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UPOV

TC/XX/10
ORIGINAL: English
DATE: October 1, 1984

INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

GENEVA

TECHNICAL COMMITTEE

Twentieth Session
Geneva, November 6 and 7, 1984

REPORT OF THE SUBGROUP ON DISEASES

Document prepared by the Office of UPOV

The Annex to this document contains a report on the work of the Subgroup on Diseases requested by the Technical Committee during its nineteenth session. It has been established by Mrs. Jutta Rasmussen (Chairman of the Subgroup) and approved by correspondence by the Technical Working Party for Agricultural Crops.

[Annex follows]

ANNEX

UPOV SUBGROUP ON DISEASES

The first session of the Subgroup on Diseases was held at the Bundessortenamt, Hanover, Federal Republic of Germany, from May 18 to 20, 1983.

The second session of the Subgroup on Diseases was held at the National Institute of Agricultural Botany, Cambridge, United Kingdom, from May 16 to 18, 1984.

Main Tasks of the Subgroup

(1) Proposals for harmonized methods of testing for mildew and rust diseases on cereals.

(2) Proposals for a common nomenclature for disease resistance and pathogen virulence.

(3) Proposals regarding the possibilities of cooperation in disease testing between member States.

General Aspects of Disease Tests for DUS Purposes

(1) The use of disease tests for DUS purposes should be considered only where no morphological characteristic is sufficient and where the applicant asks for such use.

(2) The applicant for the candidate variety should name the disease and pathotype that establish distinctness, and either supply inoculum at the request of the authority or State where it can be freely obtained.

(3) The pathotype must be available in the country in which the application is made.

(4) The difference in resistance between the varieties compared in the test must be clear-cut. The tolerances for off-types should be the same as for morphological characteristics (3 in 100 plants) where single spore isolates are used. When bulk spore isolates are used the tolerances should be 6 in 100 plants maximum, as in that case there are two sources of variation, namely the host and the pathogen. A seedling showing a reaction that is not consistent with the reaction of the majority, e.g. a small number of susceptible plants in a predominantly resistant variety, is considered an off-type.

(5) The stability requirements should be the same as for morphological characteristics, i.e. the variety must remain true to its description after repeated reproduction or propagation or, where the breeder has defined a particular cycle of reproduction or multiplication, at the end of each cycle.

(6) If a race (isolate) is used to establish the DUS of a variety, that race (isolate) should be stored for use in future tests.

(7) Different opinions were expressed on whether a variety should, at the request of the breeder, be tested with a race that is normally unavailable in the country concerned. Some countries are prepared to ask other countries to do the test for them, or to accept the other country's already available results. In that case the question of how the maintenance of the variety is controlled after approval has to be settled.

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(8) If, after approval of a variety on the basis of resistance, a morphological characteristic is found to distinguish the variety instead, it should be possible later on to control the variety indirectly by that morphological characteristc. On the other hand the variety must in principle remain true to its description, especially in the distinctive characteristic originally assessed.

Principles of Test Methods

It is important for a test method to be capable of producing repeatable results.

To achieve a resonable degree of repeatability, it is necessary to do the following:

(1) develop a storage system that enables isolates to retain their pathogenic characteristics over a period of years,

(2) produce the test plants and incubate them after inoculation with a particular isolate of the pathogen under controlled or partly controlled conditions,

(3) assess the test plants using a predetermined assessment scale.

Isolations are mostly made from selected lesions or affected areas on the infected samples.

The isolates can then be multiplied, either immediately or after storage, to provide sufficient spores for inoculation.

Guidelines for Test Methods

Storage Systems

Disease	System	Conditions	Viability
MILDEW	(1) On seedlings of a susceptible variety using a detached leaf culture technique with agar containing 150 ppm benzimidazole	Temp. = + 12°C Light = 16 h/day- 8 h/night	14 days
	(2) On seedlings of a susceptible variety grown in glass tubes	Temp. = + 0,5 - + 2,0°C Light = 16 h/day- 8 h/night	4 months
	(3) Leaves with cleistothecia (e.g. Wheat)	Temp. = - 18°C	5 years
RUST	(1) Spores	Under liquid nitrogen	6 months
	(2) Spores	Vacuum dried	>10 years

Often two different techniques are used at the same place to store isolates as an insurance against losing an isolate, because it is unlikely that both systems will break down at the same time.

Multiplicity of Isolate

Isolates to be used for testing resistance should theoretically be one isolate with one spore origin, but owing to lack of time, material, etc., batch of spores is often used. If necessary the isolate should be purified to avoid a mixed reaction. The normal procedure would be through differential varieties.

Disease	System
MILDEW	Spores are multiplied by transfer through seedlings of a susceptible variety grown in pots in a spore-proof compartment in a glasshouse.
RUST	Spores are multiplied on seedlings of a susceptible variety grown in pots. Spores produced on these seedlings fall into narrow channels, from which they are collected by vacuum pump.

Inoculation of Seedlings

Disease	System
MILDEW	Inoculation about 10 days after sowing, when the first leaf is just fully expanded. The spores fall directly on to the seedlings when the pots of the infected seedlings are shaken over them.
RUST	(1) Inoculation about 10 days after sowing, when the first leaf is just fully expanded. The spores are inoculated in a dry mixture with talc (1 part spores : 19 parts talc). The mixture is blown onto seedlings spinning round on a turntable. (2) The spores are put on the seedlings by means of a brush.

Incubation of Seedlings

Disease	System	Conditions
MILDEW (Erysiphe graminis)	Pots of infected seedlings are kept in polythene frames to raise humidity and promote infection.	Temp. = 15-20°C
	Each isolate is kept in a separate spore-proof compartment in a glass-house.	Adequate light supply for normal plant growth
YELLOW RUST (Puccinia striiformis)	Pots of infected seedlings are kept in polythene frames. Each isolate is kept in a separate spore-proof compartment in a glass-house	Temp. = 7°C for 2 days, then 15-18°C for 2 weeks. Humidity near to 100%. The lighting periods should be 16 h/day (intensity approx. 10,000-20,000 lux) and 8 h/night

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BROWN RUST (Puccinia recondita, Puccinia hordei)	As for yellow rust	Temp. = 15-25°C.
BLACK RUST (Puccinia graminis)	As for yellow rust	As for brown rust
CROWN RUST (Puccinia coronata)	As for yellow rust	As for brown rust

Assessment

Assessment is made between 10 and 14 days after inoculation, according to predetermined scales