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BIOECOLOGY OF THE DEVELOPMENT OF CULTURAL POWDERY MILDEWS MEDICINAL PLANTS OF THE FERGHANA VALLEY

G. G. Parpiev,
O.G. G‘ayratov
Andijan Institute of Agriculture and Agrotechnology
170600 1 House of Oliygokh Street, Andijan District, Andijan Region,
Andijan Region, Andijan Region of the Republic of Uzbekistan.
E-mail: oyatullo78@mail.ru: Tel: (+99890) 386-77-78

Abstract
The article discusses the bioecological aspects of the development of mealy-mildew fungi of medicinal plants, i.e. the influence of temperature and humidity on the germination of powdery mildew conidia, as well as the specialization of some forms of the genera Erysiphe and Sphaerotheca affecting cultivated medicinal plants.
In laboratory conditions, powdery mildew conidia were germinated on the surface of a water droplet. The results of our research (table 2.) show that freshly harvested conidia of the fungus Erysiphe cichoracearum DC. f. valerianae Jacz. actively germinate and the percentage of germinated conidia is 78.4%. After 8-10 hours the number of germinated conidia was 67.4%, after 16-24 hours - 54.7%, then it decreases markedly.
Regarding the dependence of spore germination, it was shown that conidia do not germinate at an air temperature of + 10C. The beginning of germination of conidia is observed at an air temperature of 50C. As the air temperature rises, the number of germinated conidia increases and reaches its maximum at a temperature of 250C. Further, as the temperature rises, the number of germinated conidia decreases, and at a temperature of 40 ° C they do not germinate.

Keywords: powdery mildew, pathogen, Erysiphe, Sphaerotheca, conidia, bioecology, moisture, temperature, cultivation, development.

Introduction

Powdery fungi (family Erysiphaceae) are of great interest from the point of view of taxonomy, floristry and mycogeography, and as obligate parasites are of great practical importance, being the causative agents of plant diseases.
Powdery mildew disease is ubiquitous on both cultivated and wild plants. It is considered very dangerous, as it can infect plants in large areas in a relatively short time.
In recent years, the spread of powdery mildew has increased on cereals, fodder, fruit and berry, vegetable and melon crops, as well as on tree, shrub and herbaceous ornamental plants, including medicinal plants [1; 2; 4; 9; 10; 11].
The species composition of the causative agent of powdery mildew on various plants is quite large and varied.
The cultures studied by us are mainly affected by pathogens from the genus Erysiphe and Sphaerotheca.

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Below we give the characteristics of the causative agents of powdery mildew of various medicinal crops (table 1.)

Valerian - Erysiphe cichoracearum DC.f. valerianae Jacz. mycelium plaque on the leaves is mealy-cobweb, spreading widely. The size of the conidia is 31-34 x 17-21 microns. Cleistothecia are randomly scattered, globular, dark brown, 156-162 microns in size. in diameter. The appendages are numerous, long, geniculate, slightly branched, brown, easily breaking off.

The bags are ovoid, uneven, their size is 68-72 x 34-37 microns. on more or less clearly defined legs. Disputes, 2 in a bag, ellipsoidal, size 24-26 x14-16 microns.

Peppermint - Erysiphe cichoracearum DC.f. menthae Jacz. The plaque of mycelium on the leaves is cobweb-like, white.

The size of the conidia is 30-34 x 16-20 microns. Cleistothecia are globular, dark brown 147-161 microns. in diameter. The appendages are numerous, long, brown.

The bags are ovoid, unequal, 68-71 x 30-34 microns in size. Disputes 2-3 in a bag, ellipsoidal, size 25-27 x 12-14 microns

Pharmacy chamomile - Erysiphe cichoracearum DC.f. matricariae Jacz. Mealy-cobweb mycelium, widespread, mainly on the upper side of the leaf blade. Conidia in chains, 22-24 x 12-14 microns in size. Cleistothecia abundant, scattered, mainly on the upper side of the leaf, dark brown, 150-156 microns. in diameter, with irregular polyhedral membrane cells, Appendages are numerous, sinuous, intertwining, brown. Bags, 5-14 in number in cleistothecia, ovoid, 58-70 x 26-32 microns in size. Disputes, 2 in a bag, ellipsoidal, 22-24 x 11-13 microns.

