

Integrated management strategies for pathogens and pest control at cucumber plants

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Abstract Cucurbitaceae includes a wide range of plants that have valuable medicinal and food properties (compounds serve as the basis for developing modern pharmaceutical agents). Approximately 130 genera and more than 800 species comprise this family. The rapid spread of plant pathogens that threaten food security has been facilitated by globalization, and cucurbitaceous species are also vulnerable to disease and pest damage. The climate change pose a more a major constraint as it facilitate and increase the impact of biotic stress (pests and diseases) over the cultivated plants with impact on economic efficiency of production. Therefore continuous and resilient plant protection methods should be developed in order to overcome this threat focusing also on products and methods that are more friendly with the environment. During the climatic conditions of 2021 at VRDS Bacău, the main pathogen recorded in cucumbers in the field was downy mildew. In countries where Cucurbits are grown on large surfaces, this is a common disease that produces important crop losses. The disease affects plants at any stage of development and it appears on their leaves. In the pedoclimatic conditions of 2021 years two pest species, *Aphis gossypii* Gov. and *Thrips tabaci* Lind. *T. tabaci* were the main pathogens that affected the crop but did not exceed the threshold for economic harm (PED). Among the six variants tested for the control of diseases of cucumber plants, the highest efficiency was found on variant treated with Boille Bordelaise WDG – 0.75%. Oleorgan had the best effectiveness in combating the aphids – 0.25 – 3% with a percentage of 63.06%.

Key words

control of pathogens, cucumber, pest and disease, VRDS Bacau

A large family of plant species, cucurbitaceae, also known as cucurbits, has 130 genera and 800 species. Additionally, vegetables and fruits from the *Cucurbitaceae* family are used in many food products [21]. In various parts of the world, cucumbers are mostly used as raw fruit, but the plant has medicinal values as well [22]. After tomato, cabbage, and onions, cucumber (*Cucumis sativus* L.) is the fourth most important vegetable crop worldwide [7; 22].

It is not uncommon for pathogens and pests to attack crops and have a significant impact on the economy. As a result of globalization, a wide range of plant pathogens, diseases, and pests have spread rapidly among cucurbitaceous plants [11; 20]. Cucumber is severely affected by various diseases, such as downy mildew, powdery mildew, anthracnose, cucumber mosaic virus etc. [12; 15; 17] and for pests, the distribution, according to the frequency of occurrence has shown that they belong to presence of 63 species worldwide and eight orders (*Acar*i, *Coleoptera*, *Diptera*, *Hemiptera*, *Hymenoptera*, *Lepidoptera*, *Orthoptera* and *Thysanoptera*) [11].

As a result of the climatic conditions at Vegetable Research and Development Station (VRDS) Bacău in 2021, the most prevalent pathogen in the field was downy mildew (*Pseudoperonospora cubensis*

(Berk. & M.A. Curtis) Rostovzev). The cucumber aphid (*Aphis gossypii* Gov.) was the most significant pest found in this field condition of our trial. *Thrips tabaci* Lind was also identified but did not exceed the threshold for economic harm (PED).

Downy mildew (*P. cubensis* (Berk. & M.A. Curtis) Rostovzev) represents a major problem for cucurbit growers [5] it is a disease commonly encountered in countries where cucumbers, yellow melons, and pumpkins are grown. The disease appears on the leaves regardless of the phenological phase of plants [1; 4] which results in inhibited growth and reduced yield [16]. Rainwater or irrigation water can spread the fungus. A heavy attack of downy mildew can be caused by applying sprinklers in the morning until 10 am, when the spread of sporangia is at its maximum. The fungus can be transmitted from one year to the next by spores found in plant debris, but infections in subsequent years can also be transmitted by wind-borne spores in mild winters, which remain viable on dry branches [1; 8]. Yellowish color stains appear on the top of the leaf delimited by ribs. A gray-violet down consisting of conidia and conidiophores is formed on the ventral side. Under favorable conditions for attack, leaf limb is dried and plants are quickly defoliated [13; 14].

