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GARLIC MOSAIC VIRUS PARTICLES AND VIRUS INFECTIONS OF SOME WILD *ALLIUM* SPECIES

J. BRČÁK

BRČÁK J. (Institute of Experimental Botany, Czechoslovak Academy of Sciences, Praha). *Garlic Mosaic Virus Particles and Virus Infections of Some Wild Allium Species.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 237-242, 1975.

Elongated flexuous virus particles 640 nm long and 14 nm in diameter were found in common garlic plants (*Allium sativum* L.) infected with garlic mosaic (GMV). Very similar particles occurred in *Allium hymenorrhizum* Ldb., *A. longicuspis* Rgl., *A. Oschanini* O. Fedtsch., *A. proliferum* hort., and in three other wild *Allium* species collected by Mr. Kloz and Mrs. Klozová in Caucasus (U. S. S. R.). Viruses isolated from the species mentioned and also from *A. galanthum* Kar. et Kir. and *A. rotundum* L. were sap transmissible to garlic plants. This demonstrated the natural occurrence of viruses belonging to the GMV group in wild *Allium* species in Caucasus as well as in further *Allium* species grown in some botanical gardens.

garlic mosaic; virus particles; wild *Allium* viruses

Former references have not enabled us to differentiate precisely the onion yellow dwarf virus (OYDV) from the garlic mosaic virus (GMV). E. g. Razvjazkina et al. (1969) concluded that OYDV and GMV were identical. No conclusive results have been obtained from electron microscopic investigations of virus diseases of the genus *Allium* L. even in the case of OYDV particles. Smirnova (1953) observed elongated flexuous particles in onion and made them like potato virus X and/or lily mosaic virus particles, but she did not believe that they would represent the onion disease agent. Procenko and Legunkova (1961) presented for the first time the length of OYDV particles (675 nm). The same length of OYDV particles was published by Razvjazkina (1971) who also found identical particles in garlic originating from the North Caucasus. Formerly, however, Schmidt and Schmelzer (1964) established a different size of OYDV particles (772 nm × approximately 16 nm). Chod and Klír (1966) noted that the particle length of their OYDV isolate was approximately the same as published by Schmidt and Schmelzer (1964). Verhoyen and Horvat (1973) stated in chlorotic streak diseased leek virus particles 822–841 nm long and noted that the leek disease was caused by a virus resembling the OYDV. Messiaen and Marrou (1965) found in mosaic diseased garlic plants elongated particles 500–600 nm long and also mentioned the difficulties with transmission of the GMV agent to onion. In mosaic diseased garlic (*Allium sativum* L.) Verhoyen (1973) mentioned shorter particles (760–780 nm) than in *A. cepa* L. and in *A. ascalonicum* Strand et Mansf. Bos (1972) – like Hollings in 1967 – found in *A. ascalonicum* Strand et Mansf. a virus differing from OYDV by its particle length which re-

sembled viruses of the potato virus S – group. Bos and Novák (inedit.) mentioned the occurrence of shorter particles than OYDV in leek.

Havránek (1973) thoroughly compared three groups of *Allium* viruses (OYDV, GMV, and "Sc" which he had isolated from *A. scorodoprasum* L.) especially according to reactions of differential host plants. His conclusions were used for preliminary grouping viruses dealt with in the present paper.

MATERIAL AND METHODS

Two samples of garlic plants (of unknown varieties and origin) were used for experiments. The first sample was examined by an electron microscope in 1971, the second one in 1974. Further *Allium* species were imported by J. Kloz, CSc., and Eva Klozová, CSc., from the U. S. S. R.; they were grown in a greenhouse under controlled conditions; specimens for investigation were taken just during the growth of the first leaves, so that the plants could not be infected after their transport to Prague.

Sap inoculation was performed using Carborundum powder (600 mesh) or the method described by Yarwood (1969): 0.1 % K_2SO_3 added before grinding, then 1 % K_2HPO_4 and 0.2 % charcoal.

For electron microscopy diluted homogenates of stripped epidermis were used. Specimen grids were covered with formvar membrane and shadow-casted with platinum. Electron micrographs (× 14,500) were taken on an electron microscope Tesla BS 413. Tobacco mosaic virus (TMV) particles treated in the same way were used in order to establish the length of virus particles. Particles were measured at a total magnification of 107,000. Other specimens were negatively stained with dodeca-tungstosilicic acid neutralized with KOH (4 %, pH 7.2). Then electron micrographs were taken (× 34,500) and particles were measured at a total magnification of 362,000.

RESULTS

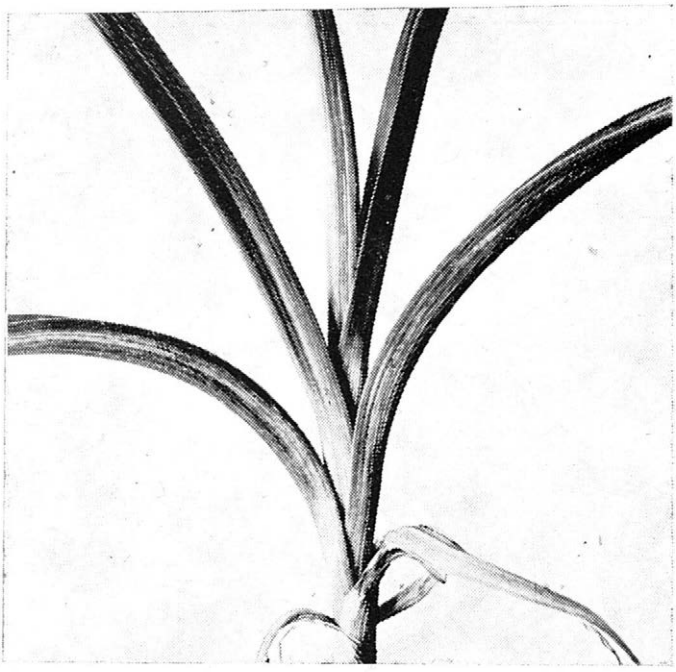
ATTEMPTS TO TRANSMIT GMV TO OTHER PLANT SPECIES

Garrlic plants showing severe GMV symptoms (Fig. 1) and being proved to have present virus particles were chosen for preparing inoculum which was used for sap transmission trials.

Chenopodium quinoa Willd. (infected in May) showed local chlorotic lesions (approx. 2 mm in diam.) in 10–11 days; sometimes the lesions got a ring-concentrical appearance. No necrosis was observed in the lesions. No systemic infection occurred and the electron microscopic examination did not reveal virus particles in newly grown leaves. The virus could be easily reisolated from locally infected leaves.

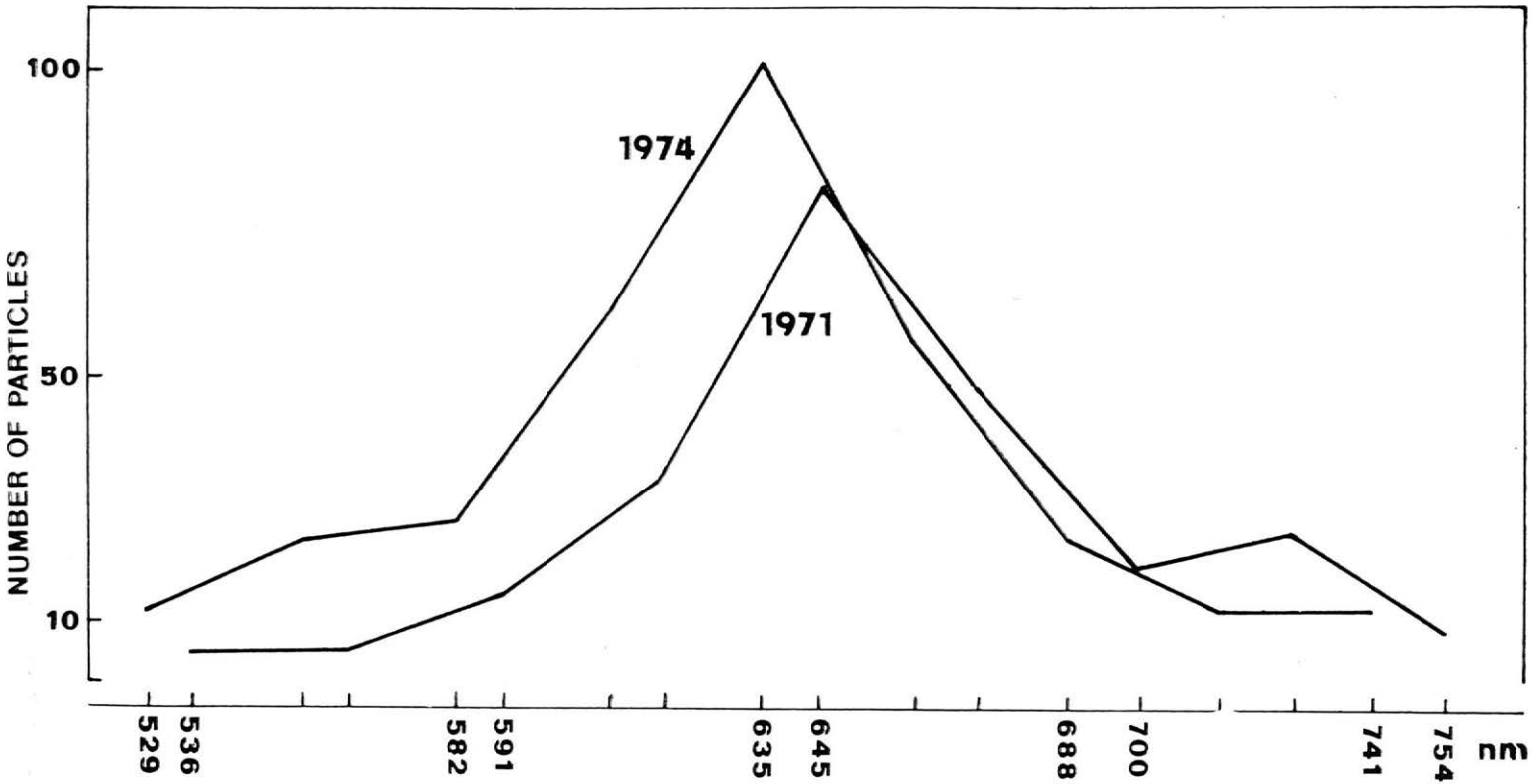
Chenopodium giganteum Don. was less susceptible to GMV than *C. quinoa* Willd.; only some of the inoculated leaves showed implications of chlorotic lesions.

Following plants were unsusceptible: Onion (*Allium cepa* L.), varieties 'Kaštická', 'Kvetoslavovská', 'Moravanka' and 'Všetatská'. Each set of an individual onion variety contained 20 plants and no virus particles could be detected in them, even 93 days after they had been inoculated. Tobacco 'Samsun' and *Nicotiana glutinosa* L. were unsusceptible as well.



1. Symptoms of garlic mosaic in a greenhouse plant of *Allium sativum* L.

2. Particles of garlic mosaic virus. Shadow--casting with platinum. × 25,000



3. Length of garlic mosaic virus particles

ATTEMPTS TO TRANSMIT INFECTIONS FROM OTHER *ALLIUM* SPECIES TO SOME DIFFERENTIAL HOST PLANTS

Virus-free garlic plants (variety 'Bzenecký paličák') supplied kindly by ing. P. Havránek, CSc., served as test plants for sap transmission experiments. Inoculation was performed according to Yarwood (1969). Garlic (*A. sativum* L.) could be infected by inocula from following species of the genus *Allium* L. (In parenthesis the numbers indicate items used in Mr Kloz's collection; BIN means the origin from the botanical garden at the Botaničeskij institut AN SSSR, Leningrad; the last word characterizes the symptom expression on garlic):

A. galanthum Kar. et Kir. (568, BIN) – severe
A. hymenorrhizum Ldb. (565, BIN) – severe
A. longicuspis Rgl. (509, BIN) – severe
A. Oschanini O. Fedtsch. (514, BIN) – mild
A. proliferum hort. (440, BIN) – mild
A. rotundum L. (577, BIN) – severe
A. sp. (sect. *Haplostemon* Boiss.) (1, peninsula Sevan, Armenia, 1900 m, Klozs leg.) – mild
A. sp. (sect. *Porrum* Don.) (2, Semjonovskij pereval, Caucasus, 2000 m, Klozs leg.) – severe
A. sp. (4, river of Baksan, Caucasus, Klozs leg.) – severe.

Attempts to transmit the isolates mentioned from garlic to broad bean (*Vicia faba* L.), *Pisum sativum* L., *Trifolium hybridum* L., *T. pratense* L., and *T. incarnatum* L. failed. These plants were unsusceptible to our isolates of GMV too.

ELECTRON MICROSCOPY OF GMV PARTICLES

Elongated flexuous virus particles were found in mosaic diseased garlic (Fig. 2). The measurement of particle length gave following results:

Investigated in the year:	1971	1974
Number of measurable particles:	287	508
Main maximum of the particle length:	536–754 nm	529–741 nm
Particle number in the main maximum:	235 (82 %)	322 (63 %)
Normal length (NL):	645 nm	635 nm
Number of particles showing NL:	80	101

Fig. 3 demonstrates the character of main maxima. The particle diameter was estimated according to a comparison with TMV particles in electron micrographs of negatively stained specimens. The diameter of GMV particles is about 14 nm.

ELECTRON MICROSCOPIC INVESTIGATION OF OTHER *ALLIUM* SPECIES

Twenty six species of the genus *Allium* L. were investigated. No virus particles could be detected in following *Allium* species: (Abbreviations are explained in the second chapter of the "results".)

A. albidum Fisch. (449, 572, BIN)
A. altaicum Pall. (562, Botanical garden Novosibirsk)
A. Barszewskii Lipsky (508, BIN)
A. caesium Schrenk (504, BIN and 177, Issyk river delta, Kazakhstan)
A. galanthum Kar. et Kir. (500, 568, BIN)
A. giganteum Rgl. (512, BIN)
A. grande Lipsky (166, BIN)
A. hymenorrhizum Ldb. (502, BIN)
A. longicuspis Rgl. (280, BIN)
A. nutans L. (563, Botanical garden Novosibirsk)
A. pskemense B. Fedtsch. (517, BIN)
A. rotundum L. (501, 505, 577, BIN)
A. scabrellum Boiss. et Buhse (507, BIN)
A. stipitatum Rgl. (513, BIN)
A. victorialis L. (533, Bajkal, leg. Klozs)
A. sp. (3, Kazbegija, Gruzia, 1500–1800 m, leg. Klozs)
A. sp. (6, Baksan river, Caucasus, leg. Klozs)
A. sp. – four species (285, 571, 575, 576, BIN)

Virus particles resembling by their shape and size GMV particles were found in following *Allium* species:

A. longicuspis Rgl. (509, BIN)
A. proliferum hort. (440, BIN)
A. sp. (sect. Haplostemon Boiss.) (1, Sevan peninsula, Armenia, 1900 m. leg. Klozs).
A. sp. (sect. *Porrum* Don.) (2, Semjonovskij pereval, Caucasus, 2000 m, leg. Klozs)

Investigation of further species also revealed flexuous virus particles. but their size could not be precisely defined:

A. hymenorrhizum Ldb. (565, BIN)
A. Oschanini O. Fedtsch. (514, BIN)
A. sp. (4, Baksan river, Caucasus, leg. Klozs).

DISCUSSION

Electron microscopic investigation of shadow-casted elongated virus particles allows an approximate determination of their size, esp. of their length. Electron micrographs taken at a magnification of about 14,400 and enlarged optically seven times show particles magnified by 100,000. It is difficult to limit precisely both particle ends at intervals shorter than 1 mm (equivalent to 10 nm) and to avoid further mistakes with flexuous particles. The mistake grows with larger particles. (Let us ignore here artificial influences of specimen preparation and the function of an electron microscope itself). I suppose that confusing results obtained by some authors e. g. in the case of determining the particle size of OYDV could

be due to using unreliable standards for comparison. (E. g. the length of other flexuous viruses used as internal reference must be known precisely, and – as a standard – it must be shown in a histogram at least.) Therefore I can say merely that the two dimensions of GMV particles (640 × 14 nm) were derived from the well known dimensions of TMV particles treated in the same way.

I have not exhausted all possibilities of checking susceptibility of a wider host range implicated by Havránek (1973). Nevertheless, the susceptibility of garlic to some isolates and the failure of their transmission to onion, broad bean, pea, and three species of clover suggest that the isolates mentioned are related to GMV or belong to the GMV group. Havránek (1973) also proved GMV infection in *A. longicuspis* Rgl. The problem of *Allium* viruses needs, of course, an investigation of their antigenic properties.

It should be noted, from the systematical point of view, that *A. sativum* L. was susceptible to viruses isolated from species belonging to following sections: *Rhiziridium* Don., *Cepa* Prokh., *Haplostemon* Boiss., and *Porrum* Don. (cf. Komarov, 1935). Consequently, if OYDV and GMV were unrelated viruses, they would not have the host ranges of *Allium* species closely depending on their systematical relationship.

Many *Allium* plants which were infected with flexuous viruses originated from botanical gardens, so that they could be infected there secondarily. Nevertheless, GMV-like viruses were also found in some wild species which were collected in natural localities of Caucasus lying in great distances far from cultivated plants. The latter plants were transported immediately (as bulbs without foliage) into controlled conditions, so that they must have been diseased in nature. This can be considered an evidence of a natural occurrence of GMV related viruses in wild *Allium* species.

Acknowledgements: I am grateful to Mrs. Eva Klozová, CSc., and Mr. J. Kloz, CSc., for supplying me with samples of *Allium* species grown in their collection. I express my sincere thanks to ing. P. Havránek, CSc., for sending me seeds of healthy *Allium* test plants and for informing me of his experience in research of *Allium* viruses.

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BRČÁK J. (Ústav experimentální botaniky ČSAV, Praha). *Částice viru mozaiky česneku a virózy některých planých druhů rodu Allium L.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 237-242, 1975.

V listech česneku (*Allium sativum* L.) nakaženého mozaikou byly zjištěny vláknité virové částice normální délky 640 nm a o průměru 14 nm. Částice podobných rozměrů byly nalezeny též v *Allium hymenorrhizum* Ldb., *A. longicuspis* Rgl., *A. Oschanini* O. Fedtsch., *A. proliferum* hort. a ve třech planých (dosud nedeterminovaných) druzích rodu *Allium*, dovezených J. Klozem a E. Klozovou z původních lokalit Kavkazu. Z uvedených druhů a též z *A. galanthum* Kar. et Kir. a z *A. rotundum* L. byly izolovány viry přenosné na česnek. Tím je dokázána existence virů příbuzných viru mozaiky česneku v planých druzích rodu *Allium* v přírodních podmínkách Kavkazu a v dalších planých druzích rodu *Allium* pěstovaných v botanických zahradách.

mozaika česneku; částice viru; plané druhy *Allium*

БРЧАК Я. (Институт экспериментальной ботаники ЧСАН, Прага). **Частицы вируса мозаики чеснока и вирусные заболевания некоторых диких видов** *Allium* L. Sbor. ÚVTI - Ochr. rostl. 11 (4) : 237-242, 1975.

В листьях чеснока (*Allium sativum* L.), зараженного мозаикой, были обнаружены нитевидные вирусные частицы 640 X 14 нм. Частицы подобных размеров найдены также в *Allium hymenorrhizum* Ldb , *A. longiouspis* Rgl., *A. Oschanini* O. Fedtsch., *A. proliferum* hort. и в трех дикорастущих (пока не определенных) видах *Allium*, доставленных Й. и Е. Клоз из природных условий Кавказа. В названных видах, а также в *A. galanthum* Kar. et Kir. и в *A. rotundum* L., были найдены вирусы, которые были перенесены соком на чеснок. Это служит доказательством существования вирусов, родственных вирусу мозаики чеснока в дикорастущих видах *Allium* в природных условиях Кавказа и в других диких видах *Allium*, растущих в ботанических садах.

мозаика чеснока; частицы вируса; дикорастущие виды чеснока

BRČÁK J. (Institut für experimentelle Botanik der Tschechoslowakischen Akademie der Wissenschaften, Praha). *Partikeln des Knoblauchmosaiksvirus und Virosen einiger wilden Arten der Gattung Allium L.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 237-242, 1975.

In den Blättern der mit Knoblauchmosaik infizierten Pflanzen (*Allium sativum* L.) wurden gestreckte flexible Viruspartikeln 640 X 14 nm festgestellt. In dem Blättern von *Allium hymenorrhizum* Ldb., *A. longicuspis* Rgl., *A. Oschanini* O. Fedtsch., *A. proliferum* hort. und drei wilden (noch nicht bestimmten) *Allium*-Arten, welche von J. Kloz und Eva Klozová an den natürlichen Fundorten in Kaukasus gesammelt waren, wurden ähnliche Virusteilchen gefunden. Aus den Pflanzen der genannten Arten und auch aus *A. galanthum* Kar. et Kir. und *A. rotundum* L. wurden an Knoblauch mechanisch übertragbare Viren isoliert. Damit wird die Existenz, der dem Knoblauchmosaikvirus verwandten Viren in den wilden *Allium*-Arten in den natürlichen Bedingungen von Kaukasus und in weiteren in den botanischen Garten angebauten *Allium*-Wildarten, bewiesen.

Knoblauchmosaik; Viruspartikeln; *Allium*-Wildarten

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THE DIAGNOSIS OF BEET YELLOWS VIRUS IN BEET PLANTS WITHIN AUTUMN PERIOD

J. POLÁK, H. HARTLEB AND H. OPEL

POLÁK J., HARTLEB H., OPEL H. (Institute of Plant Protection, Praha - Ruzyně, Institute of Phytopathology Aschersleben). *The Diagnosis of Beet Yellows Virus in Beet Plants within Autumn Period.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 243-251, 1975.

The reliability of beet yellows virus (BYV) diagnosis in leaf samples of beet plants naturally infected with beet yellows virus and beet mild yellowing virus (BMYV) was investigated during the autumn period. Diagnosis based on leaf symptoms is not exact. Among the examined objective methods, the biological method of mechanical BYV transmission to *Chenopodium quinoa* Willd. and the serological precipitin drop method were found to be reliable. Using the precipitating double-diffusion method in agar the BYV was demonstrated in a lower number of beet samples. To identify BYV in old beet leaves with yellowing symptoms during autumn season we recommend for the practice the quick and economical serological precipitin drop method. Serological negative samples can be reexamined with the biological test on *C. quinoa* to enhance the reliability.

beet; BYV and BMYV infection; BYV serological and biological diagnosis

In countries with extended cultivation of sugar beet, where the rate of yellows viruses in beet plants is higher, the question of a reliable diagnosis of these virus diseases is getting more urgent. There are two main goals to be reached by elaboration of a reliable diagnosis. Firstly the establishment of economical protective precautions to reduce yellows diseases in beet fields and to prevent their spread; secondly the breeding for virus yellows resistance. Two economically important viruses in beet plants occur in European countries: beet yellows virus (BYV) and beet mild yellowing virus (BMYV). A reliable diagnosis of these viruses is made difficult by the fact that viruses occur commonly as a complex in fields. The symptoms of the diseases on beet plants are similar and hardly distinguishable. Therefore, an estimation of the occurrence of both viruses in beet fields according to the symptoms is often very difficult even for a plant virologist. The methods of virus transmission to differential hosts, serological and electronmicroscopic methods belong to the most frequently used methods for objective virus identification. In the case of BMYV, only the method of virus transmission with the aphid *Myzus persicae* Sulz. to indicator plants is possible to be used according to our scanty knowledge. The method is very laborious, the incubation period is long. Some more possibilities are in the case of BYV diagnosis. However, the most sensitive diagnostic method of local lesions is limited by the difficult mechanical transmission of BYV. Polák and Klír (1969) found the local reaction of the indicator plant *Chenopodium quinoa* Willd. on BYV. C. *quinoa* reacts after the inoculation with BYV strains of different virulence always with local lesions (Polák 1971a).

The number of local lesions is proportional to the virus concentration in the inoculation sap. This plant can be also used for the estimation of thermal inactivation point and dilution end point of BYV (Polák, 1971b). C. *quinoa* for diagnostic purposes of BYV in beet plants was used by Opel and Fuchs (1975). The most frequently used methods in BYV diagnosis are the serological methods (e.g. Van Slogteren, 1950; Bercks and Zimmer, 1956; Jermoljev and Laštovková, 1956; Polák and Chod, 1969) and lately the precipitin double-diffusion method in agar (Pozděna et al., 1972). Serological BYV diagnosis was formerly supposed to be less reliable (Jermoljev, 1967). Especially unspecific reactions toward the end of the vegetative period bring about some difficulties. But just autumn is very important as regards beet yellows diagnosis. It is possible to estimate approximately the whole loss from the percentage of yellows diseases, the effectiveness of spraying against vectors from the average of some years and some other precautions against virus spread.

We tried to point out the reliability of BYV diagnosis during the autumn season in leaf samples of beet plants with yellows symptoms from various places in GDR using different methods. We compared subjective symptom evaluation of samples, the method of the mechanical inoculation on C. *quinoa*, the serological precipitin methods, the drop method according to Jermoljev and Hruška (1939) and the radial double-diffusion method in agar according to Ouchterlony (1948). We appreciated the suitability of serological methods for the application in practice in a similar manner as it was described by Opel and Fuchs (1975), who combined the serological precipitin drop test with the biological test on C. *quinoa* as test plant for diagnostic purposes of BYV in young beet plants under glasshouse conditions.

MATERIAL AND METHOD

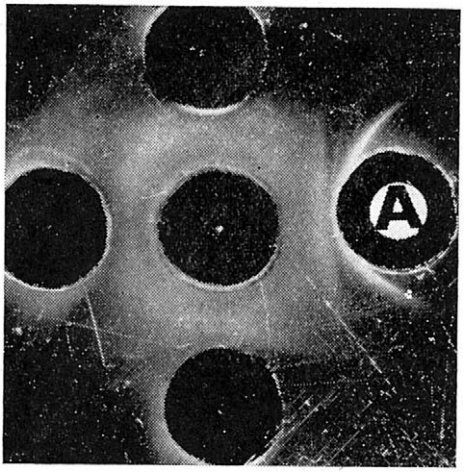
In our experiments, we examined 87 leaf samples from beet plants naturally infected with yellows viruses. Every investigated sample was represented by a beet leaf with yellows symptoms. We carried out visual appreciation of the samples according to their symptoms and divided the samples in three groups: BYV symptoms, BMYV symptoms and symptoms of both viruses. All leaves were brittle and thickened (BYV, BMYV symptoms), so that we excluded the possibility of physiological yellows. Characteristic leaf symptoms caused by the BYV are necrotic dots and lines and pale yellowish coloured areas, which often are limited by main veins of the leaf blade. BMYV-infected beet leaves never exhibit necrosis but change colour to orange yellowish, which often begins from the edge of the leaf blade. Moreover the leaf veins and neighbouring tissue remain green coloured. The presence of BMYV was established by some positive transmission experiments carried out with the vector *Myzus persicae* and the test plant *Capsella bursa-pastoris* (L.) Med.

One part of each leaf sample was used to obtain sap for serological diagnosis, the second remaining part for mechanical transmission to C. *quinoa*.

Mechanical transmissions were carried out according to Opel and Fuchs (1975). Each leaf sample (1 g) was homogenized in a mortar with tap water (4 ml) and some activated charcoal. The obtained sap was immediately inoculated on carborundum dusted leaves of the indicator plants using a glass spatula. The C. *quinoa* plants were in the stage of ten to twelve true leaves. Each sample was inoculated on six leaves of three C. *quinoa* plants. We counted the BYV-specific necrotic local lesions after an incubation period of 20—21 days.

The remaining second part of the samples was homogenized in a mortar or in an electric press with 0.01 M veronal — 0.007 M phosphate buffer and 0.007 M EDTA, pH 7.8; 1 ml of buffer was used for 1 g of leaves. The obtained sap was used without centrifugation for the serological double diffusion method in agar. Two to three drops were always immediately dropped into wells in the agar. The sap used in precipitin drop method was filtrated and centrifuged for 15 minutes at 8.700 g on a Janetzki centrifuge under cooling (4 °C).

We worked with the antiserum prepared according to Polák (1974). The antiserum was diluted with the physiological solution 1 : 16 for the precipitin drop method to enable comparison with the double diffusion in agar, when the antiserum titre is low. In the drop method, the antiserum remains equally sensitive to the dilution 1 : 64 to 1 : 128. In experiments with double diffusion method in agar, we used the absorbed and fractionated antiserum following the method of Uyemoto et al. (1972) to avoid its unspecific reactions (Polák et al., in press). The antiserum was diluted 1 : 2 and 1 : 16 with the physiological solution. We used 1 % Difco Noble agar in the phosphate buffer pH 7.2 with added 0.009 M EDTA and 0.01 % sodium azide. The warm agar solution was distributed by 15 ml in Petri dishes 10 cm in diameter. We chose the radial arrangement of the wells with the antiserum in the central well (Fig. 1).



1. Gel-diffusion serological test of BYV. Centre well contains antiserum to BYV diluted 1 : 2 with the physiological solution. Well 'A' contains sap from sample 57 of beet leaf reacting positively, other wells contain sap from samples 56, 58 and 59 respectively without reaction

Evaluation of the precipitin tests:

Experiments in which the precipitin drop method was used were arranged according to Jermoljev and Hruška (1939); normal serum in dilution 1 : 10 was dropped for control to the right side of a microscope slide. Serological reactions were measured after ten minutes in a dark field of a low-powered microscope under the magnification 15 X. The measurement was repeated after thirty minutes.

The precipitin reactions obtained by the double-diffusion method in agar were measured after 24 hours. Since the reactions are often not distinct, we raised them with the solution of acetic acid (Richter et al.). This method is quick, simple, suitable for practice and is equivalent to the reactions enhanced by organic dyes.

RESULTS AND DISCUSSION

The results of our experiments are given in Table I. From 87 investigated samples, 6 samples were qualified according to leaf symptoms as infected with BYV, 26 samples as infected with both viruses and the remaining as infected with BMYV. In seven cases, designated as infected

I. Beet yellows identification according to the evaluation of leaf symptoms, compared with the biological and serological tests on the BYV presence

Number of samples	Symptoms	No. of LL on *C. quinoa*	Serological precipitin methods	
			Drop	Double diffussion
1	BYV	57	+	+
2	BYV	273	+	+
3	BYV, BMYV	35	+	+
4	BMYV	—	—	—
5	BMYV	—	—	—
6	BMYV	—	—	—
7	BMYV	—	—	—
8	BMYV, BYV	—	—	—
9	BMYV	—	—	—
10	BMYV	—	—	—
11	BYV, BMYV	58	+	+
12	BMYV, BYV	16	—	—
13	BMYV	—	—	—
14	BMYV	—	—	—
15	BMYV	—	—	—
16	BMYV, BYV	47	+	—
17	BYV	60	+	+
18	BMYV	—	+	+
19	BMYV	—	—	—
20	BMYV	—	+	—
21	BYV, BMYV	4	+	—
22	BMYV	—	—	—
23	BMYV, BYV	—	—	—
24	BMYV	—	—	—
25	BMYV	78	+	—
26	BMYV	—	—	—
27	BMYV	46	+	+
28	BMYV	—	—	—
29	BMYV, BYV	8	+	—
30	BMYV	—	—	—
31	BMYV	—	—	—
32	BMYV	—	—	—
33	BMYV	—	—	—
34	BMYV	—	—	—
35	BMYV	—	—	—
36	BYV, BMYV	114	+	+
37	BMYV	104	+	+
38	BYV	22	+	+
39	BMYV	—	—	—
40	BMYV	—	—	—
41	BMYV, BYV	47	+	+
42	BMYV	—	—	—
43	BMYV	—	—	—
44	BMYV, BYV	4	+	—
45	BMYV	—	—	—
46	BMYV, BYV	12	+	+
47	BYV, BMYV	1	+	+
48	BMYV	3	+	—
49	BMYV	—	—	—
50	BYV, BMYV	—	—	—
51	BMYV, BYV	44	+	+
52	BMYV	—	—	—

Continuation of Tab. I

Number of samples	Symptoms	No. of LL on *C. quinoa*	Serological precipitin methods	
			Drop	Double diffussion
53	BMYV	74	+	+
54	BMYV	64	+	−
55	BMYV, BYV	76	+	−
56	BMYV	−	−	−
57	BMYV, BYV	16	+	+
58	BMYV	8	−	−
59	BYV	65	+	+
60	BMYV	−	−	−
61	BYV, BMYV	−	−	−
62	BMYV	−	−	−
63	BMYV, BYV	18	+	+
64	BMYV, BYV	−	−	+
65	BMYV	−	−	−
66	BMYV	−	−	−
67	BMYV	−	−	−
68	BMYV	−	−	−
69	BMYV	−	−	−
70	BMYV	−	−	−
71	BMYV	−	−	−
72	BYV	22	+	+
73	BMYV	−	−	−
74	BMYV, BYV	−	−	−
75	BMYV, BYV	18	+	+
76	BMYV, BYV	−	−	−
77	BMYV	−	−	−
78	BMYV, BYV	not tested	+	−
79	BMYV	−	−	−
80	BMYV	6	+	−
81	BMYV	−	−	−
82	BMYV	−	−	−
83	BMYV	−	−	−
84	BMYV	−	−	−
85	BYV, BMYV	−	−	−
86	BMYV	−	−	−
87	BMYV, BYV	4	+	+

Note: LL = local lesions on 18 leaves of 3 *C. quinoa* plants
+ = positive result
− = negative result

with both viruses according to the symptoms, BYV was found neither in biological tests nor in serological ones. On the contrary in nine samples infected according to the symptoms only with BMYV, BYV was proved in the biological and serological test or at least in one of them. In the remaining 46 samples infected according to the symptoms only with BMYV, BYV was not shown in both tests.

