentially be attacked by a plasmodiophore [4].

Mustard lettuce is an annual herbaceous plant of the cabbage family (Brassicaceae). It is grown for greenery in Indonesia and Vietnam [13], [15]. There are also references to scientific studies on increasing the yield of mustard leaves in Zimbabwe [20].

The root is taproot, penetrates to a depth of 1.5 m. The stem is thin, branched, 50-150 cm high. The lower basal leaves form a rosette. They are large, petiolate, lyre-pinnate with a large upper lobe or dissected into thin segments, rarely almost whole, smooth or curly. The color of the leaves is green or light green, sometimes with anthocyanin pigmentation along the veins and throughout the lamina [3], [6]. The stem leaves decrease up the stem to an irregular triangular shape, and the uppermost ones are oblong-linear, sessile. The flowers are 10-15 mm in diameter with golden-yellow petals, collected in a corymbose or raceme inflorescence. The fruit is a pod with a thin awl-shaped spout. There are 15-18 oval-rounded brown seeds in the pod. The weight of 1000 seeds is 1.6-2.0 g. The seeds retain germination for up to 5 years. Fresh seeds have a dormant period. Mustard salad is a cold-resistant plant. Its seeds begin to germinate already at a temperature of 3-5 ° C.

Of the diseases on mustard, root rot, fusarium, and sometimes blackleg are found. It suffers, especially during spring sowing, from cruciferous fleas, like other plants of this family. Pest and disease control is carried out in the same way as with other types of cabbage [3].

Based on the data of foreign researchers, there is evidence that salad mustard is affected by a number of diseases, such as stem rot (*Sclerotinia sclerotiorum*), rust (*Albugo candida*), alternarioses, powdery mildew, late blight (*Pseudomonas syringae*) and blackleg (*Leptosphaeria maculans*), which are extremely dangerous for it, since the varieties of these The mechanisms of resistance to these diseases have not yet been developed [16], [17].

According to the observations of Serdyuk O.A., the specified species composition of fungi of the genus *Alternaria* on mustard Sarepta is represented by the species: *A. brassicicola, A. raphani, A. brassicae* and, for the first time, by a consortium. The most common fungi were *A. brassicicola* and *A. brassicae.* When isolating pathogens from parts of plants of mustard Sarepta, the species *A. brassicicola* dominated in frequency and number of affected organs, which was isolated during necrosis of stems, leaves, pods and seeds; fungi *A. brassicae, A. raphani* – leaf necrosis, A. consortium – necrosis of roots and stems. Species *A. raphani* and *A. consortiale* are distinguished in isolated cases [7].

There is also evidence that mustard plants are affected by pathogens such as vascular bacteriosis caused by the species *Xanthomonas campestris* and parasitic oomycetes of the genus *Pythium* [18].

The purpose of the research: to identify a complex of pathogens and its effect on vegetative plants of *Eruca sativa* and mustard in the Moscow region.

Research objective: to identify the generic composition of signs of damage to vegetative plants of *Eruca sativa* and mustard. To determine the relationship between the harmfulness of the pathogen and the biochemical composition of plants of these crops.

Materials and Methods

The research material was plants of the varieties of salad mustard Dollares of the Gavrish company and indau Dikovina of the Poisk company.

The experiment had three variants in the structure of the study.

Option No. 1 (seed treatment with a composition of 2 ml of dye + 0.5 ml of preparation + 4.5 ml of water).

Option No. 2 (seed treatment with a composition of 2 ml of dye + 1 ml of preparation + 4 ml of water).

Option (control) (seed treatment with a composition of 5 ml of water + 2 ml of inlaid dye).

The preparation used is the insecticidal seed-pretreatment formulation Tabu Neo. These proportions are recommended by the manufacturer (JSC Firm August). The insecticide was provided by the August company.

2.1. Methods of conducting field experience

The study was conducted on the territory of the V.I. Edelstein Educational, Scientific and Production Center for Horticulture and Vegetable Growing, at the experimental field in 2023. The date of the sowing is from 6 to 8 June.