It has been found that disease and epidemics are much more severe than in the past due to new genotypes of downy mildew [5; 14]. *P. cubensis* also appears in the fruits and seeds of affected plants, but not in the fruit or seeds of healthy plants [4].

Cucumber aphid (*A. gossypii* Gov.) it is an economically important pest that attacks many cultures around the world [18; 19]. The insect is spread throughout the globe, migratory and polyphagous, they can feed on plants in very different families [2; 9-11] but is differentiated by host plant preference [9] that can influence the behavior and vigor of plants both directly (by feeding) and indirectly (by transmitting viruses) [3].

Aphids alternates between primary and secondary hosts. Their primary hosts are usually woody plants, where they migrate and carry out sexual reproduction during autumn [23]. Overwinter in the egg stage. In spring, from eggs, the larvae that gives rise to the generation of the foundatrix appear [10; 11]. Secondary hosts are usually herbaceous plants, where they will asexually reproduce (parthenogenesis) to produce many offspring. The most important secondary hosts are cotton, cucumber, pumpkin, zucchini, potato, and bean plants [23]. Females, ensures easy passage and spread from one plant to another or from one species to another. It is a destructive pest for many cultures and one of the most frequent pests of *Cucurbitacea* cultures [6; 10; 11; 23].

Material and Method

This research was conducted in 2021 at the Vegetable Research - Development Station (VRDS) Bacau, in the conventional agricultural scientific polygon. During the vegetation period at cucumber (*Cucumis sativus* L.), pathogens and pests were monitored and evaluated. Each observation was carried out every 10 days. Attack estimation was determined by using the following indicators:

- frequency of attack (F%);
- intensity of attack (I%);
- degree of attack (DA%).

The experimental plots used on cucumbers trial contained six variants and four repetitions per variant placed in randomized blocks designs. The surface of the experimental variants was 0.5 hectares. The biological material is represented by Mapamond variety, certified by VRDS Bacău.

The fungicides and insecticides shown in table 1 were applied to leaves. The cucumber leaves were sprayed using a hand sprayer. Pathogen and pest control was then assessed. Efficacy after treatment was also calculated. Climatic factors (temperature, relative air humidity, precipitation and wind speed) were monitored using the weather station FieldClimate.

The results will be used for pathogen and pest control to reduce the number of treatments in cucumber (*C. sativus* L.) crops and increase pest and predator populations

Table 1

Fungicides and insecticides variants for downy mildew and aphids control used in cucumber field

| Variant | The product | Active substance | Concentration (%) | Variant | The product | Active substance | Concentration (%) |
|------------|------------------------|--|-------------------|--------------|-------------------|--|-------------------|
| fungicides | | | | insecticides | | | |
| V1 | Bouille Bordelaise WDG | 20% copper and 80% neutralized copper sulphate | 0,75 | V1 | Oleorgan | 40% neem tree saponified oil extract | 0,25 – 0,3 |
| V2 | Previcur Energy | 530 g/l propamocarb + 310 g/l fosetil | 0,15 | V2 | Konflik | Quassia amara 50% Potassium soap from vegetable oils 50% | 0,3 |
| V3 | Polyram DF | 80% metiram | 0,2 | V3 | Bionid | Mixture of environmentally friendly substances | 5 |
| V4 | Aliette 80 WG | aluminum fosetil 800 g/kg | 0,2 | V4 | Neemex | <i>Azadirachta indica</i> extract | 0,3 |
| V5 | Melody Compact 49 WDG | 84 g/kg iprovalicarb + 406 g/kg Cu in the form of copper oxychloride | 0,2 | V5 | Faster 10 CE | Cipermetrinul 100 gr/l | 0,03 |
| V6 | Untreated control | x | x | V6 | Untreated control | x | x |

Results and Discussions

Under the climatic conditions of 2021 year, in Bacau area, at VRDS Bacau, moderate temperatures were recorded, especially in the summer months (June, July and August) that did not exceed 20 °C (figure 1).

A decrease in the average temperature can also be observed since the second decade of August.