Clary sage - Erysiphe labiatarum Chev.f. salviae Jacz. Mycelium plaque on both sides of the leaf; pale, poorly noticeable. Conidia are barrel-shaped, in chains 24-30 x 12-14 microns in size. Cleistothecia are dark brown, 120-144 microns. in diameter, with indistinct cells of the peridium. The appendages are colorless or light brown, sinuous, intertwined with the mycelium. Bags, 7-8 in number, are on average in clestothecia, clavate or ovate, on a stalk, 58-60 x 38-42 microns in size. The spores mature in spring and are 27-31 x 14-16 microns in size.

Calendula - Sphaerotheca fuliginea Poll. f. calendulae Jacz. Plaque of mycelium is grayish, cobweb, not very abundant, on leaves on both sides, on flower-bearing stems, wrapper of baskets, disappearing by the time of formation of clestothecia. Conidia are barrel-shaped, 31-36 x 18-20 microns. in chains. In winter, the fungus remains in a viable state in the form of cleistotecia fruit bodies. They are spherical fruit containers, which are located in crowded groups, on peduncles, longitudinally along the stem, the color is dark brown. The size of the cleistothecia is 90-100 microns. in diameter, with a few sinuous up to 42 μm. the length of the shell cells. The appendages are few 2-3 times the length of the diameter of the cleistothecium, brown, sometimes almost colorless, slightly curved. In the cavity of the fruiting body there is one bursa, ovoid, size 78-87 x 58-62 microns. The bag contains up to 8 ellipsoidal spores, the size of which is 28-33 x 20-23 microns.

Influence of temperature and humidity on the germination of powdery mildew conidia.

To determine the influence of the time that elapsed from the separation of conidia to their

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germination, special experiments were laid.

In laboratory conditions, powdery mildew conidia were germinated on the surface of a water droplet. Conidia submerged in water did not germinate. This indicates the oxygen demand of conidia during germination and development of the sprout.

The results of our research (table 2.) show that freshly harvested conidia of the fungus Erysiphe cichoracearum DC. f. valerianae Jacz. actively germinate and the percentage of germinated conidia is 78.4%. After 8-10 hours the number of germinated conidia was 67.4%, after 16-24 hours - 54.7%, then it decreases markedly. With an increase in the time from the separation of conidia to their germination, the number of germinated conidia sharply decreases, and after 48 hours the conidia lose their viability.

There are many data in the literature on the effect of temperature and air humidity on the germination of powdery mildew conidia.

In order to reveal the influence of temperature and air humidity on the germination of conidia of the fungus of the genera Erysiphe and Sphaerotheca, experiments were carried out in laboratory conditions.

Taking into account the instructions of S. Hammarlund [14] and A.A. Yachevsky [13], we used conidia from freshly harvested diseased leaves in our experiments.

Using the technique of regulation and measurement of humidity proposed by I.V. Kozhanchikov [5] for the conditions of a laboratory experiment, we prepared chambers with different relative humidity.

For this, a solution of sulfuric acid of various concentrations was poured onto the bottom of the desiccator, providing a certain percentage of relative air humidity, above the solution from 40 to 80%. To receive

At 100% relative humidity, only water was poured into the chamber. The chambers were hermetically closed by lubricating the desiccator lid with petroleum jelly.

The preparations were microscoped 12, 24 and 48 hours after insertion of the slides into the chambers and viewed in five fields of view, counting the number of germinated and non-germinated conidia.

The results of the experiments are presented in tables 3, 4, 5. As can be seen from the above tables, conidia do not germinate at an air temperature of + 1 ° C. The beginning of germination of conidia is observed at an air temperature of 50 C.