The experiment was with 3-fold repetition during the experiment. According to the methodology of field experience (S.S. Litvinov), a rectangular shape of the plots was chosen, the number of analyzed plants was up to 80 pieces per plot, the number of plants per plot was 120 pieces, the area of the plot was 405 m2; – the area of the plot was 4.5 m2.

One sowing of all crops was carried out. The placement of variants on plots was carried out by a systematic method. The placement of repetitions was carried out in a continuous way in one tier. During the research work, a seeding scheme was used for the studied crops (20+20+20+30) × 5 cm. This scheme was used for experiments to study the resistance of plants treated with the preparations to damage by pests. At the same time, a study was conducted to identify the resistance of crops to diseases. The data obtained in the framework of our study are presented in this article. The minimum amount of crop seeds for the variant is 50 g.

2.2. The method of placing out the treated parts of mustard and Eruca sativa plants on the nutrient Czapek's medium

The test material was washed in distilled water before starting work. After that, it was dried on sterile filter paper. After the expiration of time, in laboratory conditions, the layout of the test material on the Chapek nutrient medium was carried out in a laminar box.

Location: small sections of tissue were cut out with a sterile scalpel at the border of the affected and healthy tissues and placed out in prepared Petri dishes on a Czapek's nutrient medium. After that, the cups were placed in a thermostat and incubated at +23...+25 °C for 5 days.

After the expiration of the time interval, the manifested mycelium was analyzed in the field of view of a microscope at a magnification of 16 × 40. By microscopy, pathogens were identified earlier than the genus [8]. The biochemical analysis of plant products of the studied varieties was carried out according to the following methods:

• the analysis of ascorbic acid content was carried out by titrometric method;

• the analysis for the content of protein nitrogen was carried out by the spectrophotometric method;

• the analysis of the anthocyanin content was carried out by differential pH spectrophotometry in accordance with GOST R 53773-2010 "Juice products. Methods for the determination of anthocyanins";

• the analysis of the dry matter content was carried out by drying in a drying cabinet in accordance with GOST 33977-2016 "FRUIT AND VEGETABLE PROCESSING PRODUCTS. Methods for determining the total dry matter content".

Results

When harvesting *Eruca sativa* and mustard for greens, we took into account the leaf apparatus on the basis of tolerance to pathogens from the genus *Fusarium* and *Alternaria.* During this analysis, each plant in the sample was evaluated, followed by the distribution of tolerant genotypes by resistance groups. The data of this assessment are shown in Table 1.

Table 1 - Distribution of genotypes of mustard and Eruca sativa by resistance to a complex of leaf pathogens based on 100 plants

DOI: https://doi.org/10.60797/JAE.2024.49.2.1

The name of the sample	The number of genotypes with a lesion score				
	0-0.8	0.9-1.6	1.7-2.4	2.5-3.2	3.3-4
Eruca sativa salad					
Option No. 1	22	25	18	20	15
Option No. 2	20	29	19	14	18
Option (control)	18	25	15	12	30
Average by options	20	26.3	17.3	15.3	21
Average by stability groups	23.1		-	18.1	
Mustard salad					
Option No. 1	27	21	19	18	15
Option No. 2	25	21	20	20	14
Option (control)	24	26	17	15	18
Average by options	25.3	22.6	18.6	17.6	15.6
Average by stability groups	24.0		-	16.6	

Note: 2023

An analysis of the data shown in Table 1 showed that there were no significant differences in the effect of treatments on plant tolerance to pathogens.

In our study, we are more interested in the first two groups, this is a group with resistance 0-0.8 and a weakly susceptible group with a sample lesion index from 0.9 to 1.6. If we combine these groups, it turns out that in these *Eruca sativa* groups there are 23.1 resistant plants, whereas in susceptible groups there are 18.1 plants. Mustard has 24.0 resistant and 16.6 susceptible plants. We also carried out work to identify signs of damage to vegetative plants of mustard and *Eruca sativa*. The data is presented in table 2. Isolated on mustard: from the leaf pathogen of the genus *Alternaria*, from root fusarium. *Eruca sativa*: a pathogen of the genus *Alternaria* and *Fusarium* has been isolated from the leaves. At the root is the causative agent of the genus *Fusarium*.