Precipitations were more abundant in the second decade of June and in the second decade of July where values over 120 l/m² were recorded (figure 2). From the third decade of July precipitation began to

decrease, in the third decade of August precipitation were more abundant reaching 60 l/m². In September precipitation did not exceed 5 l/m².

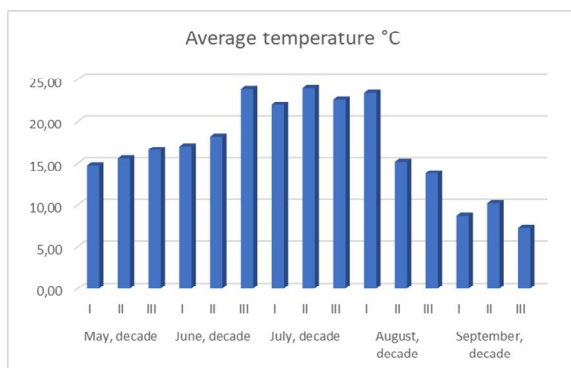


Fig. 1. Average temperature on decades in 2021 from May to September

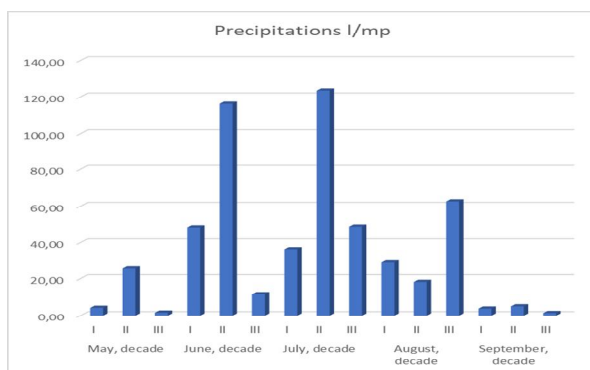


Fig. 2. Average precipitation on decades in 2021 from May to September

Attack of pathogens and pests in cucumber crops in the field varied by species. The precipitation recorded in June and July and the average temperatures of 21°C favored the occurrence and increase the DA% of downy mildew in cucumbers. The highest percentage of the *P. cubensis* fungus was recorded in the first decade of September (85%) (figure 3).

Among the pests reported in the experience of cucumber, the aphids recorded a percentage of DA% of 16.9% in the third decade of July (figure 4). This was followed by a reduction in the attack intensity of this pest. In the cucumber culture, *Thrips tabaci* were observed in the third decade of July, but the species did not exceed the threshold for economic harm (PED).

Downy mildew (*P. cubensis* (Berk. & M.A. Curtis) Rostovzev) (figure 5) was the main pathogen in cucumber culture. Boille Bordelaise WDG - 0.75% was the best fungicide against this disease in the Mapamond cucumber variety (60.99%), followed by MELODY COMAP 49 WDG - 0.2 (50.62%). Previcur® Energy had an efficacy of 42.71% and Polyram DF had an efficacy of 36.63% for cucumber downy mildew. Meanwhile, ALIETTE 80 WG - 0.2 had the lowest efficacy, only 25.10% (figure 6).

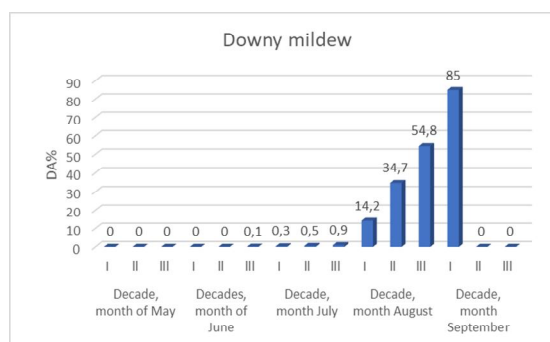


Fig. 3. Graphical representation on dynamics of cucumber pathogens under climatic conditions at VRDS Bacau in 2021