Table 1 Comparative characteristics of the causative agents of powdery mildew of medicinal plants

Culture	Causative agent	SIZE, μm			
		conidia	clestothecium	bags	сумкоспоры
Valerian	Erysiphe cichoracearum DC.f. valerianae Jacz	26-34 x 17-21	156-162	68-72 x 34-37	24-26 x14-16
Peppermint	Erysiphe cichoracearum DC.f. menthae Jacz	30-34 x 16-20	149-164	68-71 x 30-34	25-27 x 12-14
pharmaceutical camomile	Erysiphe cichoracearum DC.f. matricariae Jacz.	22-24 x12-14	150-156	58-70 x 26-32	22-24 x 11-13
Clary sage	Erysiphe labiatarum Chev.f. salviae Jacz	24-30 x 12-14	120-144	58-60 x 38-42	27-31 x 14-16
Calendula	Sphaerotheca fuliginea Poll f. calendulae Jacz	31-36 x 18-20	90-100	78-87 x 58-62	28-33 x 20-23

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with an increase in air temperature, the number of germinated conidia increases and reaches its maximum at a temperature of 250C. Further, as the temperature rises, the number of germinated conidia decreases, and at 40 ° C they do not germinate.

Table 2. Germination of conidia depending on the time of separation conidia before germination

Time elapsed from separation of conidia to their germination, hour	Number of sprouted conidia,%
0 – 8	78,4
8 – 16	67,4
16 –24	54,7
24 –36	24,1
36 – 48	4,1
48 –96	0

In addition, in our experiments, we studied the effect of relative air humidity on the germination of conidia depending on the air temperature. At the same time, it was noted that at air temperatures of 5-350C, the number of germinated conidia increases with increasing humidity. The greatest germination of conidia was observed at an air temperature of 250C and a humidity of 100%.

The same picture was observed in experiments where conidia were observed 24 and 48 hours after placing them in a drop of water.

Thus, our research has established that the optimal conditions for germination of conidia are air temperature 20-250C, humidity 80-100%, while conidia are actively growing within 12 hours. Here the germination of Erysiphe cichoracearum DC.f. valerianae Jacz. is 69.4-65.9%, and Sphaerotheca fuliginea Poll. f. calendulae Jacz. -65.4-68.7%. Germination of conidia slows down after 24 and 48 hours.

Under natural conditions with significant fluctuations in temperature and humidity within a day and during the growing season of crops, there will undoubtedly be deviations. Therefore, our data can serve as material for a comparative characterization of the responsiveness of the studied fungi Erysiphe cichoracearum DC.f. valerianae Jacz. and Sphaerotheca fuliginea Poll.f. calendulae Jacz. to the conditions of the external environment.

Specialization of some forms of the genera Erysiphe and Sphaerotheca. We examined medicinal plants for morbidity showed that valerian, peppermint, chamomile and clary sage are affected by powdery mildew of the genus Erysiphe, and the calendula genus Sphaerotheca. In this connection, our task was to study the specialization of these mushrooms.

The experiments were carried out in 2019 in lysimeters at the experimental site of the Andijan branch of the Tashkent State Agrarian University. The following medicinal plants were used for artificial and cross-contamination:

1. Althaea officinalis L.
2. Valeriana officinalis L.

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3. Calendula officinalis L.
4. Mentha epiperita L.
5. Matricaria chamomilla L.
6. Orthosiphon stamineus Benth.
7. Salvia sclarea L.
8. Sanguisorba officinalis L.
9. Achillea millefolium L.
10. Leonurus cordiaca L.

In order to protect the experimental plants in lysimeters from natural infection, they were isolated with gauze material before inoculation.

Preliminary, a thorough check of the experimental plants was carried out and only after establishing the absence (natural infection) of powdery plaque was inoculation carried out. The experimental plants were inoculated on July 18 with conidia previously tested for viability. All plants were sprayed with an aqueous suspension of freshly harvested conidia of the fungus.

Control plants were sprayed with sterile water.

Observations of the manifestation of powdery plaque and the development of the disease were carried out at 5,8,11,14,17, and 20 days after inoculation.

The results of the experiments are shown in Tables 6 and 7. The data presented in Table 6. show that conidia with Valeriana officinalis L. infested valerian plants to a moderate extent, and on the plants of peppermint, chamomile and clary sage, traces of the manifestation of the disease were observed. disappeared.