The presented results give evidence that it is not possible to distinguish reliably BYV from BMYV on the basis of the symptoms of virus yellows in beet plants. The transmission on an indicator plant or the

serological test are indispensable for the proof of BYV presence. The biological method of virus transmission to a host plant with local reaction belongs to the most reliable and sensitive ones. However, this method is comparatively laborious and can be evaluated after a long time

II. Evaluation and comparison of the BYV diagnosis based on the biological and serological methods

Number of samples	No. of LL/1 leaf of *C. quinoa*	The intensity of precipitation		
		Drop test	Double diffusion	
		DS 1 : 16	DS 1 : 16	DS 1 : 2
1	3.2	+++	++	++
2	15.2	+++	++	++
3	1.9	+++	+	+
11	3.2	+++	++	++
12	0.9	—	—	—
16	2.6	++	—	—
17	3.3	+++	++	++
18	0.0	+++	++	++
20	0.0	+	—	—
21	0.2	++	—	—
25	4.3	++	—	—
27	2 6	+++	+	+
29	0.4	+	—	—
36	6.3	+++	+++	+++
37	5.8	+++	+	+
38	1.2	+++	+	+
41	2.6	+++	++	++
44	0.2	++	—	—
46	0.7	+++	+	+
47	0.06 + BMV	+++	++	++
48	0.2	++	—	—
51	2.4	+++	+	+
53	4.1	++	+	+
54	3.6	++	—	—
55	4.2	++	—	—
57	0.9	++	++	+++
58	0.4	—	—	—
59	3.6	++	++	+
63	1.0	+	++	++
72	1.2	+	+	++
75	1.0	+++	+	++
78	not tested	+++	—	—
80	0.3	++	—	—
87	0.2	++	+	—

Explanation: Serological precipitation in drops:
+++ = strong
++ = middle strong
+ = weak
— = no precipitation (negative result)
Distinctiveness of the precipitation line using the double-diffusion method in agar:
+++ = slightly distinct already before enhancement with acetic acid
++ = distinct only after enhancement
+ = slightly distinct after enhancement
DS = diagnostic antiserum
BMV = beet mosaic virus symptoms

period. The incubation period of BYV on the indicator plant C. *quinoa* is approximately three weeks. On the other hand, the serological methods even though less sensitive, are preferable especially because they are expeditious and bring immediate results. This resulted in the effort to apply these methods in practice.

The aim of our work was to compare the reliability of the biological and serological BYV diagnosis on beet plants in autumn season. Thirty one beet samples reacted positively on C. *quinoa* plants. Using serological precipitin drop method and precipitin double-diffusion method in agar, we proved the BYV presence in 32 samples and 22 samples respectively. One sample serologically positive was not examined biologically and two samples positive in the biological test were serologically negative. On the other hand, some other two samples giving no reaction on the indicator plant, were serologically positive.

We tried to evaluate our results quantitatively and we calculated the number of local lesions on one leaf of C. *quinoa* and estimated the intensity of the serological reaction following a subjective scale (Table II). It is evident from the results, that the serological precipitin drop test is equivalent to the biological test on C. *quinoa* in BYV diagnosis during autumn period. The test is specific and even lower virus concentrations in plant can be estimated, when the average number of local lesions on one leaf of C. *quinoa* was lower than 1.0. A higher precipitation intensity corresponds usually with a higher average number of local lesions. Some inaccuracies are both in serological and biological tests. We did not investigate the reasons of these inaccuracies so that we are not able to say to what extent they are due, to the sensitivity of both tests, to the low virus concentration in plant or to a high content of inhibiting materials. Some difficulties in the biological test can arise, when the beet leaves also contain the beet mosaic virus, which causes local and systemic symptoms on C. *quinoa* (No. 47 with only 1 lesion of BYV). Using serological double-diffusion method in agar we demonstrated BYV on a lower number of beet samples. In comparison with the biological method we did not demonstrate the virus in such cases when C. *quinoa* reacted less sensitively forming a decreased number of local lesions. Precipitation lines were weak and were getting distinct only after treatment with acetic acid. Precipitation line specific for BYV appears close by the well with the antigen. Sometimes a second line appeared in addition closer to the well with the antiserum as a reminder of the precipitation line of soluble protein (Chairez and Lister, 1973). This line may be non-specific although absorbed antiserum was used.

Serological precipitin drop test, an economic method from the point of view of practice is suitable for BYV diagnosis on beet plants in autumn season. If a very exact diagnosis is desirable we shall examine serologically negative samples also using the biological test on C. *quinoa*, as it was demonstrated by Opel and Fuchs (1975) for young beet plants under glasshouse conditions. The method of serological precipitin drop test was also successfully used for diagnostic purposes in connection with the biological test on C. *quinoa*, the detection of BYV and BMYV by transmission to test plants with *Myzus persicae*, electron microscopic

identification of BYV, and evaluation of the yellowing symptoms caused by both viruses (Hartleb, 1975).

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POLÁK J., HARTLEB H., OPEL H. (Ústav ochrany rostlin, Praha - Ruzyně, Fytopatologický ústav, Aschersleben). *Diagnóza viru žloutenky řepy na rostlinách řepy v podzimním období.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 243-251, 1975.

V podzimním období byla zjišťována spolehlivost diagnózy viru žloutenky řepy — Beet yellows virus (BYV) ve vzorcích listů rostlin řepy přirozeně infikovaných virem žloutenky a virem mírné žloutenky řepy. Diagnóza stanovená podle příznaků na listech je nepřesná. Ze zkoušených objektivních metod je spolehlivá biologická metoda mechanického přenosu BYV na *Chenopodium quinoa* Willd. a sérologická kapková precipitační metoda. Metodou dvojité difuze v agaru byl BYV prokázán

v menším počtu vzorků řepy. K identifikaci BYV na starších listech řepy s příznaky žloutnutí v podzimním období doporučujeme praxi rychlou a hospodárnou sérologickou precipitační kapkovou metodu. Sérologicky negativní vzorky je možno přezkoušet biologickým testem na *C. quinoa.*

řepa; infekce viry žloutenky a mírné žloutenky řepy; sérologická a biologická diagnóza viru žloutenky řepy

ПОЛАК Я., ГАРТЛЕВ Х., ОПЕЛ Х. (Институт защиты растений, Прага - Рузыне; Фитопатологический институт, Ашерслебен). **Диагноз вируса желтухи свеклы на свекловичных растениях в осений период.** Sbor. ÚVTI - Ochr. rostl. 11 (4) : 243-251, 1975.

В осенний период определяли надежность диагноза вируса желтухи свеклы — beet yellows virus (BYV) на образцах свекловичных листьев, зараженных естественным путем вирусом желтухи и вирусом слабой желтухи свеклы. Диагноз, проводимый на основе признаков на листьях, неточен. Из испытанных объективных методов надежен биологический метод механического переноса BYV на *Chenopodium quinoa* Willd. и серологический капельный преципитатный метод. С помощью метода двойной диффузии в агаре BYV был установлен в малом количестве свекольных образцов. Для идентификации BYV на старых свекольных листьях с признаками пожелтения осенью рекомендуем быстрый и экономный серологический метод капельной преципитации. Отрицательные же в серологическом отношении образцы можно испытать биологическим тестом на *C. quinoa.*

свекла; инфекция вирусами желтухи и слабой желтухи свеклы; серологический и биологический диагноз вируса желтухи свеклы

POLÁK J., HARTLEB H., OPEL H. (Institut für Pflanzenschutz, Praha - Ruzyně, Institut für Phytopathologie, Aschersleben). *Nachweis des Nekrotischen Rübenvergilbungsvirus in Zuckerrübenpflanzen während der Herbstperiode.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 243-251, 1975.

Es wurde die Nachweissicherheit für das Nekrotische Rübenvergilbungsvirus (NRVV) während der Herbstperiode in Blattproben von Zuckerrübenpflanzen überprüft, die mit dem Nekrotischen und mit dem Milden Rübenvergilbungsvirus (MRVV) natürlich infiziert waren. Die Diagnose nach der Sichtbonitur der Symptome war ungenau. Von den geprüften Nachweisverfahren erwiesen sich die mechanische Übertragung des NRVV auf *Chenopodium quinoa* Willd. als biologischer Test und der serologische Präzipitin-Tropfentest als geeignet. Mit dem Präzipitin--Doppeldiffusionstest in Agar war das NRVV in einer geringeren Anzahl von Blattproben der Zuckerrübe nachweisbar. Zum Nachweis des NRVV in alten Zuckerrübenblättern mit Vergilbungssymptomen während der Herbstperiode empfehlen wir für die Praxis den schnellen und ökonomischen serologischen Präzipitin-Tropfentest. Serologisch negative Proben können zur Erhöhung der Nachweissicherheit mit dem biologischen Test auf *C. quinoa* nochmals überprüft werden.

Zuckerrübe; NRVV- und MRVV-Infektion; serologischer und biologischer Nachweis des NRVV

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REVIEW

ECOLOGY AND PROGNOSIS OF THE POTATO STOLBUR DISEASE

Bojňanský, V. — Kosljarová, V. — Užáková, I.: Ekológia a prognóza stolburu zemiaka. Poľnohosp. Veda, Ser. A (2), 1975. Veda, Publish. House of the Slovak Academy of Sciences, Bratislava, Czechoslovakia, 99 pp., 24 fig. Price 34,— Kčs

The publication will be useful for scientific, research and pedagogic co-workers at home, at universities and research institutes. The language is Slovak with extensive summaries in English, Russian and German, incl. description of tables and figures.

The potatoes, among the *Solanaceae* cultivated plants, are most often infected with the stolbur disease. Especially, in certain years, this mycoplasmatic disease plays an important role in the degeneration of potatoes. From a scientific and practical point of view the period of progradation and the beginning of culmination are very important for the basis on which it is possible to elaborate the prognosis and warning service of the occurrence intensity of the pathogen.

The authors during their 20-year observations had a chance to see the period of culmination, retrogradation and latency and thus they could evaluate the economic importance and range of the disease. They observed systematically the situation of the stolbur appearance on cultivated plants, especially on potato, tomato and tobacco, and on wildly-growing weeds, namely on bind-weed, and the main vector leafhopper *Hyalesthes obsoletus* in the warmest region of southern Slovakia. The observation and elaboration of existing and historical climatic data and their evaluation from the standpoint of the development and functions of the vector and pathogen was their task as well.

Besides the study of ecological and vectorological conditions even other factors were evaluated which could seriously influence the occurrence of the stolbur. The significant factors are also the structure and situation in agriculture, the composition of biotypes, the anthropological effect (the application of insecticides and herbicides), which can reduce or increase the effect of the first factor — the climate.

The observations and investigations, carried out for many years, of the research results of other authors, published in numerous papers from the year 1948 till 1970, allowed to elaborate the principles of a solid prognosis for the following years. Gained knowledge is used as a basis for forecasting and signalization of the disease occurrence and is useful for early and economic plant protection measures. It is the first forecasting of a mycoplasmatic disease. The research results can be applied in other regions and countries, too.

RESISTANCE OF SOME EUROPEAN SPRING BARLEY VARIETIES TO SEVEN RACES OF POWDERY MILDEW (*ERYSIPHE GRAMINIS* DC. F. SP. *HORDEI* MARCHAL)

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BRÜCKNER F. (Cereal Research Institute, Kroměříž). *Resistance of Some European Spring Barley Varieties to Seven Races of Powdery Mildew.* Sborník ÚVTI - Ochr. rostl. 11 (4) : 253-259, 1975.

European varieties of spring barley from the world collection of the Cereal Research Institute at Kroměříž were tested for reaction to seven powdery mildew races, namely *A*26, *D*10, *AmC*2, *EmC*2, *C*5, *AmC*12 and *C*16 for the resistance to this disease. It was found that 88 varieties resisted at least to some of these races. According to the reaction to individual races, the varieties were divided into 13 groups with different genetical background of resistance.

powdery mildew races; barley resistance breeding

Breeding of barley for mildew resistance has a long-time tradition in Europe, so that most varieties are characterized by this trait. At present, however, some types of resistance are more of historical than of practical importance, for the spectrum of powdery mildew physiological races has changed in individual countries to such a degree that these varieties are not any more suitable as regards the resistance.

Honecker (1931—1932) occupied himself with the first intentional breeding for resistance. Strain 'Weihenstephan CP 127422' from the cross 'Criewener × Pflugs Intensiv' bred by him, has influenced the barley breeding programme, especially in West-European varieties. Even though this resistance is of no practical importance at present, it has been found in a great number of newer varieties. The resistance gene is the same as the *Mlg* gene in the var. 'Goldfoil'.

Wild barley *Hordeum spontaneum* Koch. var. *nigrum* H 204 was the second significant genetic source for mildew resistance breeding. This barley was pointed out by Hoffmann and Kukuck (1938), but only Rudorf and Wienhues (1951) have bred a great number of resistant strains by the method of back-crossing, which affected breeding not only in Germany, but also in other countries, mainly in Great Britain. The resistance gene in this wild barley was designated *Mla*6 (Moseman et al., 1965).

The third most spread European source of mildew resistance is the Indian barley 'Lyallpur 3645' (Hoffmann, Nover, 1959), from which a great number of resistant lines have been bred. By means of a genetic analysis of one of these lines No. 4831 it was proved that the resistance gene, similarly as the *Hordeum spontaneum* gene, is located in the *Mla* locus and was designated *Mla*7 (Scholz, Nover, 1967).

Later on new mildew races occurred which were capable of attacking only some of analogues of the barley 'Lyallpur 3645' (Nover, 1968; Plate, Fischbeck, 1969; Slootmaker, 1970) and thus it was proved that 'Lyallpur 3645' contains another gene besides the gene *Mla*7. With the occurrence of the powdery mildew race which is virulent for the 'Lyallpur 3645' gene, Nover (1972) expressed the opinion that this second gene is *Mla*4 found before in the var. 'Weider C. I. 1021' (No. 22) by Luig et al. (1958). This gene is closely linked with the *Mla*7 gene and only in some lines it has come to the breaking of this linkage.

The Arabian two-rowed barley became the further significant source for the resistance breeding and the first varieties with this resistance were the Dutch varieties 'Emir' and 'Sultan'. However this resistance was soon overcome, after new powdery mildew races virulent to these varieties had occurred (W i b e r g, 1970; W o l f e, 1972).

The varieties with the middle resistance derived from the African barley *Hordeum laevigatum*, as the Dutch varieties 'Minerva' and 'Vada', resisted for a long time (A n o n y m, 1959). Later on the var. 'Minerva' was used in breeding new varieties, mainly in Denmark.

H a y e s (1973) reported that in 1971 Wolfe isolated powdery mildew cultures which were capable of infecting the var. Vada severely. W i b e r g (1974) reported some races found in Sweden which are capable of attacking *Hordeum laevigatum*.

As the var. 'Monte Cristo C. I. 1014' with the *Mla*$_9$ resistance gene was resistant to all powdery mildew races known in Europe (M o s e m a n, J ø r g e n s e n, 1971), it was used for breeding in Sweden. Nevertheless, in a short time after the first varieties with this resistance had been introduced into production, new races occurred which were virulent to the *Mla*$_9$ gene (W i b e r g, 1974). It is worth mentioning that these powdery mildew races simultaneously surmount also the resistance in varieties with the associated *Mla*$_4$ and *Mla*$_7$ genes.

MATERIAL AND METHOD

For the identification of genes mentioned above as well as other resistance sources we have intentionally carried out testing with selected races. The reaction

I. Reaction of 14 barley differentials to 7 powdery mildew races (*Erysiphe graminis* DC. f. sp. *hordei* Marchal)

Differential	Race						
	A_{22}	D_{11}	AmC_2	EmC_2	C_1	AmC_{12}	C_{11}
Weihenstephan CP 127422	R	R	S	S	S	S	S
Weihenstephan 37/136	R	S	S	S	S	S	S
Weihenstephan 41/145	S	S	S	S	S	S	S
Voldagsen 8141/44	R	S	R	R	S	R	R
Gatersleben Mut. 511	S	S	R	R	S	R	R
Gatersleben Mut. 501	R	S	R	R	S	R	R
Anatolien Hor. 1063	M	M	M	M	M	S	M
Indien Hor. 1657	S	S	S	S	S	S	S
Balkan Hor. 1036	R	S	R	R	R	R	R
Algerian C. I. 1179	R	R	R	R	R	R	S
Anatolien Hor. 1104	R	R	R	R	R	R	S
Anatolien Hor. 1402	M	M	M	M	M	M	M
Amsel	R	R	S	R	R	S	R
Emir	R	R	R	S	R	R	R

R – resistant
M – middle – resistant
S – susceptible

of the test assortment completed with further differentials to the inoculation with seven powdery mildew races is given in Table I.

The race A_{26} is the further race in group *A* differing with its virulence from 25 races of this group described up to now (N o v e r et al., 1968; W i b e r g 1970). It is avirulent to the *Mlg* gene and serves therefore for the identification of varieties possessing this gene. It is virulent to the *Mla* gene contained e. g. in the var. 'Rabat C. I. 4979'. This gene is also contained in the differential 'Algerian C. I. 1179', and in spite of it this variety is not attacked by the race A_{26} due to the fact that 'Algerian C. I. 1179' possesses the further *Mla*^{t} gene contained in the differential 'Anatolien Hor. 1104' (N o v e r, 1972). The race A_{26} is the only mildew race from the used ones which is not capable of attacking 'Weihenstephan 37/136'.

Besides the capability to identify the varieties with the *Mlg* gene, the race D_{10} can identify also the gene Mla_6 contained in the barley strain originating from the crossing with *Hordeum spontaneum* 'Voldagsen 8141/44'. It could serve for respective identification of the gene Mla_3 contained in 'Hor. 1036'.

The mildew race AmC_2 is virulent to the Mla_7 gene and serves therefore for its identification in varieties deriving their resistance from 'Lyallpur 3645'.

Similarly the further race EmC_2 which is indistinguishable from the preceding one on the standard differentials, identifies all varieties deriving their resistance from the Arabian two-rowed barley.

The mildew race C_5 is virulent to the Mla_6 gene similarly as the race D_{10}. In addition it is virulent to the *Mlg* gene. By means of these two races it is possible to distinguish the varieties containing one or both resistance genes.

Similarly the race AmC_{12} enables distinguishing the varieties deriving their resistance from 'Lyallpur 3645' with one gene Mla_7 or with both genes Mla_4 and Mla_7. The Mla_4 gene is contained in the differential 'Anatolie Hor. 1063'.

The last race from the used ones, C_{16} is virulent to the *Mla* as well as *Mla*^{t} genes and therefore the differential 'Algerian C. I. 1179' is attacked by this race. By means of the races A_{26} and C_{16} the varieties with these individual as well as associated genes may be identified.

With the races mentioned above, the European spring barley varieties newly accepted into the World barley collection at the Cereal Research Institute at Kroměříž were tested also in isolated chambers in 1970—1974.

RESULTS

According to the reaction to powdery mildew races used, the barley varieties may be divided into the following groups:

a) Varieties with the *Mlg* gene, resistant to races A_{25} and D_{10}, 'Abed Deba', 'Alma', 'Ararat', 'Aspa', 'Aspana', 'Berac','Berenice', 'Breuns Villa', 'Brevia', 'Caribou', 'Carstens Contra', 'Certa' ',Collimba', 'Cosmos 34' 'Černomorec', 'Denár', 'Damazy', 'Dukát', 'Favorit', 'Gerkra', 'Hilde', 'Imber', 'Julia', 'Krasnodarskij 35', 'Lilly', 'Lisa', 'Lola 35', 'Müllers Columba', 'Oděskij 36', 'Oriol', 'Osiris', 'Piri', 'Quantum Plus', 'Strengs Nackta', 'Topas', 'Zemyr'.

b) Varieties with the Mla_6 gene, resistant to races A_{26}, AmC_2, EmC_2, AmC_{12}, and C_{16}: 'Ametyst', 'Cristal', 'Dauphine', 'Legia', 'Midas', 'Prelude'.

c) Varieties with the *Mlg* and Mla_6 genes, resistant to all races with the exception of race C_5: 'Carina', 'Dora', 'Maris Canon', 'Medusa'.

d) Varieties with the Mla_7 gene, resistant to races A_{26}, D_{10}, EmC_2, C_5, C_{16}: 'Adora', 'Ammer', 'Derenburger', 'Hornisse', 'Visir', 'Wing'.

e) Varieties with the Mla_4 and Mla_7 genes, resistant to all races except for race AmC_{12}: 'Askania', 'Diana', 'Drossel', 'Elgina', 'Fitis', 'Galina', 'Mazurka', 'Ortolan'.

f) Varieties deriving their resistance from the Arabian two-rowed barley with the resistance to all races except for race EmC_2: 'Aramir', 'Hassan', 'Nudinka', 'Ofir'.

g) Varieties deriving their resistance from *Hordeum laevigatum* with the middle resistance to all the seven races: 'Abed Bomi', 'Abed Lofa', 'Abed Mala'.
h) Varieties with the resistance from *H. laevigatum* + the gene *Mlg*. resistant to races A_{26} and D_{10}, middle-resistant to the other races: 'Pauline', 'Multum'.
i) Variety with the resistance from *H. laevigatum* + the gene Mla_7, resistant to races A_{25}, D_{10}, EmC_2, C_5, C_{16}, middle-resistant to races AmC_2 and AmC_{12}: 'Belfor'.
j) Varieties resistant to all 7 powdery mildew races: 'Akka', 'Mona' and 'Rupal'. Of these the first two varieties contain the Mla_9 gene, 'Rupal' contains a different resistance gene.
k) Varieties with the resistance to race A_{26} only, conformable to the differential Weihenstephan 37/136: 'Moskevskij 121', 'Městnyj Gruzinskaja 6161', 17480, and 17491.
l) Variety with the probable gene *Mlat*, susceptible to race C_{16} only: 'Městnyj Gruzinskaja 6153'.
m) Variety with the composite and segregating resistance: 'Trumpf'.

DISCUSSION

From the review it is evident that still a considerable number of varieties contain only little effective gene *Mlg*. A substantially less number contained the only gene Mla_6 or in combination with the gene *Mlg*. The similar situation occurred in varieties with the gene Mla_7 or with the genes Mla_4 and Mla_7. These are mostly crosses with barley strains deriving their resistance from the var. 'Lyallpur 3645'. Only the var. 'Visir' has this resistance from the var. 'Long Glumes C. I. 6168'. The identity of the resistance in this variety with the varieties possessing the Mla_7 gene was proved by N o v e r and L e h m a n n (1972).

The race EmC_2 was capable of attacking only four varieties. Middle resistance to all the races is characteristic for the varieties with the resistance derived from *Hordeum laevigatum*. Resistance in the varieties 'Pauline,' 'Multum' and 'Belfor' gives evidence that this resistance may be combined with the gene *Mlg*, as well as with the genes at *Mla* locus.

The var. 'Belfor' contains 3 genes for powdery mildew resistance. This conclusion may be drawn not only from the reaction to the races used, but also with regard to its origin 'Minerva × (Heine 4808 × Piroline)'. Besides the gene from the var. 'Minerva', there are the associated genes Mla_4 and Mla_7 from the strain Heine 4808. Also the presence of the *Mlg* gene from the var. 'Piroline' is not excluded. For the precise genetic analysis of resistance in the var. 'Belfor' it would be necessary to make proper crossings and evaluate F_2 segregation ratios. The demonstration of the middle resistance of the Mla_4 gene cannot be distinguished from the *H. laevigatum* resistance gene on the basis of testing with different races.

Resistance in the var. 'Belfor' may be considered as the most valuable one from the set of examined varieties. In this variety it succeeded in combining the middle resistance transferred from the var. 'Minerva' and ineffective to only a small number of powdery mildew races with the

high resistance conditioned by the gene Mla_7 which is effective to comparatively wide mildew race spectrum.

This resistance based genetically in a complicated way should be given preference over the resistance in the varieties 'Akka' and 'Mone' which had not a long duration. Similarly as in these varieties, also in the var. 'Rupal' it may be expected that its resistance will be superceeded also soon. The races capable of infecting the var. 'Rupee C. I. 4345' from which the var. 'Rupal' derives its resistance, were found in Israel (E y a l et al., 1973).

Varieties in the group „k" with the resistance to the mildew race A_{26} only are quite unimportant for resistance breeding. The resistance of the local variety from Gruzia 6153 is more valuable. This resistance was found before in the older barley variety from USSR 'Krymskij 301' (B r ü c k n e r, 1965).

Quite unusual reaction to the examined mildew races was found in the newest, at present the most wide-spread variety in GDR Trumpf ('Hadmersleben 46566/68'). When inoculated with the races AmC_2 and AmC_{12}, besides the middle-resistant plants also the susceptible ones occurred. The reaction of plants to other races may be divided into three infection types: susceptibility, middle and high resistance. This middle resistance was very unbalanced in the range from 1 to 3 at the five-grade scale, 0 (highly resistant) to 4 (susceptible).

The var. 'Trumpf' is a very composite cross and many varieties participated in its resistance to powdery mildew, as well as to leaf rust of barley (*Puccinia hordei* Ott.) and stripe rust (*Puccinia striiformis* West.). As a young variety bred comparatively in a short time, it is either not genetically stabilized up to now, or it contains intentionally more lines with different genetical bases of resistance. It certainly contains the gene Mla_7, which is testified by the uniform reaction to the mildew races AmC_2 and AmC_{12}. The further middle resistance gene has probably its origin in the Ethiopian barley which is denoted in the pedigree of this variety as 'S 3170'. It is an older designation of Ethiopian barley collections gained by German expeditions.

This barley probably transferred also the resistance to barley leaf rust into the var. 'Trumpf'. The reaction of the var. 'Trumpf' to barley leaf rust was in accordance with the typical reaction of some Ethiopian varieties examined by 'Ab-,12' 'Ab-14' (B r ü c k n e r, 1970). These barley varieties are simultaneously characterized also with middle resistance to powdery mildew. However it is not excluded that the var. 'Trumpf' contains also another gene for middle resistance Mla_4.

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BRÜCKNER F. (Výzkumný ústav obilnářský, Kroměříž). *Odolnost některých evropských odrůd jarního ječmene proti sedmi fyziologickým rasám padlí*. Sbor. ÚVTI - - Ochr. rostl. 11 (4) : 253-259, 1975.

Evropské odrůdy jarního ječmene ze sbírky světového sortimentu Výzkumného ústavu obilnářského v Kroměříži byly zkoušeny sedmi vybranými rasami padlí A_{26}, D_{10}, AmC_2, EmC_2, C_5, AmC_{12} a C_{16} na odolnost proti této chorobě. Bylo zjištěno 88 odrůd s rezistencí alespoň proti některé z uvedených ras. Podle reakce k jednotlivým rasám byly tyto odrůdy rozděleny do 13 skupin s různým genetickým založením rezistence.

БРЮКНЕР Ф. (Научно-исследовательский институт зернового хозяйства, Кромержиж). **Устойчивость некоторых европейских сортов ярового ячменя против семи физиологических рас мучнистой росы.** Sbor. ÚVTI - Ochr. rostl. 11 (4) : 253-259, 1975.

Европейские сорта ярового ячменя из коллекции мирового сортимента Научно-исследовательского института зернового хозяйства в Кромержиже испытывались на семь избранных

рас мучнистой росы A_{26}, $Д_{10}$, AmC_2, C_5, AmC_{12}, EmC_2 и C_{16} на устойчивость против этого заболевания. Было найдено 88 сортов, устойчивых против некоторых из приведенных рас. Согласно реакции на отдельные расы эти сорта были разделены на 13 групп с разной генетически обоснованной степенью устойчивости.

BRÜCKNER F. (Forschungsinstitut für Getreidebau, Kroměříž). *Die Widerstandsfähigkeit einiger europäischer Sommergerstensorten gegen sieben physiologische Mehltaurassen.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 253-259, 1975.

Die europäischen Sommergerstensorten von der Sammlung des Weltsortimentes des Forschungsinstituts für Getreidebau in Kroměříž wurden durch sieben ausgewählte Mehltaurassen A_{26}, D_{10}, AmC_2, EmC_2, C_5, AmC_{12} und C_{16} auf Widerstandsfähigkeit gegen diese Krankheit geprüft. Man konnte 88 Sorten mit einer Resistenz zumindest gegen einige von den angeführten Rassen ermitteln. Je nach der Reaktion gegen die einzelnen Rassen wurden diese Sorten in 13 Gruppen mit verschiedener genetischen Veranlagung der Resistenz eingegliedert.

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REVIEW

INFLUENCE OF POWDERY MILDEW (*ERYSIPHE GRAMINIS* F. SP. *HORDEI* MARCHAL) ON PHYSIOLOGICAL PROCESSES IN BARLEY

Paulech, C. — Frič, F. — Haspelová-Horvatovičová, A. — Priehradný, S. — Vizárová, G.: Vplyv múčnatky na fyziologické procesy jačmeňa. Poľnohosp. Veda, Ser. A (4), 1975. VEDA, Publish. House of the Slovak Academy of Sciences, Bratislava, Czechoslovakia, 204 pp., 65 fig. Price 23,— Kčs

In this work, experimental results of a group of scientists of the plant pathological physiology division of the Institute of Experimental Biology and Ecology of the Slovak Academy of Sciences, are reviewed; the results were obtained in the course of ten years in the region of the influence of the fungus *Erysiphe graminis* on basic physiological and biochemical processes of barley plants.

Main indications of the influence of the fungus on photosynthesis rate of single barley leaves during vegetation, on chlorophyll and carotenoid contents, as well as on the mutual relation between the mentioned assimilation pigments and photosynthesis rate are shown. Also information on mildew influence on water uptake and level, on cuticular and stomatal transpiration, on the respiration during the primary infection cycle and whole pathogenesis is provided. In addition, experimental results of the influence of the fungus on nitrogen, carbohydrate and phenolic metabolism are presented. Results of the study of mildew influence on the enzyme activity, their isozyme composition, on growth regulators (auxins and cytokinins), and on total plant growth and development, are summarized in separate chapters.

The data of the mentioned regions, obtained in susceptible and resistant plants, are compared and evaluated as to their mildew resistance. The changes in the physiology of infected host plants are associated with single stages of the pathogenesis.

A literature review of knowledge from the region investigated, and concise data on the methods applied in individual experiments are shown.

It is quite a complex and, on the whole, synthetic elaboration of the problems mentioned. The knowledge, obtained in this work, supplements the known visual knowledge of symptoms of diseases by the symptoms in physiological processes of plants. This knowledge makes it possible to analyse better the harmfulness of the mildew in barley, and contributes to know the regularities of mutual relations between the autotrophic plants and heterotrophic pathogens. In addition it forms the basis for the right orientation of integrated protection, and for obtaining the plants capable to resist infection.

This work can be recommended for scientists, researchers, pedagogues, as well as for the graduates in plant production and protection, and selection. The language is Slovak with extensive summaries in English and Russian, incl. description of tables and figures.

THE PHYSIOLOGIC SPECIALIZATION OF *ERYSIPHE GRAMINIS* F. SP. *TRITICI* IN WHEAT IN CZECHOSLOVAKIA, AS EXAMINED IN 1969 AND 1970

F. MRÁZ

MRÁZ F. (Cereal Research Institute, Kroměříž). *The Physiologic Specialization of Erysiphe graminis f. sp. tritici in Wheat in Czechoslovakia, as Examined in 1969 and 1970.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 261-266, 1975.

This contribution gives a review of the occurrence of physiologic races of powdery mildew (*Erysiphe graminis* f. sp. *tritici*) in wheat in Czechoslovakia in 1969 and 1970. The races and their frequency ascertained in 1969 are shown in Tab. I, the races and their frequency from 1970 are given in Tab. II. In addition to the races ascertained previously, in 1969 races 13 and 29, in 1970 race 3 were identified. Thus from the beginning of the study of parasite specialization the spectrum of physiologic races has been increased to 22 races altogether: 0, 1, 2, 3, 4, 13, 14, 15, 16, 18, 20, 21, 22, 23, 25, 26, 27, 29, 30, 32, 33, and 34. Up to 1970 race 3 was the most frequently occurring one, according to frequency this was followed by races 18, 0, 4, 21, 34, 15.

wheat; powdery mildew; physiologic races

The significance of powdery mildew is confirmed by the fact that up to now no winter as well as spring wheat variety grown in Czechoslovakia is resistant to this disease. Moreover, namely ever since 1970 an increasing tendency of the intensity of its occurrence may be observed, especially certain physiologic races and this is connected with varietal composition and relative representation of individual varieties in practice. There is especially the physiologic race 4 which by enlarging the growing areas sown with varieties susceptible to it ('Kavkaz'), gained host plants for propagating itself, and nowadays it is the main cause inhibiting the otherwise effective varieties from their full utilization.