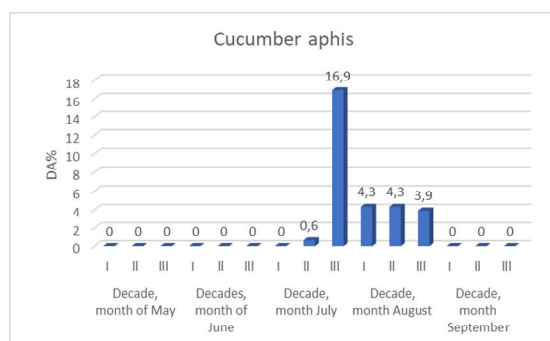


Fig. 4. Graphical representation on dynamics of cucumber pests under climatic conditions at VRDS Bacau in 2021



Fig. 5. Cucumber leaves with yellowish color stains on the top of the leaf delimited by ribs

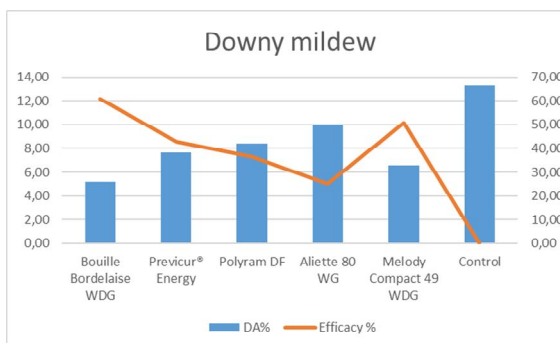


Fig. 6. Graphical representation of DA% and efficacy of some products in combating downy mildew

The cucumber aphid (*A. gossypii* Gov.) (figure 7) was the most problematic pest of cucumbers at VRDS Bacau. The most effective insecticide for pest control was Oleorgan - 0.25 - 3% with 63.06%, followed by Neemex - 0.3% (41.57%). Konflic with an efficacy of 41.14% was third, Faster 10 CE had an efficacy of 40.74 and Bionid insecticide has the lowest efficacy - 5%, only 31.31% (figure 8).



Fig. 7. *Aphis gossypii* Gov. on cucumber leaf

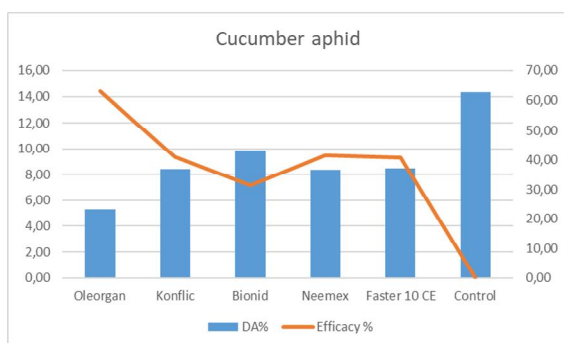


Fig. 8. Graphical representation of DA% and the effectiveness of some products in combating cucumber aphids in cucumbers

Conclusions

In 2021 year at VRDS Bacau, moderate temperatures were recorded, especially in the summer months (June, July and August) that did not exceed 20 °C. During the second decade of June and the second decade of July, precipitation exceeded 120 l / m². Pathogens and pests attack cucumber crops in the field differently, depending on the species.

For cucumber the main pathogen was represented by the downy mildew (*P. cubensis* (Berk. & M.A. Curtis) Rostovzev). For the control of this disease Boille Bordelaise WDG - 0.75% had the best efficacy (60.99%).

Regarding the pest incidence at cucumber, Mapamond variety, the cucumber aphids (*A. gossypii* Gov.) recorded a percentage of DA% of 16.9% in the third decade of July. The onion thrips (*T. tabaci* Lind.) were observed, also in the third decade of July, but the species did not exceed PED. The most effective

insecticide for cucumber aphid was Oleorgan - 0.25 - 3% with 63.06% efficacy.

Using the results of this study, pest management will be improved by decreasing the number of pesticide treatments used to control downy mildew and aphid pests and by increasing parasite and predator populations in the cucumber culture.

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