On valerian, traces of manifestation were noted on the 8th day after inoculation, on the 11th day, a weak and on the 16th day, the average manifestation of the disease. On the 12th day after the inoculation, traces of the disease appeared on peppermint and chamomile. There were no signs of the disease on the calendula.

Table 3 Germination of powdery mildew conidia depending on air temperature and humidity after 12 hours (%)

Temperature, ^{0}C	H U M I D I T Y,%							
	40		60		80		100	
	Erysiphe cichoracearum DC .f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll.f. calendulae Jacz.	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.
1	0	0	0	0	0	0	0	0
5	1,6	2,4	2,7	3,6	2,9	4,3	3,2	3,9
8	4,7	6,4	6,5	8,1	8,9	10,7	9,5	10,9
16	14,6	16,2	20,1	21,7	24,5	29,1	23,7	28,4
20	24,4	30,0	34,9	36,4	49,8	52,1	54,4	58,1
25	33,4	34,4	40,9	43,7	59,4	63,4	65,9	68,7
30	21,4	21,4	26,4	21,9	34,1	30,5	38,1	32,4
35	9,2	7,4	11,1	7,9	11,9	8,9	16,6	15,1
40	0	0	0	0	0	0	0	0

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Table 4 Deposition of dusty dew cones within 24 hours, depending on the air temperature and humidity (%)

Temperature, ^{0}C	H U M I D I T Y, %							
	40		60		80		100	
	Erysipheci cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll.f. calendulae Jacz.	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.
1	0	0	0	0	0	0	0	0
5	2,1	2,4	3,1	4,1	3,4	4,5	3,6	4,9
10	5,1	7,1	7,1	8,7	10,1	12,9	10,3	12,6
15	16,1	19,8	22,5	25,1	28,6	34,4	29,1	36,4
20	28,4	33,6	36,9	39,8	51,6	53,9	58,5	60,4
25	35,7	37,4	41,9	453	62,4	67,7	70,1	71,0
30	23,4	23,6	29,1	26,9	35,8	33,9	40,1	35,5
35	9,2	8,9	12,4	9,5	14,5	11,3	18,4	17,1
40	0	0	0	0	0	0	0	0

Table 5 Deposition of dusty dew cones, depending on the air temperature and humidity in 48 hours (%)

Temperature, ^{0}C	H U M I D I T Y, %							
	40		60		80		100	
	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.	Erysiphe cichoracearum DC.f. valerianae Jacz.	Sphaerotheca fuliginea Poll. f. calendulae Jacz.
1	0	0	0	0	0	0	0	0
5	2,1	2,4	3,7	4,1	3,9	5,6	3,8	5,4
10	6,4	7,9	7,2	9,1	10,3	13,4	10,7	15,0
15	16,1	20,9	21,7	25,2	30,0	36,2	30,9	39,1
20	29,7	35,1	37,8	42,0	51,9	55,5	60,2	61,8
25	36,9	40,0	42,9	48,0	62,8	69,8	71,0	71,9
30	25,1	23,8	28,7	26,9	36,9	34,6	41,9	36,8
35	11,9	9,4	13,4	10,2	15,2	12,0	20,0	18,1
40	0	0	0	0	0	0	0	0

Menthae piperita L. with konidiyami did not affect: chamomile pharmacy, Muscadine sage and calendula. In Valeria, the symptoms of the disease were observed on 10 day, and then disappeared.

The first signs of Thrush appeared weakly on 9 day after vaccination, on 10 day, and on average on 21 day.

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Table 6. Results of artificial and mutual contamination of medicinal plants with conidia.