We began to study the physiologic specialization of powdery mildew in the Cereal Research Institute at Kroměříž in 1965. Until that year no data were known about the spectrum and distribution of races, although powdery mildew currently occurred in wheat stands, of course to a lesser extent, and was evident in the breeding material. In 1965 we gained the first data on the race spectrum of this parasite which have been gradually supplemented in the subsequent years. Up to now the results have been published only for the years 1965 and 1966 (M r á z, 1970) and for 1967 and 1968 (M r á z, 1972). The present contribution gives information about the race spectrum found in 1969 and 1970.

MATERIAL AND METHOD

The composition of test assortment: 'Carsten V', 'Salzmünde Stamm 14/44', 'Red Fern', 'Axminster', 'Normandie', 'Halle Stamm 13471', 'Weihenstephan Stamm M1', 'Hope', 'Chul'.

Physiologic races were identified from the multiplied single-pustule isolations of parasite, in an air-conditioned chamber with artificial illumination at the temperature 15 °C ± 2 °C. In 1969 and 1970 there was a difference only in localities in which powdery mildew samples were collected for identification, and in representation of varieties from which powdery mildew samples were chosen.

RESULTS

STUDIES IN 1969

The survey of the number of collected powdery mildew samples and physiologic races ascertained in the cited localities and their frequency are shown in Table I. The data are completed with a map (Fig. 1).

1. The map of localities of sample collections and powdery mildew races identified in 1969

2. The map of localities of sample collections and powdery mildew races identified in 1970

I. Survey of the number of collected powdery mildew samples and physiologic races from individual localities in 1969

Locality	Number of powdery mildew samples from the locality	Designed physiologic races from the locality
Bohemia		
Bochov	1	3
Dobruška	1	0
Dobřenice	4	0, 1, 3, 15, 22
Hradec Králové	1	3
Jindřichův Hradec	1	3
Kněževes u Rakovníka	1	14
Lužany	1	0,1
Mělník	1	26
Písek	1	0,3
Poděbrady	1	3, 13, 14
Rychnov nad Kněžnou	1	22
Semčice	3	3, 4, 27
Slaný	1	3
Slapy	2	4, 15, 22
Úhřetice	2	0, 3, 21
Ústí n. Orl.	1	18
Moravia		
Branišovice	2	0,3
Blatnice u Veselí n. M.	1	0
Bosonohy	1	3,18
Bystřice n. Pernštejnem	1	34
Čejč	4	0, 3, 4, 27
Hrubčice	2	3, 18
Kroměříž	13	0, 1, 3, 4, 18, 20, 21
Mohelnice	1	18
Nový Jičín	1	0
Opava	1	18
Ostrava	1	0
Rožnov pod Radhoštěm	1	0
Svitavy	1	3
Šternberk	1	22
Telč	1	3
Třebíč	1	3
Zlechov u Uh. Hradiště	1	3
Slovakia		
Bučany	4	3, 18, 26, 29, 34
Gemerská Poloma	1	3
Kolta	1	3
Levice	1	15
Liptovský Mikuláš	1	15
Malý Šariš	1	3
Nové Mesto nad Váhom	1	14
Pohronský Ruskov	1	0
Radošina	2	1, 2
Rozhanovce u Košic	1	21
Sládkovičovo	5	0, 3, 4, 18, 21, 25
Solary	6	0, 3, 4, 18, 21, 27
Spišské Podhradie	1	15
Trebišov	2	3, 15, 34
Tvrdošovce	1	0, 18
Turna nad Bodvou	1	0
Víglaš	1	3
Vranov	1	3
Vrútky	1	21
Žiar nad Hronom	1	18
Žilina	1	3

The frequency of races: 0 (21), 1 (5), 2 (1), 3 (34), 4 (7), 13 (1), 14 (2), 15 (7), 18 (16), 20 (1), 21 (8), 22 (5), 25 (1), 26 (2), 27 (3), 29 (1), 34 (3).
The numbers in parentheses denote how many times the individual given races were identified.

The survey of the number of collected powdery mildew samples and physiologic races ascertained in the given localities and their frequency are demonstrated in Tab. II. The data are completed with a map (Fig. 2).

II. Survey of the number of collected powdery mildew samples and physiologic races from individual localities in 1970

Locality	Number of powdery mildew samples from the locality	Designed physiologic races from the locality
Bohemia		
Dobřenice	6	3, 4, 18, 21, 33
Klatovy	1	0
Lužany	2	3, 18
Mělník	1	3
Poděbrady	1	25
Praha	1	4
Řevničov	1	3
Semčice	2	4, 22
Slapy	3	0, 4, 15
Úhřetice	3	2, 23, 24
Moravia		
Branišovice	4	0, 4, 18, 29
Bystřice nad Pernštejnem	3	2, 4, 14
Čejč	1	18
Fulnek	1	1
Hluk u Uh. Hradiště	1	3
Hranice	1	3
Hrubčice	1	34
Kroměříž	3	3, 18, 21, 23
Olomouc	1	18
Svitavy	1	0
Slovakia		
Bučany	3	4, 18, 26
Radošina	1	4
Sládkovičovo	2	2, 21
Solary	3	4, 18
Trebišov	1	2
Víglaš	1	2

In 1970 from the total of 26 localities 49 powdery mildew samples were collected and from these 53 physiologic races were identified in Czechoslovakia.
The frequency of races: 0 (4), 1 (1), 2 (5), 3 (7), 4 (12), 14 (1), 15 (1), 18 (9), 21 (3), 22 (1), 23 (2), 25 (1), 26 (1), 29 (1), 33 (2), 34 (2).
The numbers in parentheses denote how many times the individual given races were identified.

DISCUSSION

It follows from Tables I and II that in 1969 the spectrum of physiologic races of the parasite consisted of races 0, 1, 2, 3, 4, 13, 14, 15, 18, 20, 21, 22, 25, 26, 27, 29, and 34, in 1970 there were races 0, 1, 2, 3,

4, 14, 15, 18, 21, 22, 23, 25, 26, 29, 33, and 34. When comparing these ascertained race spectra with the race scale in the period 1965 – 1968, we may see that new races were discovered in the territory of Czechoslovakia, namely races 13 and 29 in 1969 and race 23 in 1970.

Thus in the territory of Czechoslovakia the race spectrum was extended to the total of 22 races (races 0, 1, 2, 3, 4, 13, 14, 15, 16, 18, 20, 21, 22, 23, 25, 26, 27, 29, 30, 32, 33, and 34). Race 13 was found in the locality of Poděbrady on an unknown variety, race 29 in Bučany on Salzmünde St. 14/44, race 23 on 'Weihenstephan St. M_1' consistently in two localities – Kroměříž and Úhřetice. Besides the races mentioned above also some cultures of the parasite were gained, the reaction of which is different in some respects from the reaction with races described up to now. Some of them are probably new races. These are the object of further studies.

When recapitulating the present knowledge from the study of physiologic specialization from the territory of Czechoslovakia into the resultant numbers, then up to 1970 from the total of 417 isolations race 3 belongs to the most frequently identified races (80times), then there are races 18 (63times), 0 (54times), 4 (39times), 21 (31times), 34 (30times), and 15 (27times). These seven races represent almost 78 % of all isolations designed. Therefore they may be considered the economically most significant races for the contemporaneous cereal growing in our country. From these the tendency of the occurrence of race 4 is especially interesting. It is the race which attacks among winter wheat varieties grown at present the variety Kavkaz in the first place. It is because of its susceptibility to this race which was transferred to variety 'Kavkaz' from 'Salzmünder Bartweizen' (Neuzucht). This was selected for crossing because of its high resistance to rusts. With increasing the areas sown to varieties with this genetical composition in practice, we secure the conditions for the spreading of this race. Although the variety 'Kavkaz' was very good from the beginning of its growing as to the rust and powdery mildew evaluations, at the present time it preserves just the rust resistance of economically significant characteristics regarding disease resistance. Nowadays it is the variety with high susceptibility to powdery mildew, although three or four years ago it was almost without any attack.

The results of study in the last two years have proved that also in our country there are the races having a wider territory of occurrence. They are races 3, 4, 15, and 18 which show the highest frequency and were described also in other European countries – in Italy (Grasso, 1966), in Yugoslavia (Smiljaković, 1966; Stojanović et al., 1973), in Hungary (Szunics, 1969), in Germany (Nover, 1958), in Great Britain (Wolfe, 1965), in Scandinavian states – Sweden, Norway, Finland (Leijerstam, 1962; 1965), in USSR (Szunics, 1968), in Poland (Ralski, Woźniak-Strzembicka, 1972). Thus it may be supposed that all the races are uniformly pretentious to environmental conditions. It follows from their distribution that just races 3, 4, 15, and 18 have of all races the least pretension to the environment, in comparison with e. g. race 11 which is known only from Germany or race 17 which was described by Leijerstam (1962) from Sweden and later on from Poland (Ralski, Woźniak-Strzembicka, 1972).

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Příspěvek podává přehled o výskytu fyziologických ras padlí travního (*Erysiphe graminis* f. sp. *tritici*) na pšenici v ČSSR v letech 1969 a 1970. Zjištěné rasy a jejich frekvence z r. 1969 a 1970 jsou uvedeny v tabulkách. V r. 1969 byly pro území ČSSR identifikovány proti dříve zjištěným ještě rasy 13 a 29, v r. 1970 rasa 23. Jimi se rozšiřuje spektrum fyziologických ras parazita od počátku studia jeho specializace na 22: 0, 1, 3, 4, 13, 14, 15, 16, 18, 20, 21, 22, 23, 25, 26, 27, 29, 30, 32, 33 a 34. Do r. 1970 je nejpočetněji zastoupena rasa 3; pak následují rasy 18, 0, 4, 21, 34 a 15.

pšenice; padlí travní; fyziologické rasy

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В статье дается обзор о появлении физиологических рас росы злаков мучнистой (*Erysiphe graminis* f. sp. *tritici*) на пшенице в ЧССР в 1969—1970 годах. Обнаруженные расы и частота их появления в 1969 и 1970 годах приведены в таблицах. В 1969 году на территории ЧССР были идентифицированы, кроме ранее найденных, еще расы 13 и 29, в 1970 году — раса 23. Они расширяют спектр физиологических рас паразита с начала изучения его специализации до 22: 0, 1, 2, 3, 4, 13, 14, 15, 16, 18, 20, 21, 22, 23, 25, 26, 27, 29, 30, 32, 33 и 34. До 1970 года самой распространенной была раса 3; потом следуют расы 18, 0, 4, 21, 34 и 15.

пшеница; мучнистая роса злаков; физиологические расы

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A METHOD OF OBJECTIVE RESISTANCE EVALUATION TO THE LEAF SPOT (*SEPTORIA APIICOLA* SPEG.) IN CELERY

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The differences of the resistance degree of the seedlings (cca 5 true leaves) of different celery cultivars were evaluated by means of the amount of pycnidiospores per 1 g of infected material in the defined conditions. The experimental plants were subirrigated from the inoculation up to the ascertainment of the weight of their above-ground parts (trial A — 16 days, trial B — 17 days). Thus the washing off of the pycnidiospores from the leaves was prevented. All cut leaves with the known weight were given into the Erlenmeyer flasks according to the cultivars and watered (ratio 5 ml/1 g). The flask content was shaken thoroughly from time to time. The pycnidiospores from pycnidia emerged and produced a suspension with different density according to the intensity of infection of analysed material. The suspension density of the pycnidiospores (it did not change after soaking the infected material for 6 hours) was determined by means of the Bürker's chamber. From the weight data of the analysed material, the amount of used water, and the pycnidiospores suspension density — the amount of pycnidiospores per 1 g of the material was reckoned. The more susceptible variety produced 45.8 times more pycnidiospores in comparison to the more resistant variety. Differences in the virulence of different isolates of *Septoria apiicola* were determined.

celery; resistance; *Septoria apiicola*; virulence

Septoria leaf spot is a common disease of the celery leaves. In conditions favourable for the development of the disease the yields of bulbs decreased by 70–80 % (Nováková-Pfeiferová, 1962). The yield decrease is the greater the sooner in the vegetation the infection occurs; if the seedlings are already infected in hotbeds, the losses reach up to 90% (Daebeler, Giessmann, 1971). From these facts the great economical importance of this disease follows. Quite a number of possibilities exist for decreasing the infection intensity by means of repeated applications of suitable fungicides (Baumann, 1957; Hösslin, 1960; Nováková-Pfeiferová 1962; Ramson, Burth 1968 a. o.). From the point of view of integrated control of celery varieties with higher resistance degree against *Septoria* leaf spot should be bred and propagated, which would limit and/or exclude the need of fungicides application.

Böhme (1959) found considerable resistance differences among different celery cultivars against *Septoria*. At the more resistant cultivar the fructification of the fungus was substantially smaller, the infected leaves did not die, the period from the infection to the fructification was longer, the size of pycnidia and their number on the leaf area unit were smaller. Böhme (1959) based — similarly as Sörgel (1956) — the quantitative evaluation of the resistance degree on the fact that more

susceptible plants afford more suitable conditions for greater reproduction of parasites. In the case of infected celery with the fungus *Septoria apiicola*, B ö h m e (1959) chose the value of the so-called "density of pycnidia", i. e. the average number of pycnidia per 1 mm^2 of the leaf produced in a certain period (in the trial conditions in 15 days after the inoculation) in standard definable conditions. She found the pycnidia density by counting the pycnidia on all leaves of each plant in the trial, by means of a binocular magnifying glass and planimetrically ascertained the leaf area of all leaves (in mm^2); she divided the amount of pycnidia by the amount of mm^2 and the resulting portion gave the value of "pycnidia density".

S h e r i d a n (1968) studied in detail conditions suitable for the infection of celery with the fungus *Septoria apiicola*. He stated that a very strong infection occurred when the suspension with the density of 10,000 viable pycnidiospores in 1 ml of water was applied for the inoculation, and when the plants were kept for 72 hours after the inoculation in the environment with relative humidity near to 100 % and under the temperature of 15—17 °C.

B ö h m e (1959) stated differences in the virulence of *Septoria apiicola* isolates from different regions. This fact must be taken into account in resistance breeding.

The aim of the experiment was to state and verify a quick method for the objective evaluation of the resistance degree available for the analyses of the more numerous collections of breeding material, and to ascertain the differences in the virulence of the *Septoria apiicola* isolates from different regions.

MATERIAL AND METHOD

A. — THE OBJECTIVE EVALUATION OF THE DIFFERENCES IN THE RESISTANCE DEGREE OF CELERY CULTIVARS AGAINST *SEPTORIA APIICOLA*

For the trials the cultivars of the celery both slightly susceptible (cv. 'Wiener Riesen') and highly susceptible (cv. 'Non plus ultra') were used.

The inoculation was made with the mixture of pycnidiospores prepared from pure *Septoria apiicola* cultures of 12 isolates of different celery cultivars from different regions:

Isolate No.	Infected cultivar	Origin
1	'Pařížský řapíkatý'	Vegetable Research Institute Olomouc
2	Celer k řezu jemný	"
3	'Lustra'	* Holland
4	'Pražský obrovský'	Vegetable Research Institute Olomouc
5	'Ceva'	* Holland
6	'Frigga'	* G. D. R.
7	'Nerez'	Nová Ves — Ostrava
8	'Pražský obrovský'	Závada — Bohumín
9	'Pražský obrovský'	Jaroslavice — Znojmo
10	'Nerez'	Vel. Bílovice — Břeclav
11	'Pražský obrovský'	"
12	'Pražský obrovský'	Hodonice — Znojmo

Note: * — The seeds were gained from the countries mentioned.
Septoria apiicola isolated from the infected plants from first re-sowings in the Vegetable Research Institute.

The cultures of the fungus were propagated on 0.5 % decoct made of dried celery leaves, to which 2 % agar was added.

The experimental plants were grown in pots (Ø 10 cm, height 7 cm) perforated on the bottom (in each pot 5 plants, each variety in 4 pots, i. e. 20 plants). The pots

were placed in the plastic pan which enabled subirrigation and excluded the spray of the leaves. Plants were inoculated in the stage of 5—6 true leaves.

For the inoculation the pycnidiospore suspension (density 40,000 pieces in 1 ml) from the 36 days old cultures was used (after the reinoculation the cultures were incubated 14 days in the thermostat under the temperature of 17 °C, and then stored in an ice-box under the temperature near 0 °C for 22 days). For 20 plants 6 ml of the inoculum spread by means of a mouth sprayer was used. After the inoculation the plants were placed in a wet glass chamber for 8 days (relative humidity higher than 96 %) in the glasshouse with the average temperature of 20 °C. Afterwards the plants were removed from the wet chamber and placed freely on the glasshouse bench and left there 8 days. In 16 days after the inoculation the above-ground parts of the plants were cut off and their weight was immediately determined. The leaves, left freely in the air, dried and further development of the pycnidia and pycnidiospores was interrupted. The material prepared in this way (the whole quantity) from each variety was put separately in the Erlenmeyer flasks and water (5 ml/1 g of the pycnidiospore suspension remained constant. The pycnidiospore suspension was stated in the intervals 0,30, 1, 2, 4, 6, 8 and 16 hours. The contents of the flasks were thoroughly shaken before each sampling. The aim of successive sampling was to ascertain the interval of infected material soaking after which the concentration of the pycnidiospores suspension remained constant. The pycnidiospore suspension was transferred to the Bürker's chamber in which their total amount on 18 large squares (the content above 1 square was 0.1 mm^3), and from this their average amount per 0.1 mm^3 were stated. By multiplying the average amount by 10,000 the amount of the pycnidiospores in 1 ml of the suspension was stated. Since 5 ml of water were used for 1 g of the fresh matter of leaves, multiplying the pycnidiospore amount in 1 ml of the suspension 5 times gave the amount of the pycnidiospores per 1 g of the analysed material. The results are in Tab. I.

I. Effect of the time of soaking of celery foliage infected with the *Septoria apiicola* on the density of the pycnidiospores suspension (expressed in thousand pieces per 1 g of fresh matter of the above-ground parts of plants)

Time of soaking in hours	cv. Wiener Riesen (slightly susceptible)		cv. Non plus ultra (highly susceptible)	
	in thousand pieces	%	in thousand pieces	%
0.30	72,2	63.4	1,958,3	37.5
1.00	83,3	73.1	3,861,1	74.0
2.00	102,8	90.3	4,753,3	91.1
4.00	113,9	100.0	5,186,1	99.4
6.00	113,9	100.0	5,217,1	100.0
8.00	113,9	100.0	5,217,1	100.0

B. — THE VIRULENCE OF DIFFERENT *SEPTORIA APIICOLA* ISOLATES

In the trials celery cultivars slightly susceptible to *Septoria apiicola* ('Wiener Markt'), medium susceptible ('Grazer Marks') and highly susceptible ('Non plus ultra') were used. The tested plants were grown in the same way as noted in paragraph A.

Each variety was inoculated separately with the suspension of pycnidiospores from each isolate (see paragraph A). The suspension of pycnidiospores was prepared from the pure culture of the 2 months old fungus (1 month incubation in thermostat under 17 °C, 1 month kept in the ice-box — temperature near to 0 °C); in all cases the same amount of the inoculum (2 ml for 5 plants) with the same density (20,000 pycnidiospores in 1 ml) was applied. After the inoculation the potted plants placed

in the plastic pans were kept in the glasshouse (3 days in the wet chamber with the relative humidity higher than 96 %, 14 days freely on the bench under the temperature of 17—22 °C and subirrigated. The above-ground parts of the plants were cut off 17 days after the inoculation, weighed in the turgescent state and dried in fresh air. The amount of the pycnidiospores per 1 g of the original fresh matter was stated in the same way as in paragraph A after soaking for 6 hours. The results are in Tab. II.

II. Virulence of different isolates of Septoria apiicola on slightly (cv. 'Wiener Markt'), medium (cv. 'Grazer Markt') and highly susceptible (cv. 'Non plus ultra') celery cultivars expressed in thousand pieces of pycnidiospores per 1 g of fresh matter of the above-ground plant parts

Isolate No.	Cultivar			$\bar{x}$
	Wiener Markt	Grazer Markt	Non plus ultra	
1	28	144	500	224.0
2	17	72	183	90.7
3	39	172	206	139.0
4	11	50	367	142.7
5	33	139	617	263.0
6	39	117	300	152.0
7	78	150	100	109.3
8	39	78	317	144.7
9	44	72	189	101.7
10	39	122	272	144.3
11	33	39	194	88.7
12	33	56	283	124.0
$\bar{x}$	36	101	294	—

RESULTS

A. On the susceptible cultivar 'Non plus ultra' the first symptoms of infection, together with the start of the pycnidia production occurred already on the 10th day after inoculation. Symptoms of the infection were very striking the 16th day after the inoculation; the large amount of pycnidia appeared on the infected parts of the leaves. Since the infected plants were subirrigated, the pycnidiospores were not washed off from the leaves, they mostly remained in the pycnidia and/or they partly emerged from the ostiols of pycnidia in thin spirals but they did not separate from pycnidia. This fact enables quantitative determination of the pycnidiospore amount per 1 g of the fresh matter. When the infected material was put in water, the pycnidiospores emerged from the pycnidia and dispersed in water. The trial proved that it was necessary to soak the infected leaves for at least 6 hours (Tab. I) if constant density of the pycnidiospore

suspension was to be reached. The infected material had to be shaken thoroughly with water before placing the suspension in the Bürker's chamber. The suspension density was the same even after 16 hours of soaking; the pycnidiospores did not germinate at that time.

In the experimental conditions striking differences between the resistance degrees of both cultivars were stated; at the more susceptible cultivar ('Non plus ultra') 45.8 times more pycnidiospores were stated as compared with the more resistant cultivar ('Wiener Riesen').

B. The results in Tab. II suggest certain differences in the virulence between the isolates from different origin. The highest rate of the virulence was stated in isolate No. 5 from the infected leaves of the cultivar 'Ceva' (after the first re-seeding of seeds from the Netherlands), the lowest in isolate No. 11 from the infected leaves of the cultivar 'Pražský obrovský' (origin JZD Vel. Bílovice). In this trial marked differences were found among the cultivars with regard to the rate of infection.

The number of the pycnidiospores per 1 g of the fresh matter in the most susceptible cultivar 'Non plus ultra' was substantially decreased as compared with trial A (Tab. I). It was evidently affected by use of lower concentrations of the pycnidiospores in the inoculum and by shorter duration of the incubation of the inoculated plants in the wet chamber.

DISCUSSION

Reliable methods of the infection with parasites facilitate plant breeding for resistance against some diseases. The more susceptible plants give more suitable conditions for the reproduction of parasites (S ö r g e l, 1956); with lower reproduction of parasites, higher rate of resistance can be deduced.

B ö h m e (1959) developed the method of objective evaluation of celery resistance against *Septoria apiicola*. She chose the value „density of pycnidia" per 1 mm^2 of leaf as an indicator. This method is exact but technically and temporarily very pretentious. The method of determining the number of pycnidiospores per 1 g of matter, described and verified in this contribution, is also exact but considerably easier and quicker. It enables an objective evaluation of resistance of the greater collection of breeding material of celery. It is not necessary to analyse the material immediately after the incubation time had ended. The infected material of the above-ground parts of the plant can dry in fresh air after weighing (by which it is conserved) and analysing need not to be done during the work „peaks".

However, it is probable that the method of determining the number of pycnidiospores per weight unit (e. g. 1 g of fresh and/or dried matter of the plant host) perhaps can be applied in other plant species, the above-ground parts of which used to be infected by the parasites of the group *Sphaeropsidales*.

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JANÝŠKA A. (Výzkumný ústav zelinářský, Olomouc). *Metoda objektivního hodnocení rezistence celeru proti septorióze.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 267-273, 1975.

Rozdíly ve stupních rezistence mladých rostlin (asi 5 pravých listů) různých kultivarů celeru byly hodnoceny počtem pyknospór na 1 g infikovaného materiálu za definovaných podmínek. Pokusné rostliny byly od inokulace až do doby zjišťování hmotnosti (v pokuse A 16 dnů, v pokuse B 17 dnů) jejich nadzemních částí zavlažovány spodem. Tak se zabránilo splavování pyknospor z listů. Všechny odstřižené listy o známé hmotnosti byly podle kultivarů vloženy do Erlenmayerových baněk a zality vodou v poměru 5 ml na 1 g. Obsah baněk se občas dobře protřepal. Pyknospory z pyknid vystoupily a vytvořily suspenzi o různé hustotě v závislosti na intenzitě napadení rozborového materiálu. Hustota suspenze pyknospor (neměnila se po namáčení infikovaného materiálu 6 hodin) se zjišťovala pomocí Bürkerovy komůrky. Z údajů o hmotnosti rozborového materiálu, množství použité vody a zjištěné hustoty suspenze pyknospor se vypočetlo jejich množství na 1 g materiálu. Na náchylnější odrůdě se vytvořilo 45,8× více pyknospor než na odrůdě odolnější. Byly zjištěny rozdíly ve virulenci různých izolátů *Septoria apiicola.*

celer; rezistence; *Septoria apiicola*; virulence

ЯНЫШКА А. (Научно-исследовательский институт овощеводства, Оломоуц). **Метод объективной оценки устойчивости сельдерея против пятнистости белой.** Sbor. ÚVTI - Ochr. rostl. 11 (4) : 267-273, 1975.

Различия в степени устойчивости молодых растений (примерно 5 настоящих листьев) разных культиваров сельдерея определялись по числу пикноспор на 1 г инфицированного материала в определенных условиях. Опытные растения, от инокуляции вплоть до установления веса (в опыте А 16 дней, в опыте В 17 дней) их надземных частей, орошались снизу. Таким образом, было воспрепятствовано сплаву пикноспор с листьев. Все отделенные листья с известным весом согласно культиварам были вложены в колбы Эрленмайера и залиты водой в среднем 5 мл на 1 г. Содержание колб время от времени необходимо хорошо взболтнуть. Пикноспоры из пикнид вышли и образовали суспензию разной густоты в зависимости от поражения анализируемого материала. Густота суспензии пикноспор (которая не менялась после смачивания инфицируемого материала в течение 6 часов) устанавливалась при помощи камеры Бюркера. Из данных о весе анализируемого материала, количества использованной вды и установленной густоты суспензии пикноспор было вычислено их количество на 1 г материала. На самом неустойчивом сорте образовалось в 45,8 раз пикноспор больше, чем на устойчивом сорте. Были установлены различия в вирулентности разных изолятов *Septoria apiicola.*

сельдерей; устойчивость; *Septoria apiicola*; вирулентность

JANÝŠKA A. (Forschungsinstitut für Gemüsebau, Olomouc). *Eine Methode der objektiven Bewertung der Resistenz des Selleries gegen die Blattfleckenkrankheit.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 267-273, 1975.

Unterschiede der Widerstandsfähigkeitsstufen junger Pflanzen (annähernd 5 echte Blätter) verschiedener Sellerie-Kultivare wurden durch die Anzahl von Pyknosporen je 1 g infizierten Materials unter definierten Bedingungen bewertet. Die Versuchspflanzen wurden seit der Inokulation bis zur Zeit der Gewichtsfeststellung (bei dem Versuch A 16 Tage, bei dem Versuch B 17 Tage) ihrer oberirdischen Teile von unten bewässert. Auf diese Weise wurde das Abschwemmen der Pyknosporen von den Blättern verhindert. Alle abgeschnittenen Blätter von bekanntem Gewicht wurden je nach den Kultivaren in Erlenmayer-Kolben eingelegt und mit Wasser im Verhältnis von 5 ml je 1 g übergossen. Der Kolbengehalt wurde zeitweise gut durchgeschüttelt. Die Pyknosporen traten aus den Pykniden heraus und bildeten eine Suspension von verschiedener Dichte, in Abhängigkeit von der Intensität des analysierten Materials. Die Suspensionsdichte der Pyknosporen (die sich nach dem Eintauchen von infiziertem Material 6 Stunden nicht veränderte) wurde mittels der Zählkammer nach Bürker festgestellt. Aus den Angaben über die Masse des analysierten Materials, über die Menge des verwendeten Wassers und aus der ermittelten Suspensionsdichte der Pyknosporen berechnete man deren Menge je 1 g Material. Bei der anfälligeren Sorte bildeten sich 45,8mal mehr Pyknosporen, als bei der widerstandsfähigeren Sorte. Unterschiede bezüglich der Virulenz verschiedener Isolate von *Septoria apiicola* konnten festgestellt werden.

Sellerie; Resistenz; *Septoria apiicola*; Virulenz

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REVIEW

TRANSMISSION BY NEMATODES OF SOME GRAPEVINE VIRUSES OCCURRING IN CZECHOSLOVAKIA AND HUNGARY

Mali, V. R. — Vanek, G. — Bojňanský, V.: Transmission by Nematodes of Some Grapevine Viruses Occurring in Czechoslovakia and Hungary. Poľnohosp. Veda, Ser. A (3), 1975. Veda, Publish. House of the Slovak Academy of Sciences, Bratislava, Czechoslovakia, 132 pp., 9 fig. Price 10,— Kčs

The publication will be useful for scientific and pedagogic workers at home and abroad, for universities and research institutes. It is written in English with an extensive summary in French, Russian, German and Slovak, incl. the description of tables and figures.

The results of geographical research of the intensity occurrence of nematode species in vineyards in Czechoslovakia and Hungary are given. The occurrence continuity of some virus diseases in relation to nematodes is discussed. The research results of a transmission of some virus diseases of grapevine are described and with the works of other authors collated. The authors from the Institute of Experimental Phytopathology and Entomology of the Slovak Academy of Sciences and from the Research Institute for Vinegrowing and Wine in Bratislava report on experimental results with *Xiphinema index* and *X. vuittenezi*, on transmission of grapevine chrome mosaic, and complete thus the present-time knowledge gained in other countries and continents.

The occurrence of *Paralongidorus maximus* and *X. vuittenezi* in the vineyards of Czechoslovakia has been recorded for the first time. *X. index*, occurring in Hungary, is a known vector of grapevine yellow mosaic virus but as a vector of grapevine chrome mosaic virus it is recorded for the first time. In three years' trials it was not possible to prove that *X. vuittenezi* could be a vector of some virus disease of grapevine.

REACTION OF LUCERNE TO *VERTICILLIUM ALBO-ATRUM* AT DIFFERENT PHOTOPERIOD LENGTHS

V. KŮDELA

KŮDELA V. (Institute of Plant Protection, Praha-Ruzyně). *Reaction of Lucerne to Verticillium albo-atrum at Different Photoperiod Lengths.* Sbor. ÚVTI-Ochr. rostl. 11 (4) : 275-282, 1975.

Following inoculation by *Verticillium albo-atrum* lucerne plants were grown at daily cycles of 16 h of light — 8 h darkness (16 L — 8 D), 12 h light — 12 h of darkness (12 L — 12 D) and 8 h of light — 16 h darkness (8 L — 16 D), resp. The disease severity was estimated according to the root and top symptoms. At the longer photoperiod (16 L — 8 D) the proportion of resistant plants amounted to 24 %, while at a shorter photoperiod (12 L — 12 D or 8 L — 16 D) it decreased approximately to a half. In the shorter light period the affected plants showed symptoms of a smaller degree of infection on root cross sections and the symptoms on overground organs appeared sooner or were more conspicuous than in the case of the longer light period. By combining the action of short days (8 L — 16 D) and long days (16 L — 8 D) before and after inoculation in different ways it was shown that largest reduction of resistance in lucerne takes place when short days precede inoculation and, especially, when they were applied both before and after inoculation. Plants kept in darkness during inoculation showed a smaller degree of wilt symptoms on the root cross sections as compared to plants inoculated in light. The decrease in resistance due to short photoperiods was not equal in all varieties examined. Varieties which proved to be relatively more resistant at the longer photoperiod showed larger reduction of resistance than those appearing to be very susceptible even at longer photoperiods.

In previous experiments inconsistent results were obtained from testing lucerne varieties to *Verticillium* wilt under field- and greenhouse conditions (Kůdela, Řezáč, 1972) and indications of seasonal cycles in the development of the disease were observed in plants transferred to the open ground following inoculation (Kůdela, 1974). In view of these facts the variability of the resistance to *Verticillium* wilt in dependence on soil temperature and humidity, as well as on the conditions of plant nutrition is being investigated.

The present paper is aimed at establishing the effect of daylength on the resistance to *Verticillium* wilt and ascertaining whether the surprising reaction of potatoes to *Verticillium albo-atrum* (Bush, Edgington, 1967) and of chrysanthemum to *V. dahliae* (Bush, Schoolev, 1970) bears a more general character.

MATERIAL AND METHOD

The post-inoculation effect of daylength was studied in two experiments. In both cases lucerne plants were grown in a greenhouse from August until February under natural light conditions prior to inoculation. Following inoculation the plants

of the first series were given artificial lighting from fluorescent lamps at a total output of 400 W per square meter. The effect of natural light was excluded. One variant was given daily cycles of 16 h of light and 8 h of darkness (16 L —8 D), the second one received 12 h of light and 12 h of darkness (12 L — 12 D). The temperature of the air in the greenhouse ranged from 21 °C during the day to 16 °C at night.