Figure 1 - Identification of pathogens on mustard and *Eruca sativa*
DOI: https://doi.org/10.60797/JAE.2024.49.2.2

As a result of the conducted studies on the treatment of *Eruca sativa* and mustard seeds with the Tabu Neo insecticide, no special differences were found in the manifestation of pathogens on vegetating plants.

In further studies, it is necessary to analyze the presence of micromycetes in the soil and identify the presence of seed infection in the laboratory.

During the analysis of the biochemical composition of samples of lettuce mustard and indau seeds, it was found that the mustard variety "Dollares" in terms of vitamin C content in the leaves, whose index was 18.43 mg/%, was inferior to the indau variety "Oddity", in which the vitamin C content was 62.22 mg/%.

Considering the varieties according to the concentration of protein nitrogen, a slight difference in indicators was found (4.97% dry weight in the "Dollares" variety versus 4.93%/dry weight in the "Oddity" variety).

When studying the concentration of anthocyanins in samples of the above-described varieties, their higher content in salad mustard (12.51 mg/100 g dry weight) was revealed compared with seeded indau (4.17 mg/100 g dry weight).

Comparing the results on the concentration of dry mass in the studied varieties, it was concluded that on this basis, the variety "Oddity" (5.98 grams) has a higher index compared to the variety "Dollares" (5.19 grams).

Due to the results of our observations, where it was found that salad mustard is more resistant to diseases, we can assume that the lower incidence of this crop of diseases may be due to the high content of anthocyanins in salad mustard compared with Eruca sativa.

Discussion

During the literary analysis, a number of authors (A.M. Romero, R. Zapata, N. Sharma, B. D. Pant & J. Mathur, M.M. Girenko, O.A. Zvereva, P. D. Meena, M S Sujith Kumar, H. S. Meena, S. Jambhulkar, Gohartaj, D. Pathak, S. Srivastava, R. Gupta, D. Singh, B. Gurung, P. K. Rai, O. A. Serdyuk) state that the most common pathogens of Eruca sativa diseases are strains of the genera Fusarium and Alternaria. The results obtained by us, according to which the terrestrial and underground organs of the studied crops were affected by these genera of fungal diseases, confirm the observation data. It is worth noting that a number of researchers (P. D. Meena, M S Sujith Kumar, H. S. Meena, S. Jambhulkar, Gohartaj, D. Pathak, S. Srivastava, R. Gupta, D. Singh, B. Gurung, P. K. Rai) indicated in their work a possible connection between the high content of antioxidants in the biochemical composition the mutants they bred and their lower incidence of alternariasis. The assumption we obtained in the course of our analyses about the relationship between a high content of anthocyanins and a lower incidence of pathogens of the genera Alternaria and Fusarium confirms the hypothesis of the authors mentioned above.

Conclusion

As a result of our research, it was revealed that during the growing season Eruca sativa and indau are susceptible to pathogens from the genus Alternaria and Fusarium both on the leaf blade and on the root. During the biochemical analysis, it was found that Dollars mustard contains 18.4 mg/% of vitamin C, and Oddity mustard contains 62.2 mg/%. The content of protein nitrogen in both grades was clearly not different and amounted to 4.97 and 4.93%, respectively. The content of anthocyanins prevailed in salad mustard – 12.51 mg/100 g of dry weight, and in Indau this indicator was 4.17 mg/100 g.

Благодарности

Авторы выражают благодарность специалистам Всероссийского научно-исследовательского института овощеводства за помощь и советы при написании данной статьи.

Конфликт интересов

Не указан.

Рецензия

Сообщество рецензентов Международного научно-исследовательского журнала
DOI: https://doi.org/10.60797/JAE.2024.49.2.3

Acknowledgement

The authors express their gratitude to the All-Russian Research Institute of Vegetable Growing specialists for their help and advice in writing this article.

Conflict of Interest

None declared.

Review

International Research Journal Reviewers Community
DOI: https://doi.org/10.60797/JAE.2024.49.2.3

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