Vaccinated plants	Control	Mushroom cone				
		Valeriana officinalis	Menthae piperita	Matricaria chamomilla	Salvia sclarea	Calendula officinalis
Valeriana officinalis L.	_	+++	+	+	+	_
Menthae piperita L.	_	+	+++	+	_	_
Matricaria chamomilla L.	_	_	_	++	+	_
Salvia sclarea L.	_	+	_	+	+++	_
Calendulae officinalis	_	_	_	_	_	+++
Althaea officinalis L.	_	_	_	_	_	_
Orthosiphon stamineus Benth.	_	_	_	_	_	_
Sanguisorba officinalis L.	_	_	_	_	_	_
Achillea millefolium L.	_	_	_	_	_	_
Leonurus cordiaca L	_	_	_	_	_	_

Conditional signs: - no lesions; + signs of the disease; ++ weak manifestation; + + + moderate manifestation

On 12 day, signs of the disease appeared in the vaccination with conidia with Matricaria chamomilla, which eventually disappeared, in the pharmacy of valerian and Muscadine Sage, in 8 chamomile. At the host plant, the symptoms of the disease were noted on 8 day, and on 16 day the dust appeared weakly, and in the future the development of the disease was stopped.

Salvia sclarea L. of Valerian and chamomile plants with inoculation, the symptoms of the disease were determined. There were no symptoms of the disease in mint and calendula. The plant, which was the owner of Muscadine adaçai on 8 day, was smeared with powdery mildew and recorded a weak defeat on 16 day and was manifested on average on 21 day.

Table 7. Incubation period of the pathogen of powdered dewring inoculation of plants with aqueous conidium suspension (Day)

Degree of manifestation of the disease	Vaccinated plants				
	Valeriana	Menthae	Matricaria	Salvia	Calendula
Conidia with Valeriana officinalis L.					
traces of the show	8	10	0	12	0
weak appearance	11	0	0	0	0
moderate manifestation	16	0	0	0	0
Conidia with Menthae piperita L.					
traces of the show	11	9	0	0	0
weak appearance	0	10	0	0	0
moderate manifestation	0	21	0	0	0

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Conidia with Matricaria chamomilla L.					
traces of the show	11	0	8	8	0
weak appearance	0	0	0	16	0
moderate manifestation	0	0	0	0	0
Conidia with Salvia sclarea L.					
traces of the show	11	0	8	8	0
weak appearance	0	0	0	16	0
moderate manifestation	0	0	0	21	0
Conidia with Calendulae officinalis L.					
traces of the show	0	0	0	0	8
weak appearance	0	0	0	0	12
moderate manifestation	0	0	0	0	18

Conidia with calendula, which is the causative agent of Sphaerotheca fuliginea Poll. the f. calendulae Jacz., only mezbon affected the plant. On the 8 day, the manifestation of the disease was noted. Weak appearance was observed for 12 days, and on average-for 18 days. Thus, the results of the conducted studies show that the medicinal powder-mushroom fungus, which affects plants, is highly specialized. In our experience, in other crops, in addition to the owner of the plant, symptoms of the disease appeared, although they eventually disappeared.

Conclusion

1. Powdery mildew fungi (family Erysiphaceae) are of great interest from the point of view of taxonomy, floristry and mycogeography, and as obligate parasites are of great practical importance, being the causative agents of plant diseases.
2. The results of our research show that freshly harvested conidia of the fungus Erysiphe cichoracearum DC. f. valerianae Jacz. actively germinate and the percentage of germinated conidia is 78.4%. After 8-10 hours the number of germinated conidia was 67.4%, after 16-24 hours - 54.7%, then it decreases markedly. With an increase in the time from the separation of conidia to their germination, the number of germinated conidia sharply decreases, and after 48 hours the conidia lose their viability.
3. It has been established that the optimal conditions for the germination of conidia are air temperature 20-250C, humidity 80-100%, while conidia are actively growing within 12 hours. Here the germination of Erysiphe cichoracearum DC.f. valerianae Jacz. is 69.4-65.9%, and Sphaerotheca fuliginea Poll. f. calendulae Jacz. -65.4-68.7%. Germination of conidia slows down after 24 and 48 hours.
4.We examined medicinal plants for morbidity showed that valerian, peppermint, chamomile and clary sage are affected by powdery mildew of the genus Erysiphe, and calendula - Sphaerotheca. In this connection, our task was to study the specialization of these mushrooms.

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