The plants of the second series were grown following inoculation in a growth chamber at a constant temperature of 21 °C and at a relative air humidity of 72 %. One half of the plants received daily cycles of 16 L — 8 D, the other one cycles of 8 L — 16 D. The light intensity amounted to 8,000 lx.

The pre- and post-inoculation effect of the photoperiod was investigated in plants cultivated in the growth chamber. One part of the plants was given daily cycles of 16 L — 8 D, the second one cycles of 8 L — 16 D. The exact arrangement of experiment including different combinations of the pre- and post-inoculation effect of daylengths is shown in Tab. II. Only two control variants instead of four could be included into the experiment owing to lack of space in the growth chamber. The plants were exposed to different light conditions for three weeks prior to inoculation and for the same time following inoculation. The overground organs were cut 14 days prior to inoculating and immediately after inoculation.

7 or 9 months old plants were inoculated by dipping the cut roots for 24 h into a spore suspension of *Verticillium albo-atrum* at a concentration of 5×10^6 in 1 ml water.

In order to examine the effect of light during inoculation the overground organs of the plants were cut in a special experiment either immediately before inoculation or after it. During inoculation the plants were given either darkness or light from fluorescent lamps at 8,000 lx.

At least two varieties were included into each experimental variant. The varieties 'Hodonínka' and 'Přerovská' were mostly used. Besides, the varieties 'Stupická', 'BVR 2', 'Ondava' and 'Nitranka' were also tested. Before and after inoculation the plants were cultivated in wooden cases (30×50×10 cm) filled with topsoil. 120 plants were grown in one case prior to inoculation. Following inoculation the plants were placed into cases at a planting distance of 5×4 cm, one case containing 60 plants.

Wilt incidence and degree of infection of the individual plants were estimated according to the root symptoms. The plants in classes 0 and 1 were regarded as resistant. The disease severity for each group of plants in the single variants is expressed by the harmfulness of the disease in percent calculated from expected decrease in the yield of diseased plants as compared to healthy ones (K ů d e l a, 1970). According to the top symptoms the plants were divided into 5 classes: 0 — no wilt symptoms; 1 — leaves become pale green; 2 — sporadic wilting and desiccation of leaves; 3 — the majority of the leaves is wilting or become dry, the plant is stunted; 4 — the plant died. Wilt symptoms were evaluated three weeks after inoculation.

RESULTS

EFFECT OF DAYLENGTH ON *VERTICILLIUM* WILT

A larger proportion of resistant plants, a lower degree of infection as estimated according to the root symptoms and delaying or reduction of the symptoms on the overground organs were observed in plants exposed to a longer photoperiod (16 L – 8 D) following inoculation as compared to plants treated with shorter daylengths (12 L – 12 D or 8 L – 16 D.)

At daily cycles of 16 L – 8 D the proportion of resistant plants amounted to 24.11 percent in the first experimental series and to 24.77 percent in the second one. A reduction of daylength to 12 L – 12 D or 8 L – 16 D led to a decrease of about 50 percent in the number of resistant plants (Tab. I).

I. Post-inoculation effect of daylength on infection of lucerne by *Verticillium albo-atrum*

Experimental variant	Number of inoculated plants	Distribution of plants according to the degrees of infection in %				Wilt severity (harmfulness in %)
		Class				
		0 + 1	2 + 3	4	5 + 6	
Series I						
a) Light conditions 16 L – 8 D						
Control	60	100.00	–	–	–	0.00
Inoculation	170	24.11	16.47	34.71	24.71	45.29
b) Light conditions 12 L – 12 D						
Control	60	96.67	–	+	3.33	1.50
Inoculation	170	10.59	13.53	45.29	30.59	54.44
Series II						
a) Light conditions 16 L – 8 D						
Control	27	100.00	–	–	–	0.00
Inoculation	109	24.77	91.7	36.70	29.36	47.88
b) Light conditions 8 L – 16 D						
Control	27	100.00	–	–	–	0.00
Inoculation	110	12.72	7.27	19.09	60.90	66.09

At a longer photoperiod (16 L – 8 D) the disease severity expressed in terms of harmfulness of the disease in percent amounted to 45.29 % in the first experimental series and to 47.88 % in the second one. At 12 L – 12 D cycles the harmfulness increased to 54.44 % and at 8 L – 16 D cycles to 66.9 % (Tab. I).

At 16 L – 8 D cycles about 39 percent of all diseased plants showed the highest degree of infection, while at 8 L – 16 D cycles the same was true for about 70 percent of the affected plants.

An estimation of the wilt severity according to the top symptoms yielded more conspicuous differences in the reaction of plants grown at various daylengths than an evaluation according to the histological symptoms on root cross sections (Fig. 1).

At 16 L – 8 D cycles 9 – 19 percent more plants were classed with the resistant group according to top symptoms than according to the root symptoms, while at 8 L – 16 D cycles this difference amounted to 2 – 7 percent only. This means that at a longer photoperiod yellowing, wilting and desiccation of the leaves were delayed in plants the root vessels of which were clearly colonized by the pathogen. In other words, the longer photoperiod supported the occurrence of tolerance of lucerne to *Verticillium wilt.*

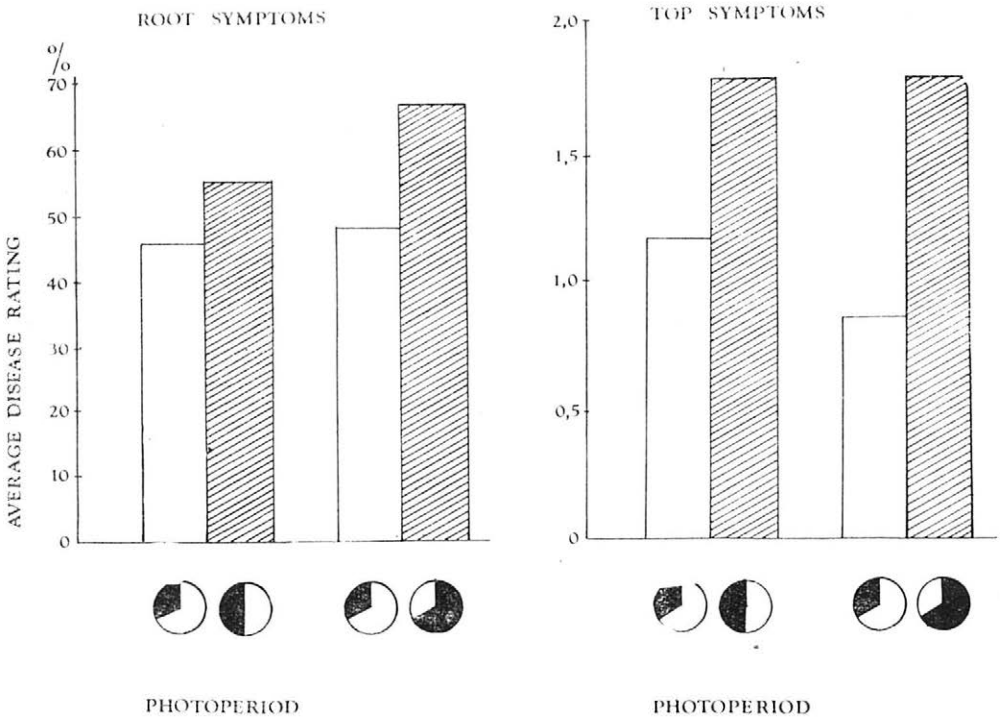

Fig. 1. Comparison of the effect of daylength on the wilt symptoms on the roots and on the overground organs

PRE-INOCULATION AND POST-INOCULATION EFFECT OF DAYLENGTH

The largest number of resistant plants (40.74 percent) and the smallest degree of infection (disease harmfulness = 33.94 percent) occurred in the experimental variants exposed to 16 L – 8 D cycles before and following inoculation.

In the variant grown at a longer photoperiod (16 L – 8 D) prior to inoculation and at a shorter one following inoculation the percentage of resistant plants amounted to 35.19 and the disease severity increased only slightly to 36.94 percent.

The manifestation of an increase in susceptibility of lucerne as a result of the effect of short photoperiods became more apparent when short days preceded inoculation. In this case the proportion of resistant plants amounted to 29.63 percent and disease severity was 44.07 percent.

In the variant in which the plants were grown at a short photoperiod (8 L – 16 D) both before and after inoculation only 7.41 percent of resistant plants were found and the disease severity was 74.44 percent (Tab. II).

EFFECT OF LIGHT DURING INOCULATION

Plants transferred to darkness during inoculation lasting 24 h showed a somewhat higher disease severity (by 1.14 to 8.46 percent) than plants

II. Pre- and post-inoculation effect of daylength on infection of lucerne by *Verticillium albo-atrum*

Experimental variant	Number of inoculated plants	Distribution of plants according to the degrees of infection in %				Wilt severity (harmfulness in %)
		Class				
		0 + 1	2 + 3	4	5 + 6	
L–L Inoculation	54	40.74	25.93	11.11	22.22	33.94
L–D Control	54	96.30	1.85	–	1.85	1.66
Inoculation	54	35.19	20.37	24.07	20.37	36.94
D–L Control	54	98.18	1.82	–	–	0.18
Inoculation	54	29.63	18.52	22.22	29.63	44.07
D–D Inoculation	54	7.41	11.11	–	81.48	74.44

Light conditions: L = 16 h light – 8 h darkness
D = 8 h light – 16 h darkness

inoculated in light. If the overground organs were cut immediately before inoculation the effect of light on the reduction of the degree of infection was less evident (Tab. III).

III. Effect of light during inoculation on infection of lucerne plants by *Verticillium albo-atrum*

Variety	Overground organs prior to inoculation	Wilt severity (harmfulness in %)	
		darkness	light
Hodonínka	cut	68.82	67.68
	not cut	80.00	74.18
Nitranka	cut	76.75	69.91
	not cut	85.46	77.00

DIFFERENCES IN THE REACTION OF THE VARIETIES TO DAYLENGTH

The decrease in resistance of lucerne to *Verticillium* wilt as a result of reduction of daylength was not identical in all varieties in the experiments used. At shorter photoperiods the decrease was larger in varieties which proved to be more resistant at a longer photoperiod than in varieties showing a high degree of susceptibility even in long days. Thus, the decrease in the occurrence of resistant plants at a short photoperiod

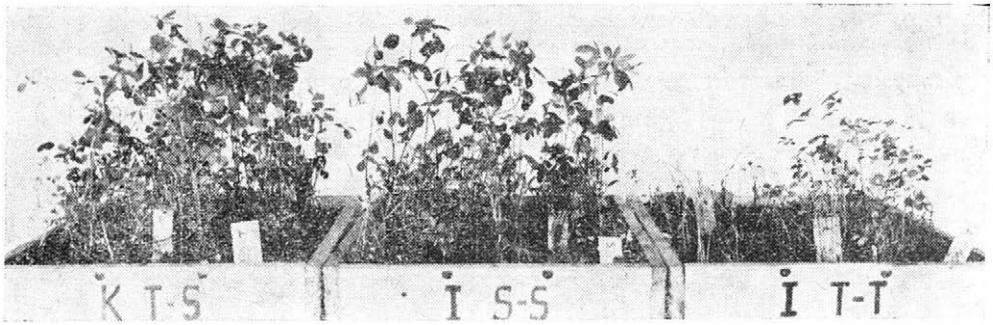

Fig. 2. Pre-inoculation and post-inoculation effect of daylength on the reaction of lucerne to *Verticillium albo-atrum*
From left to right: control plants (3 weeks short days, 3 weeks long days); inoculated plants (long days both before and after inoculation); inoculated plants (short days both before and after inoculation) Photo — M. Novák

was about twice as large in the variety Přerovská than in the variety Hodonínka. The variety Ondava showed also a relatively smaller reduction of resistance.

DISCUSSION

Unlike the effects of temperature and humidity of the environment, as well as those of fertilizing etc. the effect of daylength on infection of alfalfa by *Verticillium* wilt may be unambiguously ascribed to changes in the resistance of the host rather than to changes in aggressiveness of the pathogen.

Bush and Edgington (1967) and Bush and Schooley (1970) reported that potatoes inoculated with *Verticillium albo-atrum* and chrysanthemum inoculated with V. dahliae and grown under long-day conditions show only slight symptoms of the disease. Under short-day conditions when potatoes form tubers and chrysanthemum sets flowers severe symptoms appeared. The authors assume that these differences in disease severity at different photoperiods may be explained by the physiological state of the organism rather than by a different degree of host colonization by pathogen. It seems that the expression of the symptoms reflects aging of the host tissues which may be delayed by long days in potatoes and chrysanthemum.

The development of lucerne, too, depends on daylength (Oakley, Westover, 1921), however, the sensitivity to photoperiod is less spectacular than in potatoes and chrysanthemum. It is not possible to deduce from our experiments whether there exists a correlation of photoperiod with stage of growth of the host and the susceptibility to *Verticillium* wilt, since majority of the plants had reached the flowering condition at the termination of experiment.

The finding that susceptibility of the plants largely increases if they are grown in short days prior to infection is considered to furnish a valuable base for further work directed towards an explanation of the

effect of daylength. Light given during inoculation also proved to be relatively effective. It was possible to assume that a larger amount of spores penetrates into the host in light than in darkness. This view is confirmed by data concerning the uptake of *Verticillium dahliae* spores by mints (Melouk et al., 1973). Nevertheless, in our experiment with lucerne the symptoms of the wilt disease were less pronounced when inoculation proceeded in light than when it was performed in darkness.

The pre-inoculation effect of light, as well as the effect of light given during inoculation which we observed in our experiments with lucerne plants infected by dipping the cut roots into the inoculum, prove the decisive importance of the secondary determinants of resistance coming into play at the moment of penetration of the pathogen into the vessels.

For practical breeding of lucerne varieties our present results are made significant by showing the importance of the external conditions liable to control for testing resistance. The different light conditions might have constituted one of the main reasons leading to the differential reactions of individual varieties, as observed in our previous experiments carried out in the greenhouse and field conditions at different seasons.

It will be the scope of further experiments to define more precisely the effect of light on resistance of lucerne to *Verticillium wilt*. It should be ascertained whether photoperiodicity or the total duration of illumination and, possibly, its intensity and quality play a decisive role.

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Reakce vojtěšky vůči Verticillium albo-atrum při různé délce světelného dne. Sbor. ÚVTI - Ochr. rostl. 11 (4) : 275-282, 1975.

Rostliny vojtěšky byly po inokulaci houbou *Verticillium albo-atrum* pěstovány při světelném režimu 16 hodin světlo — 8 hodin tma (16 S — 8 T) a při světelném režimu 12 hodin světlo — 12 hodin tma (12 S — 12 T) nebo 8 hodin světlo — 16 hodin tma (8 S — 16 T). Stupeň napadení rostlin byl posuzován podle symptomů na příčném řezu kořenem a na nadzemních orgánech. Podíl odolných rostlin při delším světelném dnu (16 S — 8 T) dosáhl 24 %, zatímco při kratším světelném dnu (12 S — 12 T nebo 8 S — 16 T) klesl přibližně o polovinu. Při kratším světelném dnu vy-

kazovaly nemocné rostliny na příčném řezu kořenem symptomy mírnějšího stupně napadení a symptomy na nadzemních orgánech se objevovaly dříve a byly výraznější, než při delším světelném dnu. Různými kombinacemi působení krátkého světelného dne (8 S — 16 T) a dlouhého světelného dne (16 S — 8 T) před a po inokulaci bylo zjištěno, že k největšímu snížení odolnosti vojtěšky došlo, když krátký den předcházel inokulaci a zvláště pak při krátkém světelném dnu před i po inokulaci. Rostliny, které byly po dobu inokulace umístěny ve tmě, měly symptomy onemocnění na kořenech mírnější, než rostliny inokulované při světle. Pokles odolnosti vlivem krátkého světelného dne nebyl u sledovaných odrůd rovnoměrný. Odrůdy, které byly při delším světelném dnu relativně odolnější vykazovaly větší pokles odolnosti, než odrůdy projevující se i při delším světelném dnu jako velmi náchylné.

КУДЕЛА В. (Институт защиты растений, Прага - Рузыне). **Реакция люцерны на *Verticillium albo-atrum* при разной длине светового дня.** Sbor. ÚVTI - Ochr. rostl. 11 (4): 275-282, 1975.

Растения люцерны после инокуляции грибом *Verticillium albo-atrum* выращивались при световом режиме 16 часов свет — 8 часов — тьма (16 С — 8 Т) и при световом режиме 12 часов свет — 12 часов тьма (12 С — 12 Т), или 8 часов свет — 16 часов тьма (8 С— —18 Т). Степень поражения растений определялась по симптомам на поперечном разрезе корней и на надземных органах. Доля устойчивых растений при длинном световом дне (16 С — 8 Т) достигала 24 %, в то время как при кратком световом дне (12 С — 12 Т), или 8 С — 16 Т) понизилась примерно на половину. При кратком световом дне больные растения имели на поперечном разрезе корня симптомы слабой степени заражения, а симптомы на надземных органах появились раньше и были более заметными, чем при длинном световом дне. Путем различных комбинаций действия краткого светового дня (8 С — 16 Т) и длинного светового дня (16 С — 8 Т) до и после инокуляции было установлено, что самое максимальное понижение устойчивости у люцерны наступило, когда короткий день был накануне инокуляции и, особенно, при кратком световом дне до и после инокуляции. Растения, которые на протяжении инокуляции находились во тьме, симптомы заболевания на корнях имели более слабыми, чем у растений, инокулированных при свете. Понижение устойчивости под влияние краткого светового дня у изучаемых сортов было неравномерным. Сорта, которые при длинном световом дне были относительно более устойчивыми, отличались более сильным понижением устойчивости, чем сорта очень неустойчивые и при длинном световом дне.

KŮDELA V. (Institut für Pflanzenschutz, Praha-Ruzyně). *Reaktion von Lucerne gegen die Infektion mit Verticillium albo-atrum bei verschiedener Tageslänge.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 275-282, 1975.

Luzernepflanzen wurden nach Inokulation mit *Verticillium albo-atrum* bei folgenden Licht-Dunkel-Cyklen kultiviert: 16 St. Licht — 8 St. Dunkelheit (16 L — 8 D), 12 St. Licht — 12 St. Dunkelheit (12 L — 12 D) und 8 St. Licht — 16 St. Dunkelheit (8 L — 16 D). Die Befallsstuffe der Pflanzen wurde auf Grund der Symptome am Querschnitt durch die Wurzel und an den oberirdischen Organen beurteilt. Unter dem Einfluß einer längeren Photoperiode (16 L — 8 D) betrug der Anteil an resistenten Pflanzen 24 %, während er bei kürzeren Photoperioden (12 L — 12 D oder 8 L — 16 D) ungefähr um eine Hälfte sank. Unter dem Einfluß kürzerer Photoperioden wiesen die erkrankten Pflanzen an Querschnitten durch die Wurzel Symptome einer geringeren Befallsstuffe auf, und an den oberirdischen Organen erschienen die Symptome früher, oder waren stärker ausgeprägt als in längeren Photoperioden. Mit Hilfe von verschiedenen Kombinationen der Wirkung von Kurz- (8 L — 16 D) und Langtagsbedingungen (16 L — 8 D) vor und nach der Inokulation wurde festgestellt, daß das Absinken der Resistenz von Luzernepflanzen am größten ist, wenn der Kurztag der Inokulation vorausgeht und besonders, wenn die Pflanzen vor und nach der Inokulation unter Kurztagsbedingungen wachsen. Pflanzen, deren Inokulation in der Dunkelheit vollzogen wurde, wiesen an den Wurzeln mildere Erkrankungssymptome auf als Pflanzen, die im Licht inokuliert wurden. Die Resistenz sank unter dem Einfluß des Kurztags nicht bei allen untersuchten Sorten gleichmäßig ab. Sorten, die im Langtag verhältnismäßig resistenter waren, weisen ein stärkeres Sinken der Resistenz auf als solche, die im Langtag sehr empfindlich waren.

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RESULTS OF THIRTEEN YEARS' OBSERVATIONS OF COCKCHAFER (*MELOLONTHA MELOLONTHA* L.) SWARMING ON THE TERRITORY OF CZECHOSLOVAKIA

A. MUŠKA

MUŠKA A. (Central Control and Testing Institute of Agriculture, Brno). *Results of Thirteen Years' Observations of Cockchafer (Melolontha melolontha L.) Swarming on the Territory of Czechoslovakia.* Sbor. ÚVTI - Ochr. rostl. 11 (4) :283--294, 1975.

Studies and appropriate map documentation upon the cockchafer (*Melolontha melolontha* L.) swarming in the period 1956 till 1968 have proved that in the territory of Czechoslovakia both, three and four year frequencies (strains) occur. Occurrence of frequencies (strains) is demonstrated on attached maps No. 1—4. Evaluation of obtained results has shown that the length of three or four year development cycle depends on air temperature during the vegetation period (i. e. from April 1st till September 30th). Such an air temperature limit for Slovakia has been fixed on 13—14 °C, for Moravia-Silesia 14—15 °C. Territories with lower average temperature are occupied with four year cockchafer cycles and territories with higher average air temperature with three year cycles.

cockchafer; swarming cycles; frequencies; strains; distribution

Cockchafers become a serious pest on both the fruit and forest trees in the period of their overincreasing in number. They can have a negative effect on certain territory either every year, or every second year or once in three years or four years respectively. This depends on the length of their development (three or four years) as well as on the number of cockchafer populations, living on the territory under observation. Besides damage caused by beetles, larvae cause damage on underground parts of plants. It is therefore important to determine the territories and periodicities of cockchafer occurrence and on the base of such a survey to compile a long term prognosis.

The prognosis should identify with sufficient time start the territories of cockchafer swarming. This would enable to prepare such interventions protecting against damages, caused by cockchafers. Besides prognosis there is also the signalization, which has an important role in optimization of the timing of applying chemicals against beetles and/or larvae.

The possibility of cockchafer prognosis has been known for centuries. Maps with long term prognosis of cockchafer swarming, covering the whole country, have been published only for a limited number of European states. The oldest map of this kind was compiled in Switzerland by Heer (1841) and Decoppet (1920). The latest map was prepared and actualized by Schneider-Orreli (1949). Austrian map issued by Zweigelt (1928) has been actualized by Faber (1961). Similar long term prognosis maps exist in France by Regnier (1950), in Poland by Kozokowski (1938). According to Faber (1961) one can find sufficient data upon the cockchafer swarming in Germany — Schmidt (1926), Hungary — Szelenyi (1950), Yugoslavia — Janežić (1952). Italy is without any data (see Vicini, 1952).

The long term prognosis of cockchafer (*Melolontha melolontha* L.) swarming for Czechoslovakia has not been compiled yet. First — rather incomplete reports about the cockchafer swarming on the Bohemian territory were published by Zweigelt (1928). Later on a more detailed study upon the cockchafer swarming was compiled by Kratochvíl et al. (1953), where he introduced information about the spreading of cockchafer in Moravia. Such information about the territory of Bohemia and Slovakia were not included.

The aim of herewith delivered study is to fill this "free space", using the conclusions of longlasting observations.

MATERIAL AND METHOD

INQUIRY CAMPAIGN

Heer (1841 and Decoppet (1920) exploited the results of cockchafer collection, incorporating the conclusions in the content of a map. Zweigelt (1928) and Faber (1961) obtained requested data concerning the cockchafer swarming by means of repeated questionnaire campaigns, addressed to state administration offices, schools and state farms. Kratochvíl et al. (1953) adopted similar procedures in 1941—1944, 1949, 1950 and Landa (Kratochvíl et al., 1953) in 1954. Questionnaires upon the cockchafer swarming were sent to all local authorities as well as forest directorates.

The target of questionnaire campaign organized by Landa was determination of the cockchafer species and intensity of their swarming in 1954 as well as in previous years.

Our Institute has taken over the complete set of reference documentation from Landa in 1964. Documentation covers following territories (according to the territory division, used in the Czechoslovak Military Atlas, 1965): west part of Šumava piedmont, Všerubská brána (gate), Chodská pahorkatina (hilly land), Tachovská brázda (furrow) excluding the north part, catchment areas of the rivers Radbúza, Úhlava and Úslava, Plzeňská pahorkatina (hilly land), Karlštejnská plošina (plateau), Mostecká pánev (basin), Žatecká plošina (plateau), Děčínské stěny (rocks), Lužická pahorkatina (hilly land), České středohoří (mts.), Dokská pahorkatina (hilly land), Liberecká kotlina (basin), Jizerské podhůří (piedmont), West part of Polabí (catchment area of the river Labe), central part of Jičínská pahorkatina (hilly land), Orlické podhůří (piedmont), east part of Českomoravská vrchovina (highland), Dyjsko-svratecký úval (graben of the river), Brněnská vrchovina (highland), Vyškovská brázda (furrow), Litenčické vrchy (hills), Ždánický les (hills), Chřiby (highland), Dolnomoravský úval (graben), central part of Hornomoravský úval (graben), Hlučínská pahorkatina (hilly land), Ostravská pánev (basin), Moravská brána (gate).

When evaluating the reliability of a. m. data, it should be noted that they represent a good survey of intensity of cockchafer swarming during the year 1954. As far as the past information concerns, the quality is lower. It is because of the indication of high intensity of swarming in neighbouring localities in different years. The difference between one or two years seems (according to our view) less probable. Obtained documentation proved to be a valuable reference in spite of introduced information shortcomings, especially for territories, where no cockchafer swarming has been indicated within the period 1956—1968. In such cases we have taken available information about the cockchafer swarming from the previous period according to the domination in number. Cases, where Landa's information of this nature has been accepted for our survey, are indicated.

SYSTEMATIC OBSERVATION OF COCKCHAFER SWARMING AND MAP DOCUMENTATION

Systematic observation of cockchafer swarming on the whole territory of our country started in 1956. Observations were methodically controlled by Central Plant Quarantine Laboratory and since 1961 Dept. of Quarantine and Plant Protection of Central Control and Testing Institute of Agriculture in Brno. Intensity of cockchafer occurrence in particular districts has been followed by plant quarantine inspectors

(since 1961 Plant Quarantine Inspectors of Central Control and Testing Institute of Agriculture) in co-operation with phytopathologists of the District National Committee (since 1961 District Agricultural Councils) and other staff of plant protection service. Above described system of requested data aquisition has been established according to the administrative division of the country — i. e. district, region — as well as according to the organisation of plant protection service. Observations fluently continue.

a) Observations

Observations include registration of swarming as well as of cockchafer occurrence (*Melolontha melolontha* L.) within the specific localities of the district, using the municipalities as smallest units. Starting from the first day of the swarming period, plant quarantine inspectors follow the average number of beetles on one meter branch with leaves of attacked forest or fruit tree in the cockhafer feeding place. Observations continue in three days' intervals on ten different places of attacked alley, fruit garden or forest edge. Observers follow also the sex ratio and register it at the same time. This information is important for the application of chemicals. Observations expire when the sex ratio reaches 1 : 1. Standard forms include even negative information for cases of swarming absence in the year under survey.

Forms with cockchafer swarming data are concentrated at the Dept. of Quarantine and Plant Protection in Brno.

b) Map documentation

Plant quarantine inspectors and cooperating staff present yearly the occurrence of cockchafer (*Melolontha melolontha* L.) in the district maps since 1956. These maps give a full evidence upon the occurrence and its intensity for every administrative unit (municipality). Intensity criteria for this map documentation are standardised for the whole territory of the country as follows:

blue colour	low occurrence (10—50 beetles),
red colour	medium occurrence (51—100 beetles),
green colour	heavy occurrence (101 beetles and more).

Mentioned standard limits were estimated. Cockchafers are calculated on ten spots of a feeding place, using approximately fifteen years old trees. Average values are registered in colours.

District maps and written documentation are sent yearly to the Dept. of Quarantine and Plant Protection, where they are used for country-wide map documentation of medium and heavy occurrence of cockchafer, presenting a summary of swarming areas of economically important level for the year under survey.

If there is not any information about the intensity of cockchafer swarming available or if there is only negative information — such areas are marked with circles.

COMPILATION OF OBTAINED DATA

Thirteen years' observations (1956—1968) of cockchafer swarming (*Melolontha melolontha* L.) offer many valuable data for the whole territory of this country. Their complete compilation requires a relatively long period. Efforts of our department have been focused on delivered map documentation of cockchafer swarming intensity. Available data from districts have been transferred yearly in regional maps municipality by municipality. Available sets of thirteen maps enable us to determine the areas of different swarming cycles and swarming intensity. Regional documentation gives an idea about the distribution of particular cockchafer strains on the whole territory of the Czechoslovak Socialist Republic. The survey is introduced in the next chapter.

In order to prevent any misunderstanding in the determination of cockchafer swarming situation, there is a need of clear and explicit terminology. This is because of the occurrence of three and four year cycle on the territory of our country.

The term "cycle" is being used for the length of cockchafer development. Three populations of three year cycle and four populations of four year cycle were formerly determined as "strains". Our department has adopted the German term "Flug-

jahrfolge" introduced by F a b e r (1961), which could be translated as "frequency". We do know, that an introduction of such a new term might be discussed because of its uncertain acceptance by professionals. We are in full agreement with F a b e r, who does not want to accept the term "strain" for population, appearing during one year on large but from the geographical point of view not coherent territory. The "strain" requires a common origin, which does not seem to be acceptable for cockchafer.

Determination of particular frequencies has been elaborated according to S c h n e i d e r - O r e l l i's proposal (1949).

RESULTS

Main tasks of systematic observations of cockchafer swarming (*Melolontha melolontha* L.) on the whole territory of the Czechoslovak Socialist Republic were as follows:

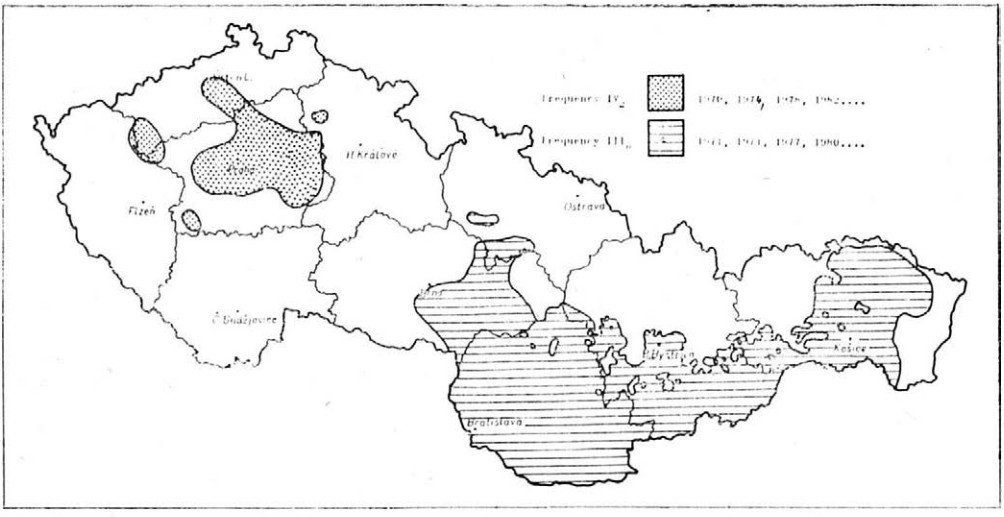
- to determine the areas threatened with cockchafers,
- to determine the development cycle of cockchafers,
- to determine the number of various cockchafer frequencies.

Our paper herewith contains the areas with distinct periodic occurrence of cockchafers. Geographical division has been taken over from the Czechoslovak Military Atlas (1965).

THREE-YEARS DEVELOPMENT CYCLE

1. Frequency III_0 with periodic occurrence of beetles in 1971, 1974, 1977, 1980... (Fig. 1).

This frequency is spread on the largest territory and represents the strongest frequency.



1. Spreading of cockchafer (*Melolontha melolontha* L.) frequencies in Czechoslovakia

Location:

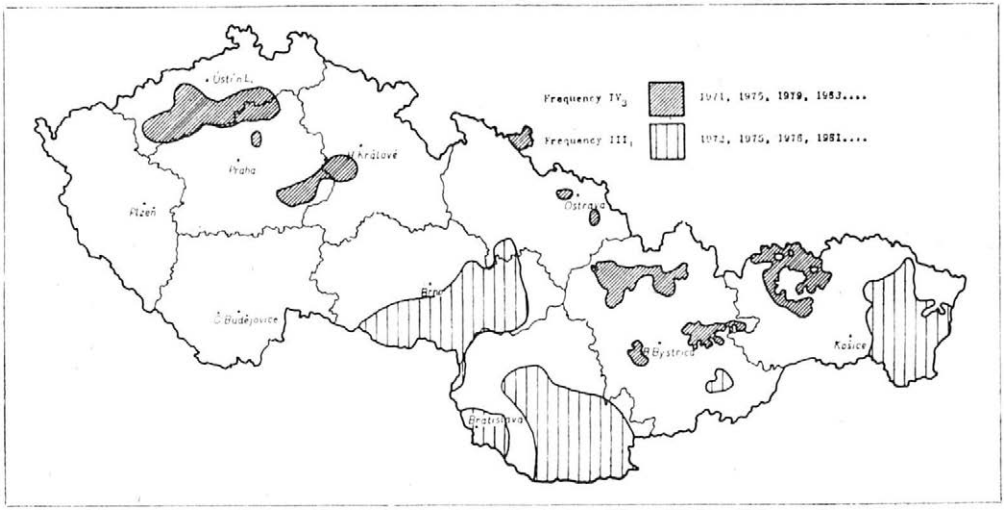
Moravia: Pavlovské vrchy (hills), Dyjskosvratecký úval (graben) till Brněnská vrchovina (highland) without the south part, Vyškovská brána (gate), south half of

Hornomoravský úval (graben), Litenčické vrchy (hills), Ždánický les (highland), Chřibské podhůří (piedmont), south part of Moravská brána (gate) till the town Hranice except of Hostýnské vrchy (hills), Dolnomoravský úval (graben) and catchment area of the rivers Olšava (from Uherský Brod) and Morava (from Uh. Hradiště), island area between the towns Litovel and Šternberk (identical determination made by K r a t o c h v í l 1953).

Slovakia: Záhorská nížina (lowland), Myjavská pahorkatina (hilly land), Považský úval (graben), Trnavská pahorkatina (hilly land), south part of Ilavská kotlina (basin), Nitrianská pahorkatina (hilly land), Hornonitrianská kotlina (basin), Žiarská kotlina (basin), Zvolenská kotlina (basin), Ipelská pahorkatina (hilly land), Dunajská nížina (lowland), Žitavská pahorkatina (hilly land), Pohronská pahorkatina (hilly land), Krupinská vrchovina (highland), Ipelská kotlina (basin), Lučenecká kotlina (basin), Rimavská kotlina (basin), Cerová vrchovina (highland), catchment area of Muráň from Revúca, Slovenský kras (carst), Košická kotlina (basin), catchment area of the river Hnilec from Gelnica till Kysak, lowland furrow between Šarišská vrchovina (highland) — Čerhovské pohoří (mts.) — Slánské pohoří (mts.), east part of Šarišská vrchovina (highland), Ondavská vrchovina (highland), northwest part of Potiská nížina (lowland).

Survey of intensity occurrence, based on 13 year observations is as follows:

— heavy until disastrous occurrence
in Moravia: vicinity of towns Hodonín and Břeclav,
in Slovakia: Myjavská pahorkatina (hilly land), vicinity of the town Bratislava, north part of Trnavská pahorkatina (hilly land), Košická kotlina (basin),
— medium until heavy occurrence
in Moravia: Chřibské podhůří (piedmont), south half of Dolnomoravský úval (graben),
in Slovakia: Trnavská pahorkatina (hilly land) except of the north part, Považský úval (graben), south half of Nitranská pahorkatina (hilly land), Hornonitranská kotlina (basin), Žiarská kotlina (basin), north part of Ipelská pahorkatina (hilly land), Zvolenská kotlina (basin), Krupinská kotlina (basin), Lučenecká kotlina (basin), Cerová vrchovina (highland), Rimavská kotlina (basin), lowland furrow between Šarišská vrchovina (highland) and Čerhovské pohoří (mts.) and Slánské pohoří (mts.) till the area of towns Bardějov — Stropkov — Giraltovce,
— low until medium occurrence
remaining parts of cockchafer occurrence.



2. Spreading of cockchafer (*Melolontha melolontha* L.) frequencies in Czechoslovakia

2. Frequency III_1 with periodic occurrence of beetles in 1972, 1975, 1978, 1981,... (Fig. 2)

Comparably to previous frequency this is on the same level of occurrence in Moravia but on lower level in Slovakia.

Location:

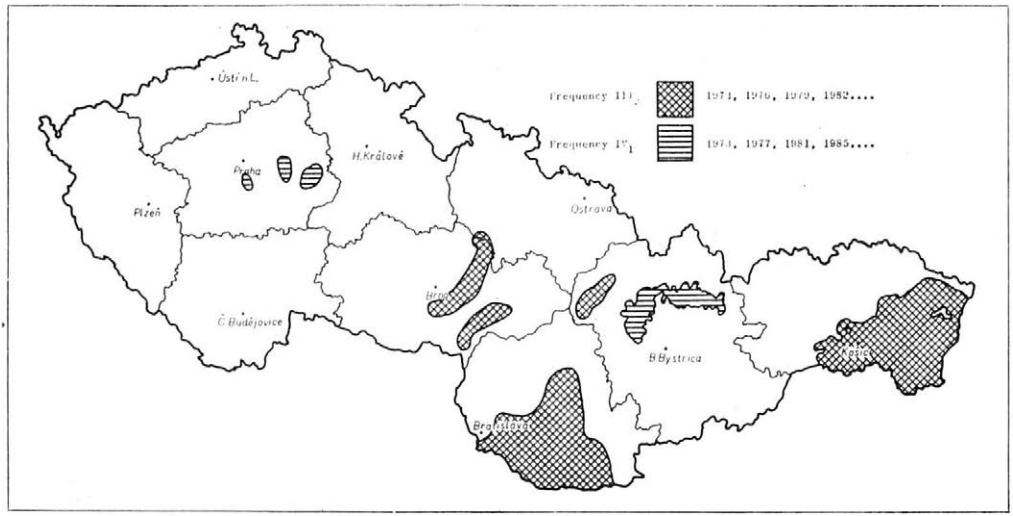
Moravia: Dyjskosvratecký úval (graben) and area between the towns Znojmo — Moravský Krumlov — Rajhrad, Vyškovská brána (gate), Litenčické vrchy (hills), southern part of Hornomoravský úval (graben), Ždánický les (highland), Chřiby (highland), Chřibské podhůří (piedmont), Dolnomoravský úval (graben), catchment area of Olšava river from Uherský Brod, catchment area of Morava river from Ostroh.

Slovakia: area between Šamorín — Senec — Pezinok — Děvínská Nová Ves, large territory of east half of Podunajská nížina (lowland), north part of Nitranská pahorkatina (hilly land) and Žitavská pahorkatina (hilly land) till the line Čalovo — Galanta — Trnava — Piešťany — Sulovce — Pohronská — Ipeľská pahorkatina (hilly land), small area south of town Lučenec to Poltár, large area of East Slovakia including Potiská nížina (lowland) and Zemplínské vrchy (hills) and central part of Ondavská vrchovina (high-land) to the line Giraltovce — Medzilaborce — Humenné and Vihorlat (mts).

Cockchafer occurrence on Moravian territory is identical to the area determined by K r a t o c h v í l et al. (1953) excluding areas between the towns Přerov and Litovel, area north of town Tišnov to Kunštát, where no swarming has been observed during the period of survey. Boundary of East Moravian swarming area which was not determined by K r a t o c h v í l clearly, could have been fixed on the base of 1956—1968 observations.

Survey of results:

— heavy until disastrous occurrence
  in Moravia the area bounded by the towns Znojmo — Moravský Krumlov — Židlochovice,
  in Slovakia the area demarcated with towns Nitra — Vráble and south of Potiská nížina (lowland),
— medium until heavy occurrence
  in Moravia vicinities of Šlapanice, Mutěnice, Podivín and Uherský Brod,
  in Slovakia vicinity of the town Trnava, area of Zlaté Moravce, Levice, Šurany and Zbehy,
— weak to medium occurrence
  remaining part of cockchafer occurrence.



3. Spreading of cockchafer (*Melolontha melolontha* L.) frequencies in Czechoslovakia

3. Frequency III_2 with periodical occurrence of beetles in years 1973, 1976, 1979, 1982, etc. (Fig. 3)

Comparably to previous frequency this is on lower level in Moravia but on the same level in Slovakia.

Location:

Moravia: small territory including the south part of Dolnomoravský úval (graben) and Chřibské podhůří (piedmont) to the town Židlochovice through Slavkov and Vyškovská brána (gate) and Prostějov to the town Olomouc,

Slovakia: Považský úval (graben) from Ilava to Bytča, large area in Dunajská nížina (lowland) including the south part of Trnavská pahorkatina (hilly land) and Žitavská pahorkatina (hilly land) to Pohronská pahorkatina (hilly land) demarked with line Pezinok — Senec — Sereď — Hlohovec — Topoľčany — Vráble and Štúrovo, in East Slovakia a large area including Košická kotlina (basin), Potiská nížina (lowland) and east part of Ondavská vrchovina to the line Moldava n. B. — Budimír — Vranov — Humenné — Snina.

Location on Moravian territory is identical with that published by Kratochvíl et al. (1953).

Survey of results:

— heavy to disastrous occurrence
Slovakia: north from the town Nitra, area within the line Sobrance — Michalovce — Velké Kapušany, between the towns Vranov and Humenné;

— medium to heavy occurrence
Moravia: vicinities of Židlochovice, Slavkov, Vyškov,
Slovakia: south of Nitra, vicinity of Považská Bystrica, south part of Potiská nížina (lowland);

— weak to medium occurrence
remaining parts of the occurrence.

FOUR-YEAR DEVELOPMENT CYCLE

1. Frequency IV_1 with periodic occurrence of beetles in years 1973, 1977, 1981, 1985 etc. (Fig. 3)

In general this frequency is quite weak and without practical importance.

Location:

Bohemia: Středočeská vrchovina (highland) in the vicinity of Jílové and Český Brod and the area Kolín — Kutná Hora;
Moravia: not registered;
Slovakia: Turčanská kotlina (basin), west part of Liptovská kotlina (basin) to Liptovský Hrádek.

Survey of results:

weak occurrence to medium occurrence in seldom cases, therefore it has no importance.

2. Frequency IV_2 with periodic occurrence of beetles in the years 1970, 1974, 1978, 1982... (Fig. 1)

This frequency is in Bohemia as strong as following frequency IV_3. In Moravia and Slovakia this is the weakest one, even weaker than the previous IV_1. Available data are not sufficient to determine the location. One can expect that the frequency is without any importance in Moravia and Slovakia.

Location: east part of Rakovnická plošina (plateau), Karlštejnská plošina (plateau), Hřebeny, north part of Středočeská vrchovina (highland), Polabí from Kutná Hora through Kolín to Ústí n. L., vicinity of the town Jičín, central part of Brdy, south part of Žatecká plošina (plateau) from the village Stebno in the direction of Podbořany and Kadaň.

Medium to heavy occurrence: vicinity of the town Litoměřice, area surrounded with the line Mělník — Libčice — Kladno — Beroun — Modřany — Brandýs n. L. — Liblice.

Weak to medium occurrence: remaining parts of total occurrence.

3. Frequency IV_3 with periodic occurrence of beetles in the years 1971, 1975, 1979, 1983... (Fig. 2)

Comparable to formerly described frequencies this is more weak in Bohemia and Slovakia, in Moravia occurs only on quite small areas.

Location:

Bohemia: south part of Žatecká plošina (plateau), valley of Džbán in the direction to the river Ohře, Dolní Poohří, west part of České středohoří (mts.), west half of Doksanská pahorkatina (hilly land), west part of Polabí to the line Litoměřice — Úštěk — Dubá — Doksy — Bělá pod Bezdězem — Mladá Bolestav — Mělník, island area north of Brandýs n. L., small area in the vicinity of Kutná Hora to Přelouč.

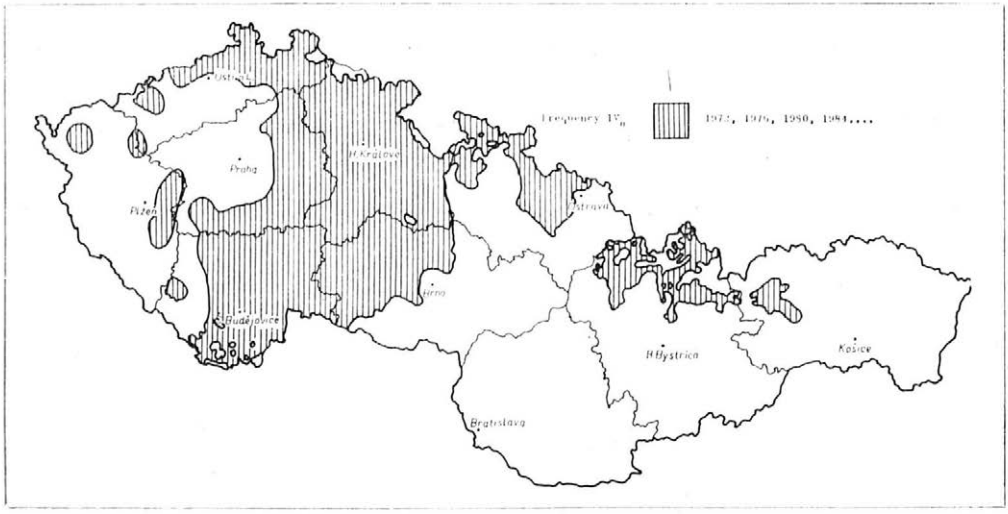
Moravia and Silesia: island areas east of Frýdek-Místek, north of Bílovec, Osoblažská pahorkatina (hilly land).

Slovakia: Žilinská kotlina (basin), Bytčanská kotlina (basin), valley of the river Váh from Ružomberok to Kralovany — Sučany — Vrútky — Kysucké Nové Mesto, valley of the river Orava from Krivá through Dolný Kubín and Kralovany, south part of Skorušické pohorie (mts.), small area in the vicinity of Kremnica, Horehronský úval (graben), north half of Popradská kotlina (basin), Levočské pohorie (mts.), Hornádská kotlina (basin), north part of Šarišská vrchovina (highland), Lubovňianská vrchovina (highland), area between the river Pieniny and Spišská Magura (mts.).

Survey of results:

— medium to heavy occurrence:
  Bohemia: area within the line Lovosice — Litoměřice — Roudnice n. L. — Libochovice — Třebenice, island area north of Brandýs n. L.;
  Slovakia: south half of Skorušické pohorie (mts.), south part of Levočské pohorie (mts.);
— weak to medium occurrence:
  remaining parts of total occurrence.

4. Frequency IV_0 with periodic occurrence of beetles in the years 1972, 1976, 1980, 1984... (Fig. 4)



4. Spreading of cockchafer (*Melolontha melolontha* L.) frequencies in Czechoslovakia

In comparison with other four year frequencies this particular one occupies the largest area of Moravia and Slovakia and represents one of the strongest frequencies.

Location:

Bohemia, Moravia and Silesia: west part of Sokolovská pánev (basin), southwest part of Žatecká plošina (plateau), north part of Mostecká pánev (basin), a large area determined as follows: north of Děčínské stěny (rocks) — Lužická pahorkatina (hilly land) — a furrow between Děčínské stěny (rocks) and České středohoří (mts.) — Lužické hory (mts.) — Jizerské podhůří (piedmont) — Liberecká kotlina (basin) — Ještědské pohoří (mts.) — Krkonošské podhůří (piedmont) — Broumovské mezihoří (highland) — Orlické podhůří (piedmont) — Jesenické podhůří (piedmont) — Vidnavská pahorkatina (hilly land) — Osoblažská pahorkatina (hilly land) — north part of Nízký Jeseník (mts.) — Hlučínská pahorkatina (hilly land); east of Oderské vrchy (hills) — Nízký Jeseník (mts.) — Hrubý Jeseník (mts.) — Třebovské mezihoří (highland) — Boskovická brázda (furrow) — north part of Brněnská vrchovina (highland) — Českomoravská vrchovina (highland) — Třeboňská pánev (basin) — Budějovická pánev (basin); south of the line Rosice — Mor. Budějovice — Vratěním — Slavonice — Nová Bystřice — České Velenice — Kaplice — Český Krumlov; west border with east part of Šumavské předhůří (piedmont) — Středočeská vrchovina (highland) through Netolice — Vodňany — Písek — Blatná — Příbram — Benešov — east half of Polabí through Kouřim — Nymburk — Jičínská pahorkatina (hilly land) through Mladá Boleslav — Mnichovo Hradiště — east half of Dokská pahorkatina (hilly land) through Mimoň — Česká Lípa and České středohoří (mts.). Small island areas east of the town Louny and between Blovice and Rokycany.

Slovakia: area including the valley furrow between Moravskoslezské Beskydy (mts.) and Javorníky (mts.), Kysucká vrchovina (highland), valley of the river Rajčanka, valley furrow between Slovenské Beskydy (mts.) and Oravská Magura (mts.), Skorušické pohoří (mts.), Liptovská kotlina (basin), Popradská kotlina (basin) excluding the north part, west half of Hornádská kotlina (basin).

According to the data originating from the questionnaire campaign by L a n d a (K r a t o c h v í l et al., 1953): Šumavské podhůří (piedmont), Plzeňská pánev (basin), Plzeňská pahorkatina (hilly land).

Spreading of four year frequencies within the Moravian territory is identical with data published by K r a t o c h v í l et al. (1953).

Medium and heavy occurrence have not been regularly on the same areas but spread out over the whole a. m. territory of cockchafer swarming.

TERRITORIES OF NON-DETERMINABLE FREQUENCIES OF COCKCHAFER (*MELOLONTHA MELOLONTHA* L.)

During the thirteen year period there were certain areas in Bohemia and Moravia without any cockchafer swarming on larger localities. Following areas could serve as an example:

Bohemia: Smrčiny (highland), Chebská pánev (basin), great part of Sokolovská pánev (basin), Tepelská plošina (plateau), Plzeňská pahorkatina (hilly land), Tachovská brázda (furrow), Chodská pahorkatina (hilly land), Všerubská brána (gate), Šumavské podhůří (piedmont), south part of Středočeská vrchovina (highland).

Moravia and Silesia: greater part of Jesenické podhůří (piedmont), north part of Hornomoravský úval (graben), Nízký Jeseník (mts.), Oderské vrchy (hills), Ostravská pánev (basin). This situation has been introduced in reports by K r a t o c h v í l et al. (1953). This is substantiated with fact that these areas are in close touch with cockchafers of the frequency IV_0, IV_3 and IV_2. Mentioned territories were in 1956—1968 without any remarkable swarming on large localities and even the questionnaire campaign by L a n d a does not give a clear reply concerning the particular cockchafer frequency.

TERRITORY WITHOUT COCKCHAFERS

Determination of territories without cockchafer occurrence is rather difficult. Negative report does not necessarily indicate that the whole territory under inspection is completely without any cockchafers. However one can declare that certain areas are not really attacked by cockcha-

fers. These are mostly territories in an altitude over 800 m, mostly covered with continuous forest.

There are following areas:
— Bohemia: Krušné hory (mts.), Krkonoše (giant mts.), Orlické hory (mts.), Slavkovský les (highland), Doupovské hory (mts.), Brdy, Český les (highland), Šumava (mts.), Novohradské hory (mts.).
— Moravia and Silesia: Žďárské vrchy (hills), Hrubý Jeseník (mts.), summits of Nízký Jeseník (highland), Moravskoslezské Beskydy (mts.), summits of Vsetínské vrchy (hills) and Hostýnské vrchy (hills), Javorníky (mts.).
— Slovakia: Bielé Karpaty (mts.), Javorníky (mts.), Považský Inovec, Strážovská hornatina, Tribeč, Vtáčnik, Štiavnické pohorie, Javorie, Vepovské Rudohorie (mts.), Polana, Slovenské Rudohorie (mts.), Nízké Tatry (Low Tatry mts.), Velká Fatra and Malá Fatra (giant mts.), Oravská Magura, Chočské pohorie, summits of Skorušinské pohorie, Vysoké Tatry (High Tatra mts.), Spišská Magura, Čerhovské pohorie, Levočské pohorie, Stratená hornatina (mts), Branisko, Spišské Rudohorie (ore mts.), Čierná Hora (mts.), Slovenské Rudohorie (ore mts.), Milič, Nízké Beskydy, Vihorlat.

DISCUSSION

On the basis of map documentation from the period 1956 – 1968 there have been prepared a long – term prognosis of occurrence of particular cockchafer frequencies (*Melolontha melolontha* L.). This prognosis has been based in certain areas of Bohemia and Moravia also on data obtained from questionnaire campaign by L a n d a (1954).

Occurrence of particular frequencies in Moravia published by K r a t o c h v í l et al. (1953) has been verified. Small discrepancies were found only on cockchafer frequency III_1. Area of frequency III_1 in Moravia has been determined more exactly and missing boundary in East Moravia has been fixed.

Correctness of long-term prognosis has been proved on the whole territory of the Czechoslovak Socialist Republic in the period 1969 – 1974 employing the method of observations and map documentation from 1956. It has been proved that distribution areas of particular cockchafer frequencies as well as the intensity of their occurrence are determined very exactly. There has not been any swarming outside the areas determined in the long-term prognosis.

One can find on the territory of this country all types of four- or three-year frequencies respectively. Three-year frequencies III_0, III_1, III_2 have an economic importance only for Slovakia, not for Moravia. As far as four-year frequency concerns, an economic importance have IV_0 and IV_3, while IV_2 occurs in Bohemia only on small localities and in Moravia and Slovakia is without any economic importance. Frequency IV_1 is without any economic importance for the whole territory of the country. Bohemia is occupied only with four-year frequencies, Moravia and Slovakia with both four and three year ones.

Paper describes the areas where cockchafer frequency is not clear because of the absence of their regular occurrence on large territories. Areas without cockchafer are determined as well.

Discussion is going to be orientated on factors influencing the length of cockchafer (*Melolontha melolontha* L.) development cycle. In the time of detail study of map documentation we have payed attention to the effect of environment on the length of development cycle. We do know

that introduction of any correlation is very difficult. The length of development cycle is influenced by many factors, e. g. soil conditions (soil temperature, soil type), precipitations etc. Unsufficient number of soil laboratories orientated on soil temperature measurement proved to be a serious obstacle for the solution of this problem. This is the reason, why the soil temperature and long-term average of soil temperature have not been compiled yet for the whole country.

Assuming this we have focused our interest on detailed compilation of country-wide information upon the average air temperatures. Maps were published in the framework of the Czechoslovak Climate Atlas (1958). We managed to determine some correlations which have to be proved in future. This is why we introduce herewith following results.

Searching for the correlations between the development cycle of cockchafers and air temperature we have adopted the following procedure. The country-wide maps of occurrence of three and four year frequencies have been transferred on transparencies. These have been put on adequate maps of average month temperatures, published in the Czechoslovak Climate Atlas.

We came to a conclusion that the average air temperature during the vegetation period (i. e. from April 1st till September 30th) has prior effect on three or four year development cycle of cockchafer (*Melolontha melolontha* L.). In this unique case the isolines of average temperatures were identical with isolines of development cycle length.

Limit line between the three and four year development cycle is identical (according to our findings) with the average air temperature 13 – 14 °C in Slovakia and 14 – 15 °C for Moravia and Silesia. Territories with lower temperature are occupied with four year frequencies, the other with higher air temperature with three year frequencies. The average air temperature of vegetation period was taken over a fifty years' period (1901 – 1950).

In this respect there is a very interesting question of three year frequency occurrence in Bohemia. In above mentioned fifty years' period the critical temperature 15 °C has been reached on small territories in the vicinity of the towns Kolín, Kutná Hora, Mělník, Poděbrady. There is of course no evidence of three year frequency occurrence.

Explanation of 1 °C difference between three year and four year cockchafer frequencies in Slovakia and Moravia and Silesia could not have been explained yet. It is preassumed that this is in connection with increasing influence of continental climate from West towards the East.

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MUŠKA A. (Ústřední kontrolní a zkušební ústav zemědělský, Brno). *Výsledky třináctiletého pozorování rojení chrousta obecného (Melolontha melolontha L.) na území Československa.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 283-294, 1975.

Zpracováním údajů mapové evidence let 1956—1968 o rojení chrousta obecného (*Melolontha melolontha* L.) ze všech okresů republiky byla v r. 1969 vypracována dlouhodobá prognóza rojení. Správnost této prognózy byla ověřena v letech 1969 až 1974. Na území ČSSR se vyskytují všechny frekvence (kmeny) tříletého a čtyřletého vývojového cyklu. Rozšíření a periodicita jednotlivých frekvencí (kmenů) chrousta obecného je detailně zpracována podle geografického členění republiky. Přehledně je rozšíření znázorněno na mapách 1—4. Délka vývojového cyklu (tříletá nebo čtyřletá) je v přímé závislosti na průměrné 50leté teplotě vzduchu v době vegetační. Její hraniční hodnoty jsou uvedeny v práci.

МУШКА А. (Центральный контрольно-испытательный институт сельского хозяйства, Брно). **Результаты тринадцатилетних наблюдений за летом хруща майского западного (*Melolontha melolontha* L.) на территории Чехословакии.** Sbor. ÚVTI - Ochr. rostl. 11 (4) : 283-294, 1975.

Путем обработки данных картографического учета за 1956—68 годы о лете хруща майского западного (*Melolontha melolontha* L.) во всех районах республики в 1969 году был разработан долгосрочный прогноз лета. Правильность этого прогноза была проверена в 1969—74 годах. На территории ЧССР встречаются все степени лета трехлетнего и четырехлетнего цикла развития. Распространение и периодичность отдельных степеней лета хруща майского западного детально обработаны согласно географическому зонированию республики. Наглядно его распрстранение изображено на картах 1—4. Продолжительность генерации (3-летняя или 4-летняя) находится в прямой зависимости от средней 50-летней температуры воздуха в вегетационный период. Ее предельные величины приводятся в работе.

MUŠKA A. (Zentrale landwirtschaftliche Kontroll- und Prüfungsanstalt, Brno). *Ergebnisse einer dreizehnjährigen Beobachtung des Schwärmens von Maikäfer (Melolontha melolontha L.) auf dem Gebiet der Tschechoslowakei.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 283-294, 1975.

Nach der Bearbeitung von Augaben der Kartoffelevidenz in den Jahren 1956—1968 über das Schwärmen des Maikäfers (*Melolontha melolontha* L.) aus allen Kreisen der Republik wurde im Jahre 1969 eine langfristige Schwärmungsprognose ausgearbeitet. Die Richtigkeit dieser Prognose wurde in den Jahren 1969—1974 bestätigt. Auf dem Gebiet der ČSSR kommen sämtliche Frequenzen (Stämme) des drei- und vierjährigen Entwicklungszyklus zum Vorschein. Die Verbreitung und Periodizität der einzelnen Frequenzen (Stämme) des Maikäfers wird eingehend nach der geographischen Gliederung der Republik bearbeitet. Die Verbreitung wird auf den Karten 1—4 übersichtlich veranschaulicht. Die Dauer des Entwicklungszyklus (drei- oder vierjährige) steht in direkter Abhängigkeit von der durchschnittlichen fünfzigjährigen Lufttemperatur während der Vegetationszeit. Ihre Grenzwerte werden in der Arbeit angeführt.

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CRITICAL NUMBER OF *AUTOGRAPHA GAMMA L. V.* CATERPILLARS (LEP., NOCTUIDAE) ON SUGAR BEET

I. NOVÁK

NOVÁK I. (Institute of Plant Protection, Praha - Ruzyně). *Critical Number of Autographa gamma L. Caterpillars (Lep., Noctuidae) on Sugar Beet.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 295-300, 1975.

Critical number of caterpillars of *A. gamma* is considered to cause 25 % loss of leaf area in sugar beet. The critical numbers are given for plants in different development stages in two weeks' intervals. There were taken into account:
1. Rate of consumption of food by caterpillars and pattern of injury in plants.
2. Regeneration power of the crop.

Economic significance of the caterpillars of different moth species is generally determined by the purpose which a crop is grown for. The criteria for harmfullness may be a loss of green matter (mainly leaves), injuries on generative organs or indirect effect on the yield.

In sugar beet the indirect defoliation influence caused by caterpillars is important. The loss of leaf area caused in spring or summer is followed by a decrease in sugar beet yield (the yield of roots or sugar). The economic threshold in sugar beet is usually considered to be at a level of about 20—30 % loss of leaf area of the crop. The defoliation reaching this or higher percentage is considered to be of economic importance (Schultz, 1963; Novák, 1964; Skuhravý et al., 1967; Fiedler, 1969; Dunning & Winder, 1972; etc.).

MATERIAL AND METHOD

To assess the critical number of caterpillars we have had to take into account two features of the process:
1. Rate of consumption of food by caterpillars and pattern of injury in plants.
2. Regeneration power of the crop.

As to the pattern of injury we had some experience from the years 1961—1962, when a calamity occurrence of *A. gamma* was observed in Central Bohemia. Besides this we made several trials with artificial infestation of beet plants with caterpillars of *A. gamma*.

The data about food consumption by caterpillars is an average of eleven solitary rearings of caterpillars noted daily. I am indebted to Mrs. D. Štěpánová (VÚRV Praha - Ruzyně) for the help with these observations.

The data about sugar beet growth refer to the sort 'Dobrovice A' grown under climatic conditions of Central Bohemia. Mr. Z. Petrák (VÚŘ Semčice) offered me very kindly the unpublished data of ten years' average of the growth rate of sugar beet. The youngest stages of development were completed according to our own observations.

RESULTS AND DISCUSSION

CONSUMPTION OF LEAVES BY CATERPILLARS AND PATTERN OF INJURY IN PLANTS

One caterpillar eats during life in an average 8089 mm^2 of leaf area (tab. I). The part belonging to the different instars is given in Fig. 1.

I. Consumption of sugar beet leaves by A. gamma L. caterpillars (mean, n = 11)

Instar of caterpillar	Leaf area eaten by one caterpillar (mm^2)	%
1.	10	0.12
2.	45	0.57
3.	260	3.21
4.	927	11.46
5.	6847	84.64
Total	8089	100.00

The consumption of food in time is of great importance, too. In the temperature about 23 °C the caterpillars take about 20 days to complete their development. The percentage of food consumption was observed as follows:

1st – 5th day	0.1 %
6th – 10th day	0.9 %
11th – 15th day	10 %
16th – 20th day	89 %
1st – 10th day	1 %
11th – 20th day	99 %

As the majority of consumption is realised in very few days, very little time remains to control this pest.

Apart from the seed crop of sugar beet A. gamma destroyes only the leaves of the plants. The caterpillars of the 1 st and 2 nd instars eat only the superficial layer of a leaf, leaving intact the epidermis of the opposite side. Starting the 3 rd instar the caterpillar makes holes in the lamina of the leaf. It begins with eating in the centre of the leaf avoiding the veins.

Marginal feeding is not usual in this species. Ripe leaves are preferred. The caterpillars eat younger leaves only after having destroyed the old ones. The heart of plants and the leaf-stalks are destroyed only in the case of calamity occurrence of *A. gamma*. The caterpillars do not waste leaves under normal conditions. Wasting was observed to occur when 20 % of leaf area were eaten. The separated parts of leaves dry off or fall down. The crop can be practically destroyed when about 60 % of leaf area have been eaten (Fig. 2).

RATE OF GROWTH OF A SUGAR BEET CROP

According to our own results and some other sources following data about sugar beet were stated:

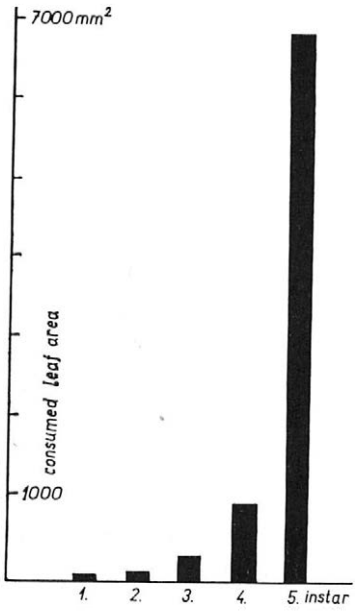
Mean weight of 1 cm^2 leaf area (ripe leaf.): 0.033 g
Mean weight of 1 cm^2 leaf area (young leaf): 0.023 g
Area of one leaf lamina: 100 – 200 cm^2 (and more)
Leaf area of one plant in summer: 3000 – 5000 cm^2
Leaf area of 1 ha of the crop in summer: 30 000 – 60 000 m^2
Optimum number of plants per hectare: 75 000 – 80 000

The rate of growth of sugar beet in spring and summer was observed every second week (Tab. II). Different weights of young and ripe leaves were taken into account.

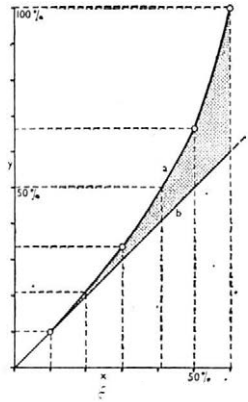
CRITICAL NUMBERS OF THE CATERPILLARS OF *A. GAMMA* ON SUGAR BEET

The lost of yield depends first of all on the percentage of destroyed leaf area and not on the absolute weight of destroyed green matter in

sugar beet (N o v á k, 1964 and unpublished data). We considered therefore 25 % of destroyed leaf area to be the economic threshold of injury. The critical number is that of caterpillars that are able to cause the mentioned degree of defoliation (Tab. II). The data about the population density of caterpillars, which may cause the defoliation of 50 % and



1. Leaf area of sugar beet (means in mm²) consumed by one caterpillar of *A. gamma* in different instars



2. Relation between leaf area consumed by caterpillars and total leaf area actually destroyed (both in percent of total leaf area of the crop)
x — Leaf area of the crop eaten by caterpillars
y — Damaged leaf area including wasting by caterpillars
a — Defoliation observed in the field (o — empirical values) caused by a certain number of caterpillars
b — Theoretical leaf area consumption without wasting punctate area — wasted part of leaves

100 % are given in this table, too. These values do not answer exactly to the mechanical calculation resulting from the food consumption by the caterpillars. They are lower with respect to wasting (Fig. 2). The critical numbers agree with our experience from the mass occurrence of silver y moth in 1961 – 1962.

II. Rate of growth of sugar beet under climatic conditions of Central Bohemia (10 years' mean) and number of A. gamma L. caterpillars causing the percentage of defoliation in different stages of development of the crop

Growth of sugar beet plants				Critical numbers of caterpillars per plant causing the respective percentages of defoliation		
Date	Number of leaves per plant	Weight of leaves of one plant (g)	Area (cm^2) of leaves per plant	25 %	50 %	100 %
15. 5.	2.0	1	22	0.07	0.11	0.16
30. 5.	6.5	7	152	0.5	0.7	1
15. 6.	11.6	51	1020	3	5	7
30. 6.	16.6	265	5448	16	28	40
15. 7.	20.2	395	7509	23	38	55
30. 7.	22.7	426	7931	24	40	58
15. 8.	24.7	480	8817	25	43	62
30. 8.	28.9	465	8449	25	43	62
15. 9.	31.8	462	8180	20	42	60

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NOVÁK I. (Ústav ochrany rostlin, Praha - Ruzyně). *Kritické číslo housenek můry gama (Autographa gamma L., Lep., Noctuidae) na cukrovce.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 295-300, 1975.

Za ekonomický práh škodlivosti u cukrovky je považována ztráta přibližně 25 % listové plochy porostu. Kritické množství housenek můry gama způsobuje tuto ztrátu listové plochy. Kritická čísla jsou propočtena na jednu rostlinu napadeného porostu v závislosti na vývoji porostu ve dvoutýdenních intervalech. Bralo se v úvahu: 1. Spotřeba potravy housenkami a charakter poškození rostlin. 2. Regenerační schopnost porostu.

můra gama; cukrovka; škodlivost; housenky; kritické číslo

НОВАК И. (Институт защиты растений, Прага - Рузыне). **Критическое количество гусениц совки-гамма (*Autographa gamma* L., Lep., Noctuidae) на сахарной свекле.** Sbor. ÚVTI - - Ochr. rostl. 11 (4) : 295-300, 1975.

Экономическим порогом вредности для сах. свеклы считается потеря около 25 % листовой площади посева. Эту потерю вызывает критическое количество гусениц совки-гамма. Критические числа вычисляются на одно растение пораженного посева в зависимости от развития последнего в двухнедельные интервалы. Учитываются как пищепотребление гусениц и характер повреждения растений, так и регенеративная способность посева.

совка-гамма; сахарная свекла; вредность; гусеницы; критическое количество

NOVÁK I. (Institut für Pflanzenschutz, Praha - Ruzyně). *Kritische Zahl der Raupen von Gammaeule (Autographa gamma L., Lep., Noctuidae) auf Zuckerrüben.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 295-300, 1975.

Der Verlust von etwa 25 % Bestandesblattfläche wird bei Zuckerrübe als ökonomische Schädlichkeitsschwelle betrachtet. Dieser Blattflächenverlust wird durch die kritische Menge der Raupen von Nachtfalter Gamma verursacht. Kritische Zahlen werden auf eine Pflanze des befallenen Bestandes in Abhängigkeit von der Entwicklung des Bestandes in Zweiwochenintervallen berechnet. Es wurde einerseits der Futterverbrauch durch Raupen, andererseits das Regenerationsvermögen des Bestandes berücksichtigt.

Gammaeule; Zeckerrübe; Schädlichkeit; Raupen; kritische Zahl

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A DECLINE OF MEVINPHOS RESIDUES IN SWEET PEPPER FRUITS STORED AT VARIOUS TEMPERATURES

P. LÁSKA

LÁSKA P. (Vegetable Research Institute, Olomouc). *A Decline of Mevinphos Residues in Sweet Pepper Fruits Stored at Various Temperatures.* Sbor. ÚVTI - - Ochr. rostl. 11 (4) : 301-305, 1975.

The harvested sweet pepper fruits were sprayed with mevinphos, either at a normal rate of 0.288 kg/ha (i. e. 1.2 l Phosdrin per ha), or 5 times greater than normal. We have found the following half lives of residues: in fruits stored in the open at mean temperature 7 °C during October — 11.6 days, in those stored in a storage room at mean temperature 12.5 °C — 8.2 days, and those stored in a glasshouse at mean temperature 25 °C — 1.8 days. Two weeks after spray at a normal rate the residues were reaching the value of 0.4 p. p. m. in the open, while in the glasshouse one week after spray at a rate 5 times greater than normal the residues declined to 0.2 p. p. m. With regard to the dependence of the rate of residue decline on temperature it would be desirable to set down the minimum temperatures the waiting period is valid at.

sweet pepper; pesticide residues; mevinphos; temperature effects

Although it is generally supposed that the rate of pesticide residue decline is dependent on temperature, the data on this problem are rather rare with the exception of several reports, e. g. Fahmy (1961), Kalkat et al. (1961), and waiting period restrictions valid in various countries are not fixed to temperature level. Therefore, it is necessary to obtain new data on the residue decline as related to temperature, especially with high toxic insecticides the initial concentration of which is exceeding the tolerance limit many times. The low toxic insecticides often have the initial residue concentration below the tolerance limit immediately after spray. The representative of high toxic insecticides with a relatively short waiting period is mevinphos which was chosen as a model pesticide for our trials. In the bioassay *Drosophila* was used for studying the residue decline in sweet pepper fruits kept under various conditions differing especially in temperature. The trials were made with harvested fruits but during the storage the fruits were getting ripe physiologically so that they served to some extent as a model for the fruit ripening on plants.

MATERIAL AND METHOD

The fruits of sweet pepper var. 'Severka' grown in the field were harvested on October 4, 1972 in a state of edible maturity (green fruits). The fruits chosen for the trial were approximately of the same size, rather small, 6—7 cm long and 5—6 cm wide with an average weight of 57 g and longitudinal section area of 28 cm^2.

The pepper fruits were sprayed in a glasshouse on 5 October. Before spraying, the fruits were divided into 3 groups, put on the flat surface, and deprived from

touching each other. By means of a hand sprayer the first group was treated with Phosdrin (24% a. i.) at the rate of 1.2 l/ha, i. e. 0.288 kg mevinphos per ha, the second group received the rate of 6 l/ha, i. e. 1.44 kg mevinphos per ha, the third one remained untreated. The spray was of a high volume character, the water consumption equalled 1000 l/ha. In the course of spraying and drying the glasshouse temperature was ranging between 13 and 14 °C, and the relative humidity was about 40 %. Approximately 90 minutes after spraying when the fruits were dry the first residue test was carried out and at the same time each group was divided into 3 subgroups. One subgroup was then stored in the open, the second one in a storage room and the third one in a glasshouse.

In the open, the temperature was relatively low. The average temperature during the whole period was 7 °C, average daily minimum 3 °C, average daily maximum 11.5 °C. The average relative humidity of the experimental period equalled 81 %. The weak rainfall recorded 8 times totalled 9.3 mm.

The temperature in the storage room was decreasing from 13.5 °C in the beginning to 11.5 °C at the end of the trial. The average temperature equalled 12.5 °C. The relative humidity was nearly constant and it was ranging between 75 % and 80 %.

The temperature in the glasshouse varied between 20 °C and 30 °C, the average temperature was approximately 25 °C. The relative humidity was ranging between 45 % and 70 % with an average of about 60 %.

The residues in homogenized pepper fruits were tested by means of Drosophila melanogaster in a similar way as given previously for carrots by Janýška and Láska (1962).

The half life of the residue was determined graphically according to the slope of the line passing through the points plotted on the millimeter paper where time was plotted on the abscissa and insecticide concentration logarithm on the ordinate.

I. Residues of mevinphos in sweet pepper fruits stored at various temperatures

Mevinphos rate (kg/ha)	Place of storage	Interval between spraying and bioassay	Mean temperature during the interval (°C)	Residue concentration (p. p. m.)
1.44	—	1.5 hours	13.5	2.4
1.44	in the open	7 days	9.3	2.0
1.44	in the open	14 days	8.0	1.5
1.44	in the open	21 days	6.7	0.9
1.44	in the open	28 days	7.0	0.4
1.44	storage room	12 days	13.2	0.7
1.44	storage room	19 days	12.8	0.4
1.44	storage room	26 days	12.5	0.3
1.44	glasshouse	7 days	25.0	0.2
0.288	—	1.5 hours	13.5	0.8
0.288	in the open	14 days	8.0	0.4

RESULTS

The results of testing (Tab. I) clearly show that the rate of residue decline is strongly dependent on temperature. In the glasshouse where the temperature was high, the residue content declined after 7 days to 0.2 p. p. m. although the concentration of the spray was 5 times greater than normal. Under cold conditions in the field the residues declined after 4 weeks to 0.4 p. p. m. only providing the peppers were treated in the same way as mentioned above.

We have found following half lives:

place of storage	average temperature	half life
glasshouse	25 °C	1.8 days
storage room	12.5 °C	8.2 days
in the open	7 °C	11.6 days

It is apparent that the residue decline was somewhat related to the physiological maturity of the fruits. After a week's storage in a glasshouse most fruits were red (0.2 p. p. m.) while in the field there was only a part of half-red fruits after 4 weeks (0.4 p. p. m.).

DISCUSSION

Mevinphos belongs to the most toxic insecticides, LD 50 for rats perorally is 6–7 mg/kg live weight (Perkow, 1971). In most European countries the maximum tolerance limit in harvested fruits is 0.1 p. p. m., the waiting period is usually 4 days for field crops (e. g. West Germany, Denmark, Finland, Sweden), for glasshouse crops the period is prolonged by 3 days in Denmark and 7 days in West Germany (except for cucumbers and tomatoes) (Perkow, 1971; Fjelddalen, Renvall, 1974).

Although the mevinphos residues will mostly decline below 0.1 p. p. m. level within 4 days after spraying (Anonym, 1961; Casida et al., 1956; Coffin, McKinley, 1964; Klee, 1962; Maier-Bode, 1965), on some occasions this limit is exceeded, e. g. in some cases with lettuce (Maier-Bode, 1965; Fjelddalen, Renvall, 1974), grapes (Wirtz, 1962) and strawberries (Hughes et al., 1966). While in strawberries this is perhaps due to the physiologic-biochemical properties of fruits it is possible that the grapes may be partially affected by low temperatures, as the residues have been recorded during ripening of the grapes, which takes place at lower autumn temperatures. The same applies for lettuce which is grown at relatively low temperatures although we should admit a considerable influence of rather a high level of initial residues caused by a relative large plant surface.

With regard to the evident dependence of residue decline on temperature it would be desirable to set down also minimum temperatures the waiting periods are valid at although it may be necessary to count with differences in various pesticides, which has been discussed by Vail et al. (1967). According to our trials the residue decline at 12.5 °C was so

slow that the minimum temperature set down for a waiting period should be higher.

In Czechoslovakia and some other countries the waiting period of most pesticides is prolonged automatically by 1 week for glasshouse crops. (Mevinphos is not permitted for glasshouse crop treatment in Czechoslovakia). The fact is that the highest amounts of residues – 0.3 and 0.6 p. p. m. after 7 days (Anonym, 1961) – were found in glasshouse lettuce but as we have pointed out glasshouse lettuce is grown at relatively low temperatures, usually below 15 °C. Most forced crops, especially solanaceous and vine vegetables are grown at higher temperatures in the glasshouse as compared to the same crops grown in the field. Although other weather conditions including air flow, relative humidity (its effect was studied by Hopkins (1967) for malathion) and rainfall increase the rate of residue loss, it is possible that the higher temperature in a glasshouse compensates for a lack of other factors mentioned. In this connection we are pointing out that in West Germany the waiting period of mevinphos is the same for both glasshouse and field cucumbers and tomatoes, and in glasshouses it is not prolonged by 1 week as it is done with other crops. Peppers might have entered the same category as tomatoes but no data concerning the mevinphos residues in peppers had been available. Further investigation of pesticide residues in vegetables grown under field and glasshouse conditions would be very desirable.

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LÁSKA P. (Výzkumný ústav zelinářský, Olomouc). *Úbytek reziduí mevinphosu z plodů papriky skladovaných při různé teplotě.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 301-305, 1975.

Sklizené plody papriky byly postříkány mevinphosem jednak normální dávkou 0,288 kg/ha (= 1,2 litry Phosdrinu na ha), jednak dávkou pětinásobně vyšší. U plodů skladovaných venku během října při průměrné teplotě 7 °C byl zjištěn poločas rozpadu reziduí 11,6 dnů, u plodů ve skladu při průměrné teplotě 12,5 °C 8,2 dne a ve skleníku při průměrné teplotě 25 °C 1,8 dne. Dva týdny po postřiku normální dávkou dosahovala venku rezidua hodnoty 0,4 ppm, zatímco týden po postřiku pětinásobnou dávkou poklesla rezidua ve skleníku na 0,2 ppm. Vzhledem k závislosti rychlosti úbytku reziduí na teplotě by bylo žádoucí stanovit i spodní hranici teplot, při kterých platí ochranná lhůta.

paprika; rezidua pesticidů; mevinphos; vliv teploty

ЛАСКА П. (Научно-исследовательский институт овощеводства, Оломоуц). **Убыль остатков мевинфоса из плодов перца, хранимого при разной температуре.** Sbor. ÚVTI - Ochr. rostl. 11 (4) : 301-305, 1975.

Убранные плоды перца опрыскивались мевинфосом обычной дозой 0,288 кг/га (= 1,2 литра Фосдрина на га), а также дозой а пять раз выше. У плодов, хранимых снаружи в течение октября при средней температуре 7 °C был установлен период распада остатков 11,6 дней, у плодов, хранимых при средней температуре 12,5 °C — 8,2 дня, а в теплице при средней температуре 25 °C — 1,8 дня. Спустя две недели после опрыскивания обычной дозой снаружи остатки достигали величины 0,4 мг/кг, в то время, как, спустя неделю после опрыскивания пятикратной дозой, остаток в теплице понизился до 0,2 мг/кг. В связи с зависимостью скорости убывания остатков от температуры было бы желательно определить и нижнюю границу температур при которых действует защитный срок.

перец; остатки пестицидов; мевинфос; влияние температуры

LÁSKA P. (Forschungsinstitut für Gemüsebau, Olomouc). *Die Abnahme der Residuen von Mevinphos von den bei verschiedener Temperatur gelagerten Paprikafrüchten.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 301-305, 1975.

Die geernteten Paprikafrüchte wurden mit Mevinphos, einerseits mit der Normaldosis von 0,288 kg/ha (= 1,2 Liter Phosdrin je 1 ha), andererseits mit einer fünfmal höheren Dosis bespritzt. Bei den im Freien während des Monates Oktober bei durchschnittlicher Temperatur von 7 °C gelagerten Früchten wurde die Halbzeit des Residuenzerfalls mit 11,6 Tagen, bei Früchten im Lager bei einer Durschschnittstemperatur von 12,5 °C 8,2 Tage und im Gewächshaus bei einer Durchschnittstemperatur von 25 °C 1,8 Tage ermittelt. Zwei Wochen nach der Bespritzung mit Normaldosis erreichten die Residuen im Freien den Wert von 0.4 ppm, wogegen eine Woche nach der Bespritzung mit einer fünffachen Dosis die Residuen im Gewächshaus auf 0,2 ppm senkten. Mit Rücksicht auf die Abhängigkeit der Schnelligkeit der Abnahme der Residuen von der Temperatur wäre es wünschenswert, auch die untere Grenze der Temperaturen, bei denen die Schutzfrist ihre Gültigkeit behält, festzulegen.

Paprika; Residuen der Pestizide; Mevinphos; Einfluß der Temperatur

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THE SIXTH NATIONAL CONFERENCE ON PLANT PROTECTION

The Institute of Plant Protection in Prague - Ruzyně together with the University of Agriculture in České Budějovice organize the Sixth National Conference on Plant Protection on September 7—9, 1976. This conference will be held as a part of the 25th anniversary of founding the Research Institutes for Crop Production in Prague - Ruzyně.

The conference agenda of the first day will be devoted to complex papers on the following topics:

I. Interactions of phytopathogen microorganisms, pests and weeds from the point of view of epidemiology, or pest gradology, plant resistance and total yield losses.

II. Pesticides in plant protection today and in the future.

III. The range, achieved results and the prospects of plant breeding for resistance in the CSSR.

IV. Changes in spreading and harmfulness of diseases, pests and weeds within last 15 years and consequent conclusions for practical plant protection.

The other days of The Sixth National Conference will be reserved for sessions in the following sections: virology, mycology, bacteriology, entomology, hygiene-toxicology and protection against weeds. In the cited sections original scientific information concerning a complex survey of the range and results of scientific-research work in plant protection in the CSSR in the last two years will be presented. The total number of papers has exceeded 160.

The summaries of presented papers will be published in three languages in the Proceedings from The Sixth National Conference on Plant Protection, which according to the SZN (State Agricultural Publishing House) editor's plan are to appear in March 1977. Complex papers will be printed in Czech with summaries in foreign languages.

Applications for participation in The Sixth National Conference on Plant Protection are to be addressed to the Director's Secretariate of the Institute of Plant Protection in Prague - Ruzyně.

Ing. Jana Beránková

POSSIBILITIES OF COMBINATION OF GLASSHOUSE WHITEFLY CHEMICAL CONTROL AND TWO-SPOTTED SPIDER MITE BIOLOGICAL CONTROL

P. LÁSKA

LÁSKA P. (Vegetable Research Institute, Olomouc). *Possibilities of Combination of Glasshouse Whitefly Chemical Control and Two-Spotted Spider Mite Biological Control.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 307-313, 1975.

The trials have shown that the glasshouse whitefly occurring in the Vegetable Research Institute at Olomouc can be controlled by methomyl, monocrotophos, pirimiphosmethyl, bioresmethrin, methidathion, carbofuran and acephate. The efficiency of the insecticides used until now for whitefly control — e. g. mevinphos, dichlorvos and malathion — was not sufficient. The most efficient insecticide against larvae was carbofuran with a special mode of action — the treatment of larvae performed only during and after emergence of adults from puparia. The *Phytoseiulus* predator was the least damaged by carbofuran. It was killed partially by pirimiphosmethyl and completely by methidathion and bioresmethrin.

glasshouse pests; insecticides; glasshouse whitefly; *Phytoseiulus*

Some years ago the problem of whitefly control seemed to have been well solved by the use of Vapona strips with dichlorvos as active ingredient. At present, the circumstances have evoked a search for new methods of glasshouse whitefly control as (1) the whiteflies become resistant to insecticides (Wardlow et al., 1972; French et al., 1973), and (2) there is an increasing interest in biological control of two-spotted spider mite by means of *Phytoseiulus* predator which is killed by most insecticides in current use, including dichlorvos. The promising method would be a complete biological control: red spider mites by *Phytoseiulus,* glasshouse whiteflies by *Encarsia formosa* (Hussey, 1967; Scopes, Biggerstaff, 1971) and aphids by *Aphidiidae,* green peach aphid *Myzus persicae* by *Aphidius matricariae* (Scopes, 1970). The ideal aim of research should be the biological control but for the time being the use of *Encarsia* is expensive and difficult, especially in vegetable growing. Therefore, it is necessary to look for the alternative method of integrated control comprising the biological control of two-spotted spider mite and the chemical control of other pests. The chemical control of aphids within the scope of integrated control has been successfully realized by pirimicarb (Parr, Scopes, 1971). The aim of this work was to contribute to finding an effective chemical control of the glasshouse whitefly occurring in our institute, and to make preliminary tests for influence of chemicals on the predator *Phytoseiulus persimilis.*

MATERIAL AND METHOD

The trials were carried out with young bush bean and cucumber plants in a glasshouse and in a controlled-environment cabinet. In the controlled cabinet the

temperature was maintained at 20 °C ± 1 °C, the relative humidity was ranging between 50 and 70 %, illumination was provided by eight 80 W fluorescent tubes installed at 45 cm above the plants, the day length being 16 hours.

The insecticides were applied by dipping the plants in the insecticide solution for 15 sec.

TRIAL 1

In a screening glasshouse trial the cucumber plants at a stage of 1—2 true leaves were dipped (without wetting agent). The plants dried off within an hour (at 25—30 °C), each was covered then with an isolation cage and infested by 100 whitefly adults. After 2 days a count was made of the live whiteflies on the plants. During the two days there were considerable temperature fluctuations (15—35 °C).

TRIAL 2

In a glassouse trial we have used 18 days old bean plants 'Jantar' and cucumbers 'Znojmia'. The cucumbers were at the stage of cotyledons with a developing 1st true leaf, the weight of the above-ground part was 1—1.2 g. The bean plants had 2 primordial leaves and another growing leaf, the weight of the above-ground part was 1.4—1.5 g. On October 21, 1974 the experimental plants were dipped (without wetter).

The plants chosen for studying the effect of insecticides on glasshouse whitefly were covered with isolation cages and 24 hours after treatment infested by 100 whitefly adults each. Whitefly infestation was then repeated 4 and 10 days after treatment. Mortality of the whiteflies was assessed 2—3 days after infestation. There were 4 isolation cages (30×30 cm) for each variant, two and two contained 2 bean plants and 2 cucumber plants each, so that the total of 4×100 whiteflies was used in each variant.

The plants chosen for studying the effect of insecticides on *Phytoseiulus* predator were infested by two-spotted spider mites and by *Phytoseiulus* 5 and 3 days before treatment, respectively. In every variant there were 4 bean plants, all in pots and isolated from one another by placing the pots in Petri dishes filled with water. 8 days after dipping, counts were made of live predator mites, their eggs, and live two-spotted spider mites on each plant.

The trial was carried out at relatively low temperatures ranging between 15 and 18 °C (at noon the temperature usually rose above 20 °C for a short period) and relative humidity 65—85 %.

TRIAL 3

The plants of beans 'Šárka' at the stage of 2 primary leaves were deprived of a growing point and one primary leaf. The plants bearing just one leaf were exposed to whitefly infestation and laying eggs (at 15—20 °C) in a glasshouse for 24 hours. After the 24 hours' period the whiteflies were removed and the plants were transferred to the controlled cabinet (20 °C). 19 days later (December 12, 1974) when the whitefly larvae were mostly at the stage of the second or third instar the leaves were dipped in the insecticide solutions with an addition of the wetting agent — 0.01 % Agral; the control plants were dipped in 0.01 % Agral only. After 12 days when the first emergence of whiteflies occurred counts were made of the developed puparia and the plants were transferred to the glasshouse (15—20 °C) with space enough for each plant to be put in the isolation cage. The whitefly adults were counted on the plants at a time when majority of whiteflies emerged, 11 days after the first emergence.

TRIAL 4

This trial was similar to trial 3 but it was made later. The dipping in insecticide solutions (each of them contained 2 Agral concentrations — 0.01 % and 0.1 %) was carried out on 21st day of development (December 27, 1974) when the

larvae were predominantly in the 3rd and partially in the 4th instar. At a time of the first emergence — 10 days after treatment — the plants were transferred to the glasshouse and put in the isolation cages for 11 more days.

Carbofuran was used for whitefly control not only in the trials mentioned but also in growing practice within the scope of our institute resulting in some useful observations and experiences.

The statistical evaluation using the *U*-test (W e b e r, 1961) was carried out in the trials where there were more values of each insecticide available.

RESULTS

The results of all the trials 1–4 are given in Tables I–IV. The tables show that the whitefly adults were efficiently controlled by methomyl, monocrotophos, pirimiphos-methyl, bioresmethrin, methidathion, carbofuran and acephate. The most effective insecticide against whitefly

I. A survey of chemicals used in trials and results of screening test (Trial 1)

Insecticide (common name)	Commercial product — formulation	a. i. concn. in insecticide solution	Efficiency*)
isothioate	Hosdon 30 EC	0.03 %	1
mevinphos	Phosdrin 24 EC	0.048 %	1
phosalone	Zolone liquid EC 35	0.07 %	1
endosulfan	Thiodan 35 EC	0.07 %	1
tetrachlorvinfos	Gardona 24 EC	0.072 %	1
DDT + lindan	Lidykol tWP + 46 + 4)	0.046 + 0.004 %	1
propoxur	Unden 20 EC	0.05 %	2
mercaptodimethur	Mesurol 50 WP	0.2 %	2
cartap	Padan 50 SP	0.05 %	2
dichlorvos	Nogos 50 EC	0.1 %	2
malathion	Fosfotion E 50	0.1 %	2
bromophos	Nexion EC 40	0.08 %	2
diazinon	Basudin EC 60	0.12 %	2
demephion	Tinox 50 EC	0.025 %	2
acephate	Orthen 75 WP	0.075 %	3
carbofuran	Furadan 75 WP	0.15 %	3
methidathion	Ultracid 40 WP	0.08 %	3
bioresmethrin	Bioresmethrin 100 EC	0.005 %	2
bioresmethrin	Bioresmethrin 100 EC	0.01 %	3
pirimiphos-methyl	Actellic 50 EC	0.05 %	3
monocrotophos	Nuvacron 20 EC	0.04 %	3
methomyl	Lannate 90 WP	0.045	3

*) Efficiency: 1 — insufficient (below 50 %)
2 — moderate
3 — good (100 %)

II. Effect of insecticides on whitefly adults and on *Phytoseiulus* predator (Trial 2)

Insecticide	Concn. of solution	% of whiteflies surviving			Number of *Phytoseiulus* per plant 8 days after treatment	
		Interval between treatment of plants and whitefly infestation				
		1	4	10	eggs	mobile stages
carbofuran	0.15 %	0.5 a	4.8 b	31.2 b	0 a	17 bc
methidathion	0.08 %	0 a	0 a	2.2 a	0 a	0 a
bioresmethrin	0.01 %	0 a	24.2 b	77.8 c	0 a	0 a
bioresmethrin	0.02 %	0 a	8.8 ab	55.5 bc	0 a	0 a
pirimiphos-methyl	0.1 %	0 a	23.8 b	95.0 c	0 a	1 ab
control	+	98.2 b	96.5 c	98.0 c	36 b	40 c

The values not marked with the same letter differ significantly

III. Effect of insecticides, used against glasshouse whitefly larvae, on puparia formation and viability of emerged adults (Trial 3)

Insecticide (0.01 % of Agral added)	Concn. of solution	% of well developed puparia	% of viable adults emerged
carbofuran	0.15 %	80	0
methidathion	0.08 %	19	1
monocrotophos	0.04 %	8	1
acephate	0.075 %	45	8
methomyl	0.045 %	15	15
pirimiphos-methyl	0.05 %	18	16
bioresmethrin	0.01 %	18	18
dichlorvos	0.1 %	39	34
mevinphos	0.048 %	76	62
malathion	0.1 %	80	64
control*)	—	100	91

*) Treated with 0.01% Agral only

larvae was carbofuran regarding the number of emerged viable adults. The effect of different Agral concentrations was not unambiguous. *Phytoseiulus* predator was less damaged by carbofuran.

During the use of carbofuran in growing practice the control of whiteflies on beans, tomatoes, cucumbers, geraniums, etc. was complete at first but in some cases the effect of the formulation was insufficient due

IV. Effect of insecticides, used against glasshouse whitefly larvae, on puparia formation and viability of emerged adults (Trial 4)

Insecticide	Concn. of solution	% of well developed puparia			% of viable adults emerged		
		Agral 0.01%	Agral 0.1%	Mean	Agral 0.01%	Agral 0.1%	Mean
carbofuran	0.15 %	82	68	75.0 cd	1	1	1.0 a
carbofuran	0.30 %	77	56	66.5 bc	0	0	0.0 a
pirimiphos-methyl	0.05 %	29	12	20.5 a	27	11	19.0 b
bioresmethrin	0.01 %	16	58	37.0 ab	15	49	32.0 b
control	—	92	88	90.0 d	82	87	84.5 c

The values not marked with the same letter differ significantly

to undefined factors, the 100% effect being reached after a repeated spray. Most whiteflies emerging from puparia after spray died in the course of emergence.

During the treatment of the beans with carbofuran (0.15%) on September 12, 1974 there were also two-spotted spider mites and *Phytoseiulus* predators on the plants. The checks made on September 20 and October 1 revealed a great number of live *Phytoseiulus* predators (on October 1 there were ca 10 live predators and 10 *Phytoseiulus* eggs per leaf). On October 1 the spray was repeated thoroughly on both sides of the leaves with the same predators. On October 7 the live *Phytoseiulus* predators were found on plants again.

DISCUSSION

The whiteflies we used were resistant to some extent. In the present trials the malathion efficiency was insufficient while in 1961 (L á s k a, 1967) it reached 100% concerning both larvae and adults.

A promising insecticide is carbofuran which gave the best results and seems to be perspective for combination with *Phytoseiulus*. It will be necessary to study the mechanism of its effect in details to explain the fact why the insecticide does not control the treated larvae and puparia but during and after adult emergence, and why the effect of the spray fails occasionally. A disadvantage of this insecticide is its high toxicity (LD 50 for rats 8–14 mg/kg) which will restrict its use in vegetable growing with regard to its considerable persistence.

Primiphos-methyl is a standard insecticide giving a complete control of whitefly adults in spite of being in use for several years. Because of less effective control of immature stages and shorter residual effect the spray should be repeated more often. It is advantageous for its low toxicity (LD 50 = 2050 mg/kg) which, together with short persistence, gives possibilities of a wide application in vegetable growing.

Bioresmethrin has short-term effects similar to those of pirimiphos-methyl. Its greatest advantage is a very low toxicity. LD 50 is more than 10 000 mg/kg, and at the same time the formulation is used at moderate concentrations. Toxicity of 15.000 l of 0.01% solution of bioresmethrin is comparable to that of ca 1 l of 0.15% solution of carbofuran. Up to now there has been no selective influence found as to Phytoseiulus, which is supposed to be owing to the short-term efficiency of the formulation.

It will be necessary to make the trials with monocrotophos, acephate and particularly methomyl. The effect of methomyl on 14 whitefly strains was studied by W a r d l o w and L u d l a m (1973) the results of which showed it was the only insecticide the whitefly strains were not resistant to. Good results with methomyl were also obtained by K r u e g e r et al. (1973).

In general we must count on the fact that there will be a rapid increase in the number of insecticides the whiteflies are resistant to. Although W a r d l o w and L u d l a m (1973) found that out of 17 strains studied most were resistant to some insecticides only their combination would lead to higher resistance to 3 out of 4 insecticides tested.

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LÁSKA P. (Výzkumný ústav zelinářský, Olomouc). *Možnosti kombinace chemické ochrany proti molici skleníkové s biologickou ochranou proti sviluškám.* Sbor. ÚVTI-Ochr. rostl. 11 (4) : 307-313, 1975.

V pokusech bylo zjištěno, že molice skleníkové v objektech Výzkumného ústavu zelinářského v Olomouci může být hubena methomylem, monocrotophosem, pirimiphos-methylem, bioresmethrinem, methidathionem carbofuranem a acephatem. Dosud používané insekticidy, např. mevinphos, dichlorvos a malathion neměly na molici dostatečnou účinnost. Nejúčinnější proti larvám byl carbofuran, který měl zvláštní způsob účinku, při němž se ošetření larev projevilo hynutím až při líhnutí a po

vylíhnutí imág z pupárií. Dravý roztoč *Phytoseiulus* byl nejméně poškozen carbofuranem. Zcela byl vyhuben methidathionem a bioresmethrinem a z převážné části pirimiphos-methylem.

sklenkoví škůdci; insekticidy; molice skleníková; *Phytoseiulus*

ЛАСКА П. (Научно-исследовательский институт овощеводства, Оломоуц). **Возможности комбинации химической защиты против белокрылки с биологической защитой против клещей.** Sbor. ÚVTI - Ochr. rostl. 11 (4) : 307-313, 1975.

Во время опытов было установлено, что белокрылки в объектах Научно-исследовательского института овощеводства в Оломоуце уничтожались при помощи метомила, монокротофоса, пиримифос-метила, биоресметрина, метидатиона, карбофурана и ацефата. Применяемые до сих пор инсектициды, например, мевинфос, дихлорвос и малатион не были против белокрылки достаточно эффективны. Самым эффективным против личинок был карбофуран, который имел особый способ воздействия, при котором обработка личинок проявилась в гибели только при выведении и после выведения имаго из пупариев. Хищный клещ *Phytoseiulus* наименее был поражен карбофураном. Абсолютно был выведен метидатионом и биоресметрином, и в большинстве случаев — пиримифос-метилом.

тепличные вредители; инсектициды; белокрылка; *Phytoseiulus*

LÁSKA P. (Forschungsinstitut für Gemüsebau, Olomouc). *Möglichkeiten der Kombination des chemischen Schutzes gegen weiße Fliege mit dem biologischen Schutz gegen Spinnmilben.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 307-313, 1975.

Durch Versuche konnte festgestellt werden, daß der übliche Stamm der weißen Fliege in den Objekten des Forschungsinstituts für Gemüsebau in Olomouc mit Methomyl, Monocrotophos, Pirimiphos-Methyl, Bioresmethrin, Methidathion, Carbofuren und Acephat bekämpft werden kann. Die bisher verwendeten Insektizide, z. B. Mevinphos, Dichlorvos und Malathion übte gegen die weiße Fliege keine ausreichende Wirkung aus. Das wirksamste Mittel gegen die Larven war Carbofuran mit einer besonderen Wirkungsart, bei der die Behandlung der Larven durch Absterben erst beim Ausschlüpfen und nach dem Ausschlüpfen der Imagines aus den Pupparien erschien. Die Raubmilbe *Phytoseiulus* wurde am wenigsten mit Carbofuran beschädigt. Sie wurde mit Methidathion und Bioresmethrin vollkommen und in der Mehrheit der Fälle mit Pirimiphos-Methyl ausgerottet.

Gewächshausschädlinge; Insektizide; weiße Fliege; *Phytoseiulus*

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REVIEW

POTATO BREEDING — METHODS USED IN PLANT BREEDING AND IN POTATO BREEDING MATERIAL EVALUATION

Zadina, J. — Jermoljev, E.: Šlechtění brambor — Metody používané ve šlechtění a při hodnocení šlechtitelského materiálu brambor. 1974, Publish. Academia, Praha, Czechoslovakia, 384 pp. Price 52,— Kčs

The book describes new and verified methods of breeding new varieties and methods of maintenance breeding of the existing potato varieties.

In the chapter „Breeding of New Varieties" the methods of crossing, the methods of obtaining potato haploids, experimental polyploidy and methods of evaluation and testing the hybrids during the breeding process — morphologic evaluation, physiologic tests, determination of technologic value (starch and spirit production, drying value), determination of feeding and table value, phytopathological tests aimed at laboratory or field determination of the hybrid resistance against pathogenic agents — fungus, bacterial and virus diseases, the most important diagnostic methods of the virus diseases and the methods of the determination of the resistance to pests and unfavourable climatic conditions are given. The methods of the evaluation of the earliness of hybrids, maximum productivity of new varieties and evaluation of the storage ability of new potato varieties are described in detail.

The applying of the computer for the selection of suitable parents in crossing is discussed.

The technique and evaluation of comparative potato variety trials are given — the testing of ecological plasticity and regionalization of potato varieties.

In the chapter „Maintenance Breeding of Potato" the methods of roguing in fields are given, the methods of premature haulm destruction, the verified methods of chitting and presprouting and the methods used for breaking the dormancy in seed potatoes. Details are given to the testing of the health state in the greenhouse, methods of virus — free seed production, quickened seed propagation and due storage of breeding material and seeds in particular storehouses. Great effort was made so that the book would be useful not only for potato breeders, but also for seed growers.

Classification mark is given of the characteristics of potato, which enables a simple evaluation of potato characteristics and their transmission into the numerical symbols for their codification on punched cards.

Some chapters of the book, e. g. electron microscopy, some chemical analyses etc. will be described by the qualified experts so that a high special level of the book is fully guaranteed.

It can be said that in the world literature no book of similar contents exists yet.

ANTIFUNGAL SUBSTANCES OF 1,4-BENZOXAZINE GROUP IN RYE PLANTS (*SECALE CEREALE* L.)

J. HOFMAN

HOFMAN J. (Institute of Experimental Botany, Czechoslovak Academy of Sciences, Praha). *Antifungal Substances of 1,4-benzoxazine Group in Rye Plants (Secale cereale L.)*. Sbor. ÚVTI - Ochr. rostl. 11 (4) : 315-319, 1975.

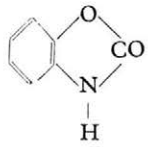
The resistance of some cultivated plants against pathogens and pests is connected with 1,4-benzoxazine derivatives having antifungal properties. In plants they are bound in the form of glucosides. The paper describes gel fractionation, isolation and identification of the 1,4-benzoxazine glucosides from rye plants.

graminae; resistance; 1,4-benzoxazine; antifungal substances; glucosides; rye (*Secale cereale* L.)

Derivatives of 1,4-benzoxazine are natural antifungal substances found in some cultivated plants, which have some significance for their resistance against pathogens and pests.

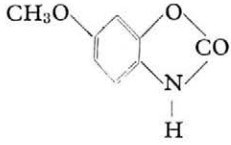
The first antifungal factor from rye plants was isolated by Virtanen and Hietala (1955) in their study of the causes of considerable losses in rye due to snow mould *Fusarium nivale* Ces. In Finland, breeders knew about the different resistance of some rye varieties to fusariose. Virtanen with co-workers studied these differences in testing the extracts of several days old rye plants. They demonstrated the presence of a factor inhibiting the growth of Fusarium nivale. This knowledge had basic significance for the investigation of rye resistance and gave hope of the possibility to produce such varieties which would possess enough own protective substances against pathogens.

After isolation and identification of the antifungal rye factor it was found that this substance was 2(3)-benzoxazolinon (BOA) (Virtanen and Hietala, 1955). It completely inhibits Fusarium nivale in the concentration of 0.05 per cent.



BOA

Also in numerous other tested plants an antifungal activity was found (Virtanen et al., 1956a). The factor isolated from wheat and maize had similar properties, yet was not completely identical with BOA. Subsequent studies confirmed that the active factor was 6-methoxy-2(3)-benzoxazolinon (MBOA) (Virtanen et al. 1956b).

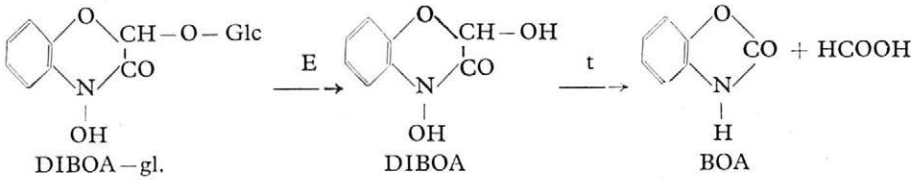


MBOA

Isolation of antifungal factors called forth considerable attention. Other methods gradually led to the conclusion that the isolated factors BOA and MBOA were degradation products of other plant substances which split during isolation. These original substances belong to 1,4-benzoxazine group and appear in the plants in the

form of glucosides. W a h l r o o s and V i r t a n e n (1959a) isolated DIBOA-gl. from rye and its 7 — methoxy derivative (DIMBOA-gl.) from wheat and maize (W a h l r o o s and V i r t a n e n 1959b).

The origin and isolation of BOA and MBOA as the first factors was explained according to the following scheme: glucosides are hydrolytically splitted and under higher extract temperature the resulting aglucones undergo conversion to 2(3)-benzoxazolinones. The aglucones DIBOA and DIMBOA have the same antifungal properties as BOA and MBOA.



DIBOA—gl. DIBOA BOA

Our studies develop Virtanen's results. A survey of the whole problem of 1,4-benzoxazines was published in the same journal (H o f m a n, 1974). VIRTANEN described one glucoside — DIBOA-gl. in rye. This article describes the finding and isolation of three other glucosides which were not known in rye. By gel chromatography on Sephadex G-10 fractions of four different 1,4-benzoxazine glucoside derivatives were obtained.

MATERIAL AND METHOD

It was necessary to choose such a method of plant fixation and homogenization that would eliminate or reduce to a minimum the effect of hydrolytic enzymes (β-glucosidase) under simultaneous quantitative glucoside extraction (H o f m a n and H o f m a n o v á, 1969).

PLANT HOMOGENIZATION

2 g of overground parts or roots of rye seedlings (aged 10 days, approx. 10 cm high) are frozen in liquid nitrogen and ground in nitrogen cooled china mortar. The obtained homogenous powder is overpoured with 100 ml distilled acetone. The extract (temperature —50 to —30 °C) is poured off into an Erlenmeyer flask and the sample is warmed at room temperature to 0 — +5 °C, sucked off and the rest on the filter is rinsed twice with 10 ml acetone. Glucosides together with chlorophyll from the plant extracts are quantitatively eluted (0.2 per cent losses). The filtrate is concentrated on a rotating vacuum evaporator almost to dry state. A small part of the glucosides (0.5 per cent) is precipitated together with chlorophyll. In the majority of the cases a bright yellowish extract free of β-glucosidase activity is obtained. If the plants contain more anthocyans, also the extract has a red-violet color.

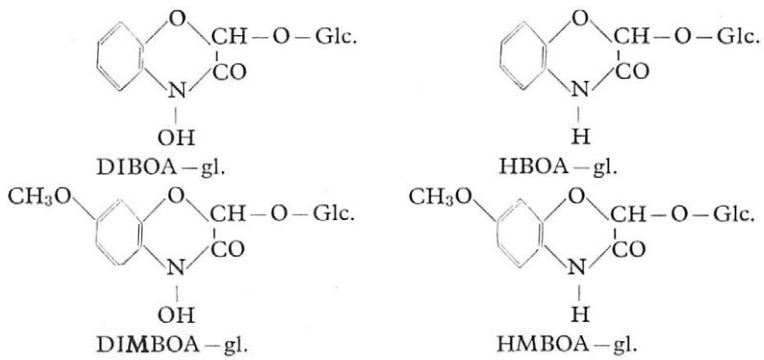
GEL CHROMATOGRAPHY

The obtained extract is fractionated by gel chromatography in silica column (1 X 40 cm) on Sephadex G-10 at 4 ml/hr. flow rate. $CHCl_3$-saturated water serves as an eluent. For the detection of 1,4-benzoxazine glucosides and other uv-active substances a through-flow uv-photometer Uvicord I LKB at 254 nm was used. For preparatory purposes silica column 2.5 X 150 cm was selected and the homogenization was performed with 2 kg plants. Silica columns allow the following of the course of chromatography in UV-light.

RESULTS

By means of gel chromatography of glucosides on Sephadex G-10, DIBOA-gl. and HBOA-gl. were isolated from roots and DIBOA-gl.,

DIMBOA-gl. and HMBOA-gl. from the overground parts of rye seedlings. These compounds were purified by thin-layer chromatography on silica gel after gel filtration.



CHARACTERISTICS OF GLUCOSIDES AND AGLUCONES

2-(2,4-dihydroxy-2H-1,4-benzoxazin-3/4H/-one-β-D-glucopyranoside (DIBOA-gl., UVλ_{max} (H_2O) 255, 282 nm) and *2-(2,4-dihydroxy-7-methoxy-2H-1,4-benzoxazin-3/4H/-one-β-glucopyranoside* (DIMBOA-gl., UVλ_{max} (H_2O) 262, shoulder 282 nm). Degradation products of DIBOA and DIMBOA aglucones were obtained by boiling in water, with characteristic UV-spectra – 2(3)-benzoxazolinone (BOA, UVλ_{max} (H_2O) 270 nm) and 6-methoxy-2(3)-benzoxazolinone (MBOA, UVλ_{max} (H_2O) 229, 284 nm). These hydroxam forms of glucosides and aglucones react positively with $FeCl_3$ solution under the formation of a dark blue complex.

2-(2-hydroxy-7-methoxy-2H-1,4-benzoxazin-3/4H/-one)-β-D-glucopyranoside (HMBOA-gl., UVλ_{max} (H_2O) 262, shoulder 282 nm). The properties of the isolated HMBOA-gl. were identical with the product obtained by DIMBOA-gl. reduction with zinc in acetic acid (Honkanen and Virtanen, 1960). HMBOA aglucone: m. p. 198 – 200 °C. UVλ_{max} (H_2O) 262, inflex 282 nm. For $C_9H_9NO_4$ calculated: C, 55.38; H, 4.65; N, 7.18; found: C, 55.27; H, 4.78; N, 7.10.

2-(2-hydroxy-2H-1,4-benzoxazin-3/4H/-one)-β-D-glucopyranoside (HBOA-gl., UVλ_{max} (H_2O) 250, 282 nm). HBOA-gl. obtained by DIBOA-gl. reduction with zinc in acetic acid had identical properties with the isolated HBOA-gl. HBOA aglucone: m. p. 200 – 203 °C, UVλ_{max} (H_2O) 250, 282 nm).

For $C_8H_7NO_3$ calculated: C, 58.18; H, 4.27; N, 8.48; found: C, 58.36; H, 4.28; N, 8.31. HBOA aglucone was also prepared synthetically by dichloracetylation of o-aminophenol; the product N-dichlora-acetyl-o-aminophenol is hydrolysed and cyclised in 0.2 M $NaHCO_3$ solution under the formation of HBOA (Honkanen and Virtanen 1960). IR spectra of the isolated and synthetical HBOA were identical.

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HOFMAN J. (Ústav experimentální botaniky, ČSAV, Praha). *Antifungální látky skupiny 1,4-benzoxazinu v žitných rostlinách (Secale cereale L.).* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 315-319, 1975.

Rezistence některých kulturních rostlin k patogenům a škůdcům souvisí s deriváty 1,4-benzoxazinu, které mají antifungální vlastnosti. V rostlinách jsou vázány ve formě glukozidů. Článek popisuje gelovou frakcionaci, izolaci a identifikaci glukozidů 1,4-benzoxazinu z rostlin žita.

graminae; odolnost; 1,4-benzoxazin; antifungální látky; glukozidy; žito (*Secale cereale* L.)

ГОФМАН Й. (Институт экспериментальной ботаники, ЧСАН, Прага). **Антифунгальные вещества группы 1,4-бензоксазина, в растениях ржи (*Secale cereale* L.)** Sbor. ÚVTI - Ochr. rostl. 11 (4) : 315-319, 1975.

Устойчивость некоторых культурных растений против патогенов и вредителей связана с дериватами 1,4-бензоксазина, которые имеют антифунгальные свойства. В растениях они связаны в форме гликозидов. В статье описана гелевая фракционация, изоляция и идентификация гликозидов 1,4-бензоксазина из растений ржи.

graminae; устойчивость; 1,4-бензоксазин; антифунгальные вещества; гликозиды; рожь (*Secale cereale* L.)

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REVIEW

DISEASES AND PESTS OF ORNAMENTAL PLANTS

Valášková, E.: Choroby a škůdci okrasných rostlin. 1976, State Agricultural Publishing House (SZN), Praha, Czechoslovakia, 272 pp., 110 illustrations. Price 15,— Kčs

This book has been written for plant breeders, growers, gardeners on state and cooperative farms, amateur gardeners and all other ornamental plant lovers. At the same time it can be used as a textbook for students of specialized schools. It is a link between the textbooks and original literature. From this point of view the authors wish to deal with the whole matter in this publication, which in the choice of given plant species and in the biology of all harmful agents and harmonic control of theirs is orientated to the modern ornamental gardening on a large scale.

Part I as a general part is devoted to the physiological disorders in the plant growth, pathogenic bacteria, viruses and mycoplasmas, pathogenic fungi and pests. For each group of pathogens (Viruses, Bacteria and Fungi) typical biological properties and biological marks, the manner of spread and surviving of pathogens in the nature, the methods of identification and possibilities of prevention are given. These chapters are followed by detailed information on biology of individual and specially chosen pathogens of each basic group, symptoms of diseases, and possibilities of their control. The same scheme is in the chapter devoted to the animal pests in which a table arrangement of all control precautions against harmful animals is given.

This part of book might appear rather theoretical but the authors lay stress on a thorough knowledge of the biology of main harmful agents of ornamental plants not only because some of them are in the Czech literature entirely new and less known to most readers but also for the fact that a rational approach to their control is not only the use of tested pesticides but provides a deeper insight into a mutual relationship between hosts and pathogens or other harmful agents with the main aim to use the control measures at the most critical stage of development of this pathogen or pest and with the minimum of applied chemicals. It is a pity that the extent of this book cannot, of course, exhaust the subject with respect to those pathogens specialized only for some ornamental plant species.

Further chapters of Part I will inform the reader on some effective means of disease and pest control among ornamentals. Various methods of thermal, chemical and other disinfection of soil, pots, tools, empty glass- and storehouses are listed. Methods of seed and living plant part dressing and disinfection are given in brief. Quarantine regulations and safety precautions for use of chemicals are not omitted.

The discovery and manufacture of hundreds of new fungicides, insecticides, nematocides and other control materials and practices improved the means of control; detailed tables of all pesticides applied in ornamental plants with additional data e. g. active substance, host range of pathogens, application forms, and used concentrations are involved. All pesticides listed in the tables are cited according to the Official List of Approved Chemicals Used in Disease and Pest Control, published by the Czechoslovak Federal Ministry of Agriculture and Nutrition in 1974. The great development of chemical industry furnished us with some new pesticides but the general rules given in this chapter e. g. specific application methods for the use of organic fungicides, including the latest directions for the exploitation of systemic fungicide effects have permanent validity.

In Part II — special part — the host plants (annual, biennial and others, bulb and tuber plants grown in the open air

and in glasshouses) are arranged alphabetically. The reader will find for each plant the most important disease and pest symptoms, why they appear, what they indicate, and the most effective means of control. Special measures or biology of pathogens which are specific for the mentioned plant species are given in details. With pathogens which are widespread among many hosts all necessary and important references are contained in Part I to which the reader may turn his attention.

What impresses us most in this part of the book is the valuable information related to the specific susceptibility of individual plant species towards various pesticides.

Index of Czech and Latin names of cited plants as well as harmful agents and special terminology are appended to this book. The factual basis of this book is mainly the many-year experience of Dr. E. Valášková and her collegues in various Research and Experimental Institutes, chiefly in the Research Institute of Ornamental Plants at Průhonice and the extensive use of all information available in the recent publications dealing with the diseases that attack ornamental plants. In the Czech phytopathological literature it is the first comprehensive book in such a specialized sphere as the control of diseases and pests in ornamental plants seems to be.

The limited extent of this book cannot of course exploit all experiences of authors and furnish detailed description of biology of all pathogens and does not allow the enlargement of the range of given ornamental plants. However, this book will help amateurs and professional gardeners and all readers to control the manifold diseases and pests of ornamental plants.

B. A. Kvíčala

UTILIZATION OF DOSE-EFFECT CURVES FOR TESTING VARIETAL SENSITIVITY OF CEREALS TO SOIL HERBICIDES

J. BENADA, M. VÁŇOVÁ

BENADA J., VÁŇOVÁ M. (Cereal Research Institute, Kroměříž). *Utilization of Dose-Effect Curves for Testing Varietal Sensitivity of Cereals to Soil Herbicides.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 321-332, 1975.

In greenhouse experiments the course of dose-effect curves was assessed in two soil herbicides, Dicuran and Zeazin using two varieties of winter wheat 'Kavkaz' and 'Mironovská' and two spring barley varieties 'Ametyst' and 'Diamant'. The plants were grown in water culture with the herbicide doses increasing according to coefficient 2 from 1.25 mg l^{-1} to 320 mg l^{-1}. From numerous experiments performed in the greenhouse at various times, the ones performed with each variety and herbicide in a relatively longer day and a relatively very short day were selected. It was found out that: a) the course of curves in the overground part length and its dry weight was accordant in most cases, even if the variety differences and those according to the date when the experiments were started could be seen, b) in higher Dicuran concentrations and in most cases also in Zeazin the root length was inhibited more than the root dry matter and therefore the course of these curves did not agree, c) in experiments performed in a shorter day, lower herbicide concentration stimulated the growth, d) Dicuran curves approached the ideal sigmoid curve more than those in the case of Zeazin, e) Dicuran was more toxic than Zeazin in the experiments performed in early autumn. The dose--effect curves strongly depend on external conditions and are not so regular as to allow using the GR factor derived from them for univocal phytotoxicity and varietal sensitivity evaluation.

atrazine; chlortoluron; wheat; barley

The susceptibility of cereals to selective soil herbicides used for the control of special weeds as well as to the residues of soil herbicides used in the forecrops is of great economic importance. The information on the degree of the susceptibility may be obtained from field trials and from glasshouse experiments.

The effect of phytotoxicity in the field is mainly in the dying off of seedlings, eventually in the reduction of tillering. Both effects may reduce the number of ears per square unit. In the field conditions yield is the most important characteristic but not a constant one. The sources of differences in the results are the absorption on the soil ingredient, the soil moisture, nutrition with nitrogen (Krakkai, 1970), and the compensation among yield components in the dependence on the course of the year. The phytotoxicity of soil herbicides is influenced by the sorption and detoxificant properties of the soil (Hammerton, 1968; Grice and Hays, 1970; Maas, 1970; Vojtechova, 1971). In soil with a great content of organic matter the effect of soil herbicides as well as its phytotoxicity is lower. The lower number of ears per square unit may be compensated by longer ears and higher weight of 1000 grains. Or the lower number of plants may be compensated by the more vigorous tillering of remaining plants. In such cases yield does not characterize precisely the phytotoxic effect of the preparate. The compensation factors have different validity in dependence on climatic conditions in the course of the year. Therefore, yield as the criterion of phytotoxicity is taken with limitation only (Unterstenhöfer, 1963; Zemánek, 1970).

In the field experiments we cannot generally evaluate the effect of herbicides on the roots which primarily came in contact with them.

Recently, several methods have been reported on testing the varietal susceptibility in glasshouse conditions on young plants. The methods used differ in details and are developing. Hiele et al. (1970) used soil mixed with sand for growing. To exclude the absorption on soil ingredients and colloids, Maas and Orth (1970) used sand culture. In our previous experiment we used water culture which excluded the absorption completely (Benada, 1974; Benada, Váňová, 1974). Also the methods of evaluating such experiments are different. Maas and Orth (1970) and Thiede (1970) evaluated the phytotoxicity by estimation according to the selected scale. Hiele et al. (1970) estimated the dry weight matter of overground parts and roots.

For the precise comparison of experiments there was an effort aimed to characterize the phytotoxic effect by a single value, lethal dose, effective dose or in the case of herbicides by the GR (growth reduction) (Zemánek, 1970).

In our previous experiments (Benada, 1974; Benada, Váňová, 1974) with Dicuran and Zeazin, when using only a less number of herbicide concentrations it was not possible to find out the GR factor suitable for evaluation of varietal susceptibility in relation to the growth of plants and dry matter production. Therefore, in the present paper, results of the experiment are given in which the whole course of dose-response curves with two soil herbicides was examined.

MATERIAL AND METHOD

Two winter wheat varieties 'Mironovská' and 'Kavkaz' and two spring barley varieties 'Diamant' and 'Ametyst' were taken for experiments.

The herbicides used:

Zeazin, product of Chemical factories of J. Dimitrov, Bratislava, ČSSR, containing 50 % atrazine. Solubility of atrazine in water at 25 °C is 70 ppm (Martin, 1968).

Dicuran 80, product of Ciba-Geigy, Swiss, containing 80 % chlortoluron. Solubility of chlortoluron is 10 ppm (Ciba, 1970).

The plants were grown in the glasshouse in one litre glass vessels arranged for hydroponic culture. The seeds were placed into the little holes in special plastic covers (Kousalová, Nátr, 1972). As source of nutrients the tablet form of Herbapon produced by Synthesia, Pardubice - Semtín, ČSSR, was used.

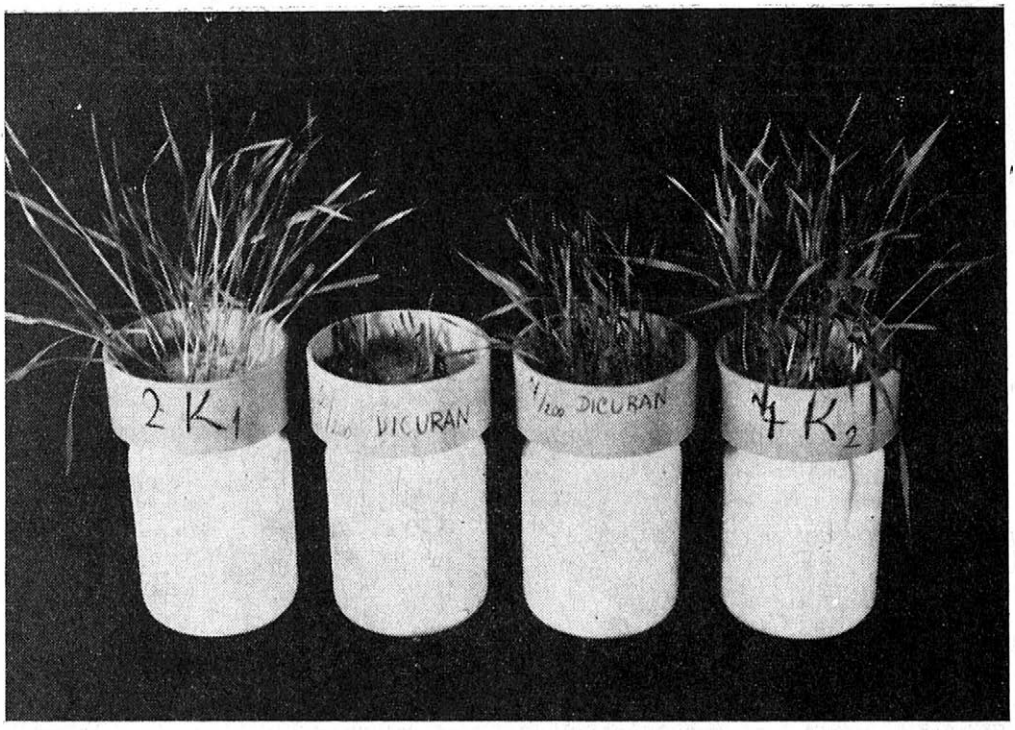
The doses of herbicides were used in increasing concentrations with the coefficient 2 : 1.25; 2.5; 5; 10; 20; 40; 80; 160; 320 mg l^{-1} of the product. Pure active ingredients were not used in these experiments because the phytotoxicity might be influenced by the additives, too. Each concentration was used in two vessels and in each experiment there were 18 control vessels without herbicides. From each vessel 20 plants were measured. The length of duration and the date of each experiment are given in the graphs.

As in our experiment very high doses as well as very low doses of herbicides were used, it was necessary to eliminate the rests of herbicides from the vessels when repeating the experiment. Thin plastic purses were laid into the glass vessels which were used for one experiment only. Before each experiment the plastic covers have been washed out in the running tap water for several days.

For the proper germination it was necessary to put a layer of some porous material onto the grains and to water them. Pure siliceous sand and perlite (material of high absorption capacity and of fine granular structure, produced by Korko, Košice, ČSSR, under the name Experlit) were used by some authors for experiments with cereal seedlings (Priehradný and Nižňanský, 1969). Perlite appeared to be inconvenient for this presented type of experiments.

In previous experiments the effect of Dicuran on the germination was examined. On the basis of these preliminary experiments (Benada, 1974), our experiments were arranged in such a way that the seeds were covered with a layer of siliceous sand, the sand was moistened with tap water and protected against evaporation with glass desks, before the plants were emerged. The arrangement of experiments see Fig. 1.

On plants the length of the overground parts and that of roots and dry weight of them were measured.



1. Demonstration of hydroponic vessels and the way of performing the experiments

From a greater series of experiments those were selected for presentation in which all herbicides and all varieties given above were performed during longer and shorter light-days.

During these experiments the temperature, relative humidity and illumination were measured and given in Table I. The results are shown in graphs, in which abscissa (concentration of the herbicide) is in logarithmical scale and ordinate (reduction of growth or weight) in linear scale in comparison with the control.

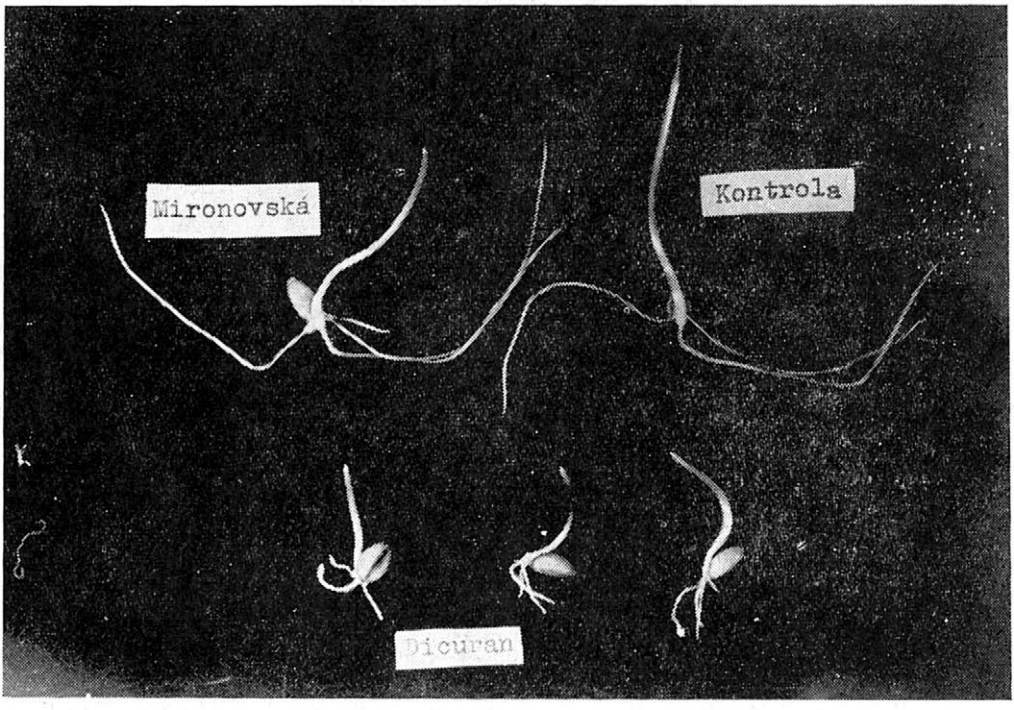
I. Mean temperature during the experiment (A), mean relative humidity (B) and mean sum of illumination (C) relating to figures 5a, b, c, d, e, f, g, h

Variety	Date	A °C	B %	C cal cm^{-2} day^{-1}
Diamant	4. 1.+15. 1.	20.2	60.0	33.5
	17. 10.+ 1. 11.	12.1	64.1	87.1
Ametyst	4. 1.+15. 1.	20.2	60.0	33.5
	12. 10.−24. 10.	9.9	73.0	84.1
Kavkaz	3. 12.+18. 12.	18.0	47.1	56.7
	18. 9.+ 3. 10.	7.4	94.0	94.6
Mironovská	3. 12.+18. 12.	18.0	47.1	59.2
	24. 9.− 9. 10.	7.7	89.8	87.4

RESULTS

EXAMINATION OF THE EFFECT OF HERBICIDES ON GERMINATION AND GROWTH OF CEREALS

Even at the concentration 160 mg l^{-1} of Dicuran the seed germination on filter paper in Petri dishes was not substantially influenced but the roots and germs were shorter (Fig. 2). The formation of secondary

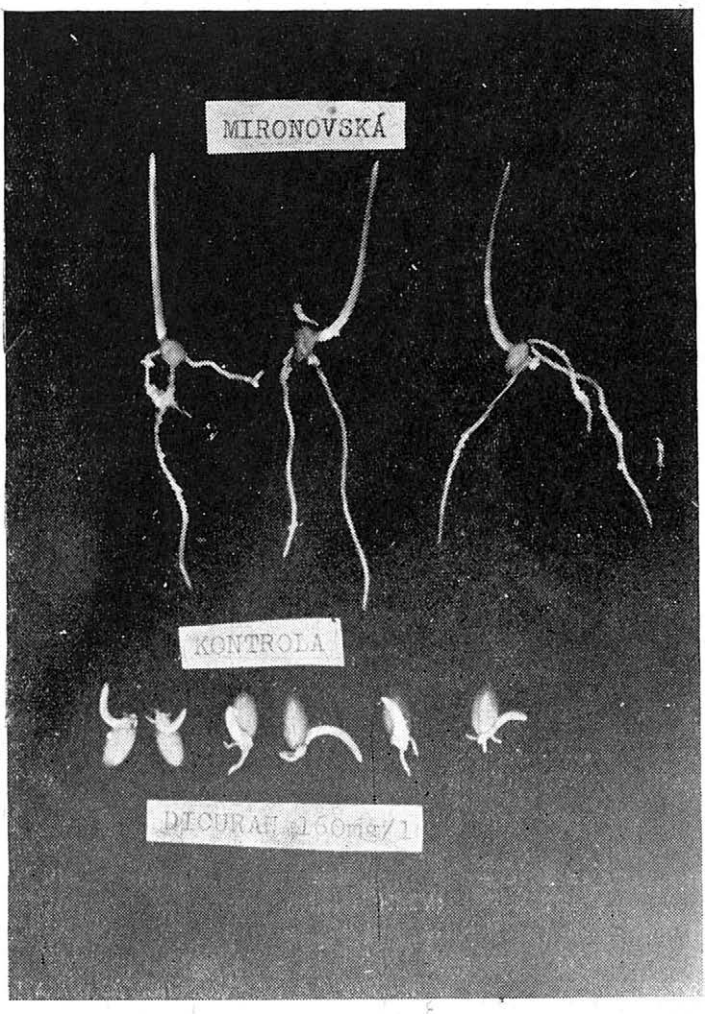


2. Germination of winter wheat on filter paper with the action of Dicuran at 160 mg l^{-1} concentration in comparison with control plants

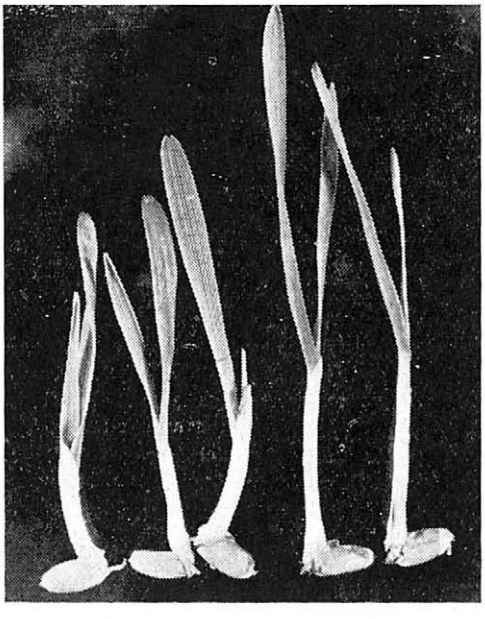
roots was depressed and therefore the plants did not adhere to the filter paper. The roots on the tips were swollen to some extent and were thicker. When the germination was examined in the perlite, the inhibition of root and shoot formation by the herbicide was higher than on filter paper (Fig. 3). In older plants the root formation was inhibited, nevertheless, the growth of the overground parts has continued for some time (Fig. 4). The plants were deeply green and with both short and thick bases.

THE DOSE-RESPONSE CURVES

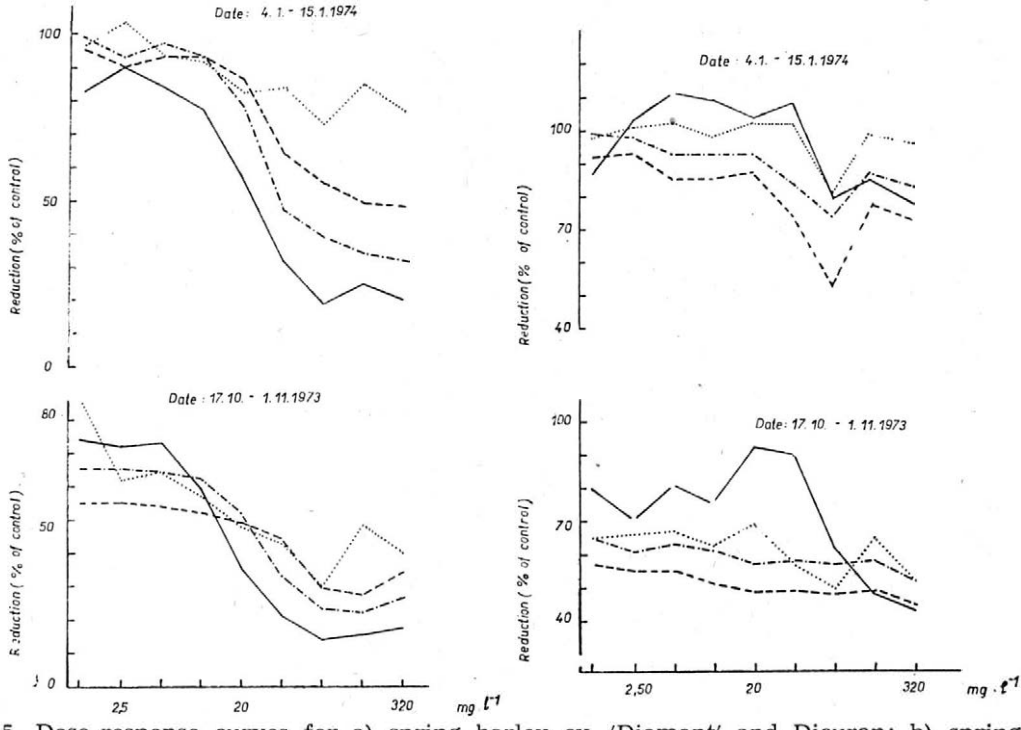
From figures 5a-h it may be concluded:
– Dicuran is more toxic than Zeazin during early autumn months.



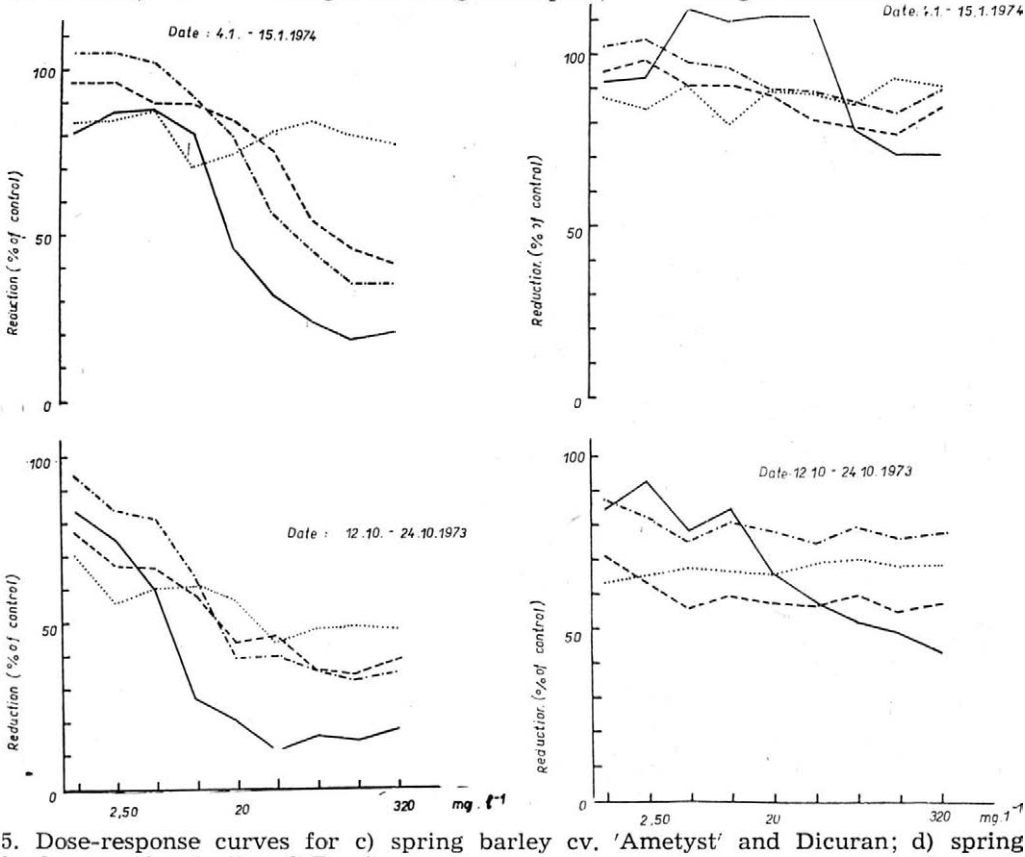
3. Germination of winter wheat var. 'Mironovská' in perlite with the action of Dicuran at 160 mg l^{-1} concentration. The plants were at the same age as in Fig. 2



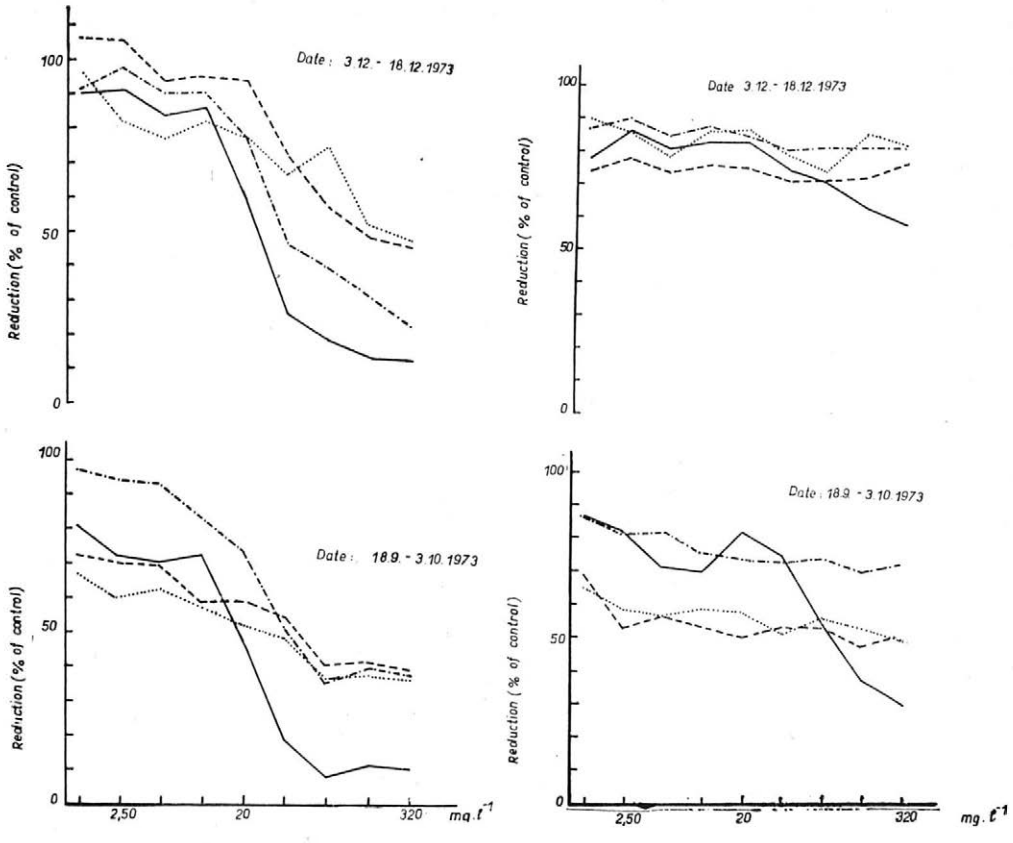
4. Winter wheat var. 'Kavkaz' grown in perlite with the action of Dicuran at 200 mg l^{-1} concentration



5. Dose-response curves for a) spring barley cv. 'Diamant' and Dicuran; b) spring barley cv. 'Diamant' and Zeazin ———— dry wt of overground part; . . . . . dry wt of roots; —.—.—. length of overground part; ——— length of roots

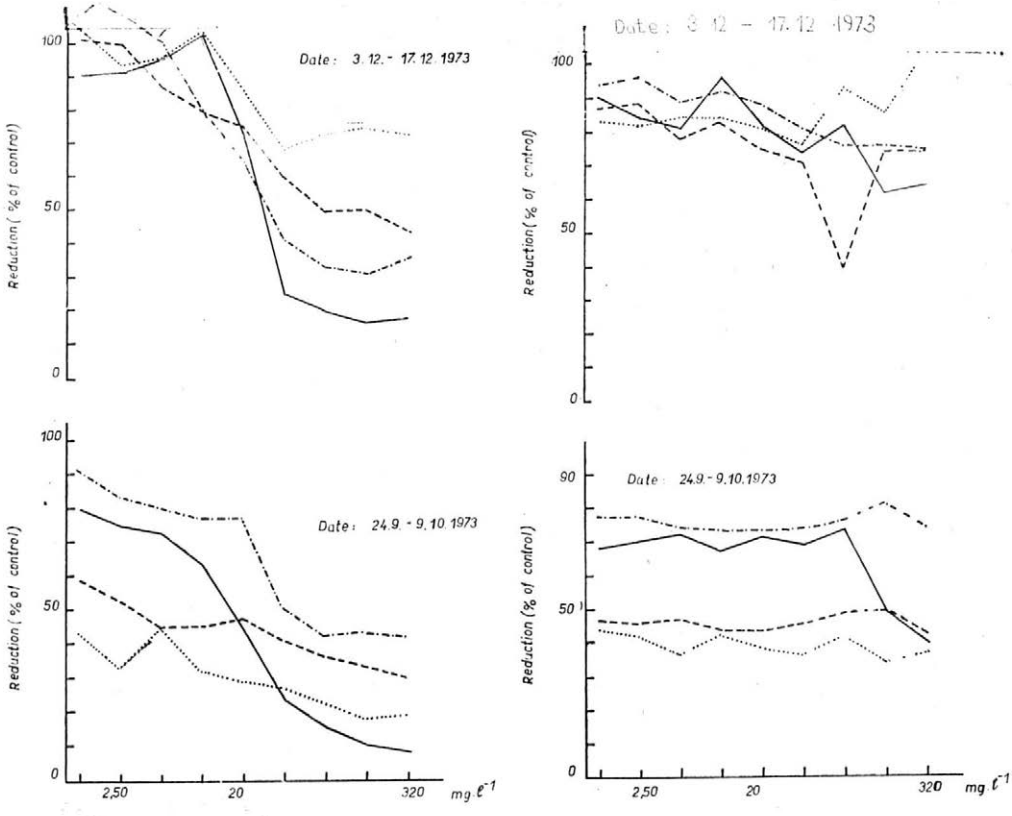


5. Dose-response curves for c) spring barley cv. 'Ametyst' and Dicuran; d) spring barley cv. 'Ametyst' and Zeazin



5. Dose-response curves for e) winter wheat cv. 'Kavkaz' and Dicuran; f) winter wheat cv. 'Kavkaz' and Zeazin

- The dose-response curves of Dicuran rather approach an ideal sigmoid curve.
- The curves of Zeazin are very irregular in these experiments.
- During December there was stimulation instead of inhibition in most cases. Namely the length of leaves and their dry weight were stimulated by lower concentrations.
- With higher concentration of Dicuran and in most cases with Zeazin too, the length of roots was inhibited to a higher degree than the dry weight of theirs. It is due to thicker roots in these cases.
- The course of dose-response curves for the growth of overground parts and their dry weight is parallel in most cases, even when there are varietal differences in this direction and differences in dependence on the date of experiments.
- In the course of dose-response curves there are differences between the varieties and sorts. The variety 'Kavkaz' appears to be relatively the most sensitive one to Zeazine also in December.



5. Dose-response curves for g) winter wheat cv. 'Mironovská' and Dicuran; h) winter wheat cv. 'Mironovská' and Zeazin

DISCUSSION

From the presented experiments it may be seen that the relation between the dose and response in soil herbicides is not so regular as to make possible the use of GR factor for evaluating the varietal sensitivity, as reported already in previous papers (B e n a d a, 1974; B e n a d a, V á ň o v á, 1974). The more regular curve-courses may be seen in the length of the overground parts and their dry matter. The root length has often a different course and with higher concentrations there is an inverted relation between dry weight of roots and their length. This is connected with the fact that the roots are decreased on one hand, on the other hand they are much swollen, as it was shown also in other varieties (B e n a d a, 1974). The toxicity of preparates has been much changed according to external conditions. If there were controlled conditions during the experiments, probably considerably regular results would be obtained, but such results would be of little use for field conditions where the external climatic conditions are continually changing.

From external conditions light intensity had the greatest influence, even when temperature and relative humidity were changing to a certain

extent. Figuerola and Furtick (1972) and Houseworth and Tweedy (1971) obtained higher phytotoxicity to terbutryne in wheat plants grown at higher light intensity in their experiments in growth chamber. Similarly Ladonin (1971) obtained in his experiments lower toxicity of two soil herbicides in plants grown in the shade. Translocation of atrazine was higher in Convolvulus arvensis in full light than in shaded plants (Bergmanová and Kůdelová, not yet published).

The influence of light on phytotoxicity is explained in relationship with the translocation of the herbicide. Decreased illumination causes the decrease of transpiration and in this manner the decreased translocation of herbicides and lower phytotoxicity (Minshall, 1957; Oorschot, 1965; Sheets, 1961; Ashton, 1965).

From the experiments presented and papers previously published (Benada, 1974; Benada, Váňová, 1974) it may be supposed that external conditions do not influence the phytotoxicity directly, but through the change of physiologic state in the plant, probably through the change of translocation of the substance examined in the plant. In this connection it may be considered that Dicuran with its low solubility should not cause further inhibition from the dose cca 20 mg l^{-1}. As also higher doses act inhibitorily, it may be supposed that higher concentrations of a commercial preparate change the physiologic state in roots enabling thus further transport of herbicide into the plant. Probably the active ingredient of a herbicide does not participate alone in these processes.

Similarly the problems of plant stimulation by sublethal concentrations seem to be very complex and none of up-to-date studies has given a consistent explanation of its mechanism (Wiedman and Appleby, 1972). In the case of triazine herbicides it is known that in sublethal concentrations they increase fresh weight, dry weight and protein content of a variety or species (Freney, 1965; Lorenzoni, 1962). As it is shown in the present study, sublethal concentration differs with dependence on light. The stimulation in December is caused presumably by lower intake of herbicide in the plant, even when growing the plants in the solution of herbicide which was inhibitory during September or October.

The cause of irregularity in dose-response curves is not explained and may be similarly complex as it is in the case of stimulation doses.

When studying the dose-response relation, the proper period for carrying out the experiments should be chosen. In long light-day Dicuran brings about the drying up of leaves from the tips already at 10 mg l^{-1} concentration. In the intermediate day the same doses bring about the rise of yellow stripes which may be measured objectively with difficulties (Benada, Váňová, 1974). In short light-day Dicuran makes inhibition, but in too short light-days on the contrary, lower doses effect stimulation.

Dicuran seems to be more toxic than Zeazin in the conditions of short light-day. With this fact its stronger action to weeds in the autumn and in the early spring is connected, while the herbicidal effect as well as the phytotoxicity of Zeazin manifest well till in the longer light-day (Benada, 1974).

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BENADA J., VÁŇOVÁ M. (Výzkumný ústav obilnářský, Kroměříž). *Využití křivek dávka-účinek pro testování odrůdové citlivosti obilnin vůči půdním herbicidům.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 321-331, 1975.

Ve skleníkových pokusech byl ověřován průběh křivek dávka-účinek u dvou půdních herbicidů Dicuran a Zeazin u dvou odrůd ozimé pšenice 'Kavkaz' a 'Mironovská' a dvou odrůd jarního ječmene 'Ametyst' a 'Diamant'. Rostliny byly pěstovány ve vodní kultuře v dávkách herbicidů stoupajících podle koeficientu 2 od 1,25 mg l^{-1} do 320 mg l^{-1}. Z řady pokusů provedených ve skleníku v různou dobu byly vybrány varianty provedené s každou odrůdou a herbicidem v relativně delším dni a relativně velmi krátkém dni. Byla měřena délka a sušina nadzemní části a délka a sušina kořenů. Bylo zjištěno: a) průběh křivek u délky nadzemní části a její suché hmotnosti je ve většině případů souhlasný, i když se projevují odrůdové rozdíly a rozdíly podle data založení pokusů, b) při vyšších koncentracích Dicuranu a ve většině případů i u Zeazinu délka kořenů je inhibována více než jejich sušina a proto průběh těchto křivek nesouhlasí, c) v pokusech provedených v krátkém dnu nižší koncentrace herbicidů stimulovala růst, d) křivky Dicuranu se blíží ideální sigmoidní křivce více než u Zeazinu, e) Dicuran byl v pokusech provedených v časném podzimu více toxický než Zeazin. Křivky dávka-účinek závisí silně na vnějších podmínkách a nejsou tak pravidelné, aby z nich odvozený faktor GR mohl být použit pro jednoznačné hodnocení fytotoxicity a odrůdové citlivosti.

atrazin; chlortoluron; pšenice; ječmen

БЕНАДА Я., ВАНЕВА М. (Научно-исследовательский институт зернового хозяйства, Кромержиж). **Использование кривых доза-действие для определения чувствительности сортов зерновых к почвенным гербицидам.** Sbor. ÚVTI - Ochr. rostl. 11 (4) : 321-331, 1975.

Во время тепличных опытов проверялась кривая доза-действие у двух почвенных гербицидов Дикуран и Зеазин у двух сортов озимой пшеницы Кавказ и Мироновская и двух сортов ярового ячменя Аметист и Диамант. Растения выращивались в водной культуре с дозами гербицидов, возрастающих согласно коэффициенту 2 от 1,25 мг . $л^{-1}$ до 320 мг . $л^{-1}$. Из ряда опытов, проводимых в теплице в разное время, были избраны варианты с каждым сортом и гербицидом с относительно более длинным днем и относительно очень коротким днем. Измерялась длина и сухое вещество в надземной части растений, длина и сухое вещество корней. Было установлено: а) протекание кривой и длины надземной части и ее сухой массы в большинстве случаев согласовано, хотя и проявляются сортовые различия и различия по срокам начала опытов, б) при более высоких концентрациях Дикурана и в большинстве случаев у Зеазина длина корней ингибирована больше, чем их сухое вещество, поэтому протекание этих кривых несогласовано, в) в опытах, проводимых в краткие дни, низкая концентрация гербицидов стимулировала рост, г) кривые Дикурана приближаются к идеальной сигмоидной кривой больше, чем у Зеазина, д) Дикуран в опытах, проводимых ранней осенью, был более токсичен, чем Зеазин. Кривые доза-действие сильно зависят от внешних условий и не так регулярны, чтобы из них выводимый фактор ГР мог быть применен для однозначной оценки фитотоксичности и сортовой чуствительности.

антразин; хлортолурон; пшеница; ячмень

BENADA J., VÁŇOVÁ, M. (Forschungsinstitut für Getreidebau, Kroměříž). *Die Ausnutzung der Kurven Gabe-Wirkung zur Testung der Sortenempfindlichkeit von Getreidearten gegen die Bodenherbizide.* Sbor. ÚVTI - Ochr. rostl. 11 (4) : 321-332, 1975.

In Gewächshausversuchen überprüfte man den Verlauf der Kurven Gabe-Wirkung bei zwei Bodenherbiziden Dicuran und Zeazin, u. zw. bei zwei Winterweizensorten Kavkaz und Mironowskaja und zwei Sommergerstensorten Ametyst und Diamant.

Die Pflanzen wurden in Wasserkultur bei ansteigenden Herbizidengaben nach dem Koeffizienten 2 von 1,25 mg l^{-1} bis 320 mg l^{-1} gehalten. Von einer Reihe der Versuche, durchgeführt im Gewächshaus in verschiedener Zeit, wurden Varianten, die mit einer jeden Sorte und jedem Herbizid in einem relativ längeren Tag und relativ sehr kurzem Tag vorgenommen wurden, ausgesucht. Es wurde die Länge und die Trockensubstanz des oberirdischen Teils und die Länge und Trockensubstanz der Wurzeln gemessen. Folgendes wurde festgestellt: a) der Kurvenverlauf bei der Länge des oberirdischen Teils und bei seinem Trockengewicht ist in meisten Fällen übereinstimmend, wenn auch Sortenunterschiede und Unterschiede je nach dem Datum des Versuchsanlegens zum Vorschein kommen, b) bei höheren Konzentrationen von Dicuran und in meisten Fällen auch bei Zeazin wird die Länge der Wurzeln mehr als ihre Trockensubstanz inhibiert und deshalb ist der Verlauf dieser Kurven nicht übereinstimmend, c) bei den im Kurztag vorgenommenen Versuchen stimulierte die niedrigere Konzentration der Herbizide das Wachstum, d) die Dicuran-Kurven nähern sich der idealen sigmoiden Kurve mehr, als es bei Zeazin der Fall ist, e) Dicuran war bei den im frühen Herbst durchgeführten Versuchen mehr toxisch, als Zeazin. Die Kurven Gabe-Wirkung sind stark von äußeren Bedingungen abhängig und sind nicht so regelmäßig, um den von ihnen abgeleiteten Faktor RG für eindeutige Bewertung der Phytotoxizität und Sortenempfindlichkeit verwenden zu können.

Antrazine; Chlortolurone; Weizen; Gersten

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SHORT COMMUNICATION

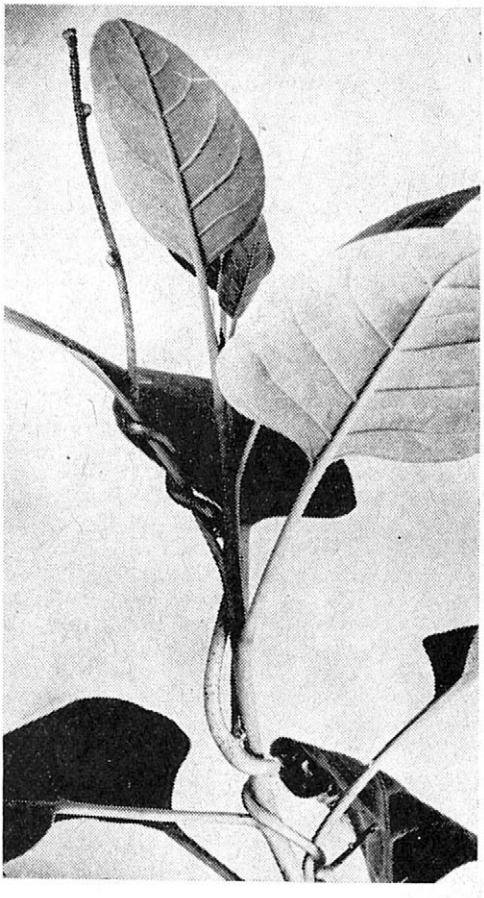
TRANSMISSION OF POTATO WITCHES' BROOM BY THE DODDER *MONOGYNELLA LEHMANNIANA* (BUNGE) HADAČ ET CHRTEK

Experimental transmission of potato witches' broom disease (PWB) by five dodder species was summarized by Hosford (1967). The present paper deals with attempted transmission of PWB agent by a further dodder species *Monogynella lehmanniana* (Bunge) Hadač et Chrtek (Hadač, Chrtek, 1970).

A PWB isolate proved to be of mycoplasma origin (Brčák et al., 1969) was used for experiments. Seeds of *M. lehmanniana* were kindly supplied by prof. E. Hadač, DrSc., who collected them in Iraq (near Baghdad). The seeds germinated well either on wetted filter paper in Petri dishes at about 30 °C or in moist peat in a warm greenhouse. In transmission trials bridging dodder (that was parasiting both infection source and a test plant) or stem pieces (cut off from the dodder parasiting an infection source and then transferred to test plants) were used.

No infection was achieved with detached stems of the dodder parasiting 135 or 141 days PWB infected *Nicotiana glauca* Grah. and transferred to healthy *N. glauca* or *Vinca rosea* L. for 32 or 26 days respectively. However, PWB agent was transmitted from *N. glauca* to *N. glauca* by *M. lehmanniana* bridging both plants from a healthy test plant (which was parasited first for 26 days) to an infection source (connected later). This connection continued for additional 52 days. The PWB transmission was proved on the 25th day after the interruption of the dodder bridge by means of grafting tomato seedlings with scions detached from the symptomless test plant. The incubation period in the tomato plants extended to nearly 50 days; control tomato plants grafted on the same day with scions taken from the infection source showed symptoms approximately two weeks sooner.

Negative results were obtained with test plants connected by a bridging dodder with an infection source in the way that the dodder was parasiting first the infection source and then the test plant. This was attempted with various time intervals in 15 experiments. Tomato plants and *N. glauca* served as sources of infection first parasited by *M. lehmanniana* for 12, 17, 108, and 119—120 days. The dodder bridge connecting the infection source with test plants (*N. glau-*



1. *Monogynella lehmanniana* parasiting *Nicotiana glauca*

ca, *V. rosea*, tomato) continued for the additional 14, 16, 17, 23, 28, and 76 days. In one experiment the dodder (parasiting first PWB infected *N. glauca* for 136 days) was gradually connected by its top part with healthy *V. rosea* test plants, so that seven test plants were connected together by the dodder bridge in 24 days with the infection source for 31, 28, 26, 21, 17, 13, and 7 days. No infection was obtained in this experiment as well.

The transmission of PWB agent only achieved by dodder parasiting first a test plant and then connected with the infection source seems to be more successful than a reverse procedure. This was also verified in dodder transmission of some viruses (Cochran, 1946; Brčák, 1964). The prolonged PWB incubation period observed in our experiments could be compared with the results by Fukushi and Shikata (1955) who mentioned a similar phenomenon in transmission of PWB by *Monogynella japonica* (Choisy) Hadač et Chrtek and *Grammica chinensis* (Lam.) Hadač et Chrtek. This suggests a poor inoculum supplied by dodder into test plants. Nevertheless, some plant pathogenic mycoplasmas related to PWB agent evidently cause infections of some dodder species, as demonstrated e. g. by Valenta (1958) and with *Cuscuta europaea* L. and *Monogynella monogyna* (Vahl) Hadač et Chrtek by Caudwell (1965).

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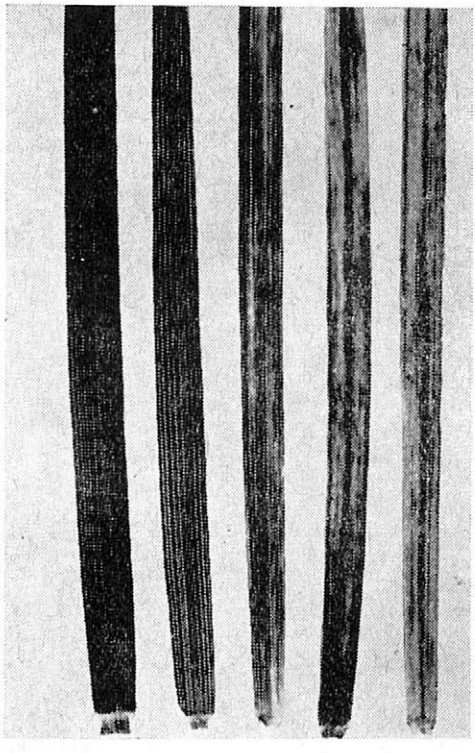
LEAFHOPPER-BORNE MOSAIC DISEASE OF WHEAT NEW TO CZECHOSLOVAKIA

Up to this time three leafhopper-borne diseases of wheat, namely wheat striate, wheat dwarf and wheat pale-green dwarf have been described to occur in Czechoslovakia (Průša and Vacke, 1960; Vacke 1961, 1973). However, in 1972—1973 a mosaic disease on winter wheat showing distinct symptoms from those diseases mentioned above was found in some localities in the districts of Litoměřice, Olomouc and Opava. Wheat mosaic seemed to be a new disease or in any case a disease which has not earlier been observed in Czechoslovakia. This paper reports on some studies on transmission, host cereals and symptoms caused by the disease agent of this wheat mosaic.

In the first stage of the studies the transmission of this wheat mosaic disease by manual inoculation, by seed, by soil and by aphids (*Rhopalosiphum padi* L.) was tried by the same way as described earlier (Průša and Vacke, 1961), but all trials gave negative results. The leafhoppers *Javesella marginata* F., *J. pellucida* F., *Macrosteles cristatus* Rib., *M. laevis* Rib. and *Psammotettix alienus* Dahlb. of non-infectious colonies were used in the transmission experiments as well. The larvae of insects were first caged for three weeks on diseased winter wheat plants from field, and then tested for one week on wheat seedlings (cv. 'Kaštická osinatka') in groups of three individuals per plant. Of the leafhopper species tested only *Psammotettix alienus* was found to be the vector of wheat mosaic disease agent. Out of 40 groups of the insects 19 groups provoked disease symptoms on winter wheat plants.

In the further experiment young larvae of *Ps. alienus* were fed on diseased wheat for one week and then serially transferred every week to new young test plants till the death. Out of 109 leafhoppers which survived the fourth test interval, 31 became infective and caused symptoms of mosaic on wheat plants. A latent period of the disease agent within the insects varied from 14 to 35 days, but most individuals became infective between 21 and 28 days. The infectivity of vectors manifested mostly without interruptions during the whole test series lasting in individuals usually till the death. It was found that both larvae and adults of *Ps. alienus* can transmit wheat mosaic disease agent.

In addition to winter wheat (cv. 'Kaštická osinatka') the disease agent was found to be transmitted in spring wheat (cv. 'Zlatka'), winter rye (cv. 'České'), spring rye (cv. 'Těšovské'), winter barley (cv. 'Dura'), spring barley (cv. 'Diamant') and oat (cv. 'Český žlutý'). The first symptoms caused by wheat mosaic disease agent on these cereals showed up about 15—25 days after the first day of inoculation feeding as vein chlorosis and uneven swellings of the veins on the lower surface of the youngest leaves.



1. Chlorotic stripes and spots on the leaves of winter wheat (cv. 'Kaštická osinatka') caused by wheat mosaic disease agent, on the right a leaf of healthy plant

Later on chlorotic stripes along the veins and spots on the leaf blades appear and the whole leaves finally become yellow. The diseased plants are more or less severely dwarfed, their heading is also reduced and spikes are partly or fully sterile.

Results of the experiments showed that wheat mosaic disease under investigation is new to Czechoslovakia and quite distinct in many respects from those known earlier like wheat striate, wheat dwarf and wheat pale-green dwarf. However, very little is known as yet about the disease agent, the occurrence, and the economic importance of this new disease.

We are of an opinion that wheat mosaic disease here investigated is closely related or identical with wheat mosaic virus disease described in Poland by Hoppe (1969, 1972). The conclusion is made on the basis of similarity in symptoms caused as well as identity of host plants and vector of both disease agents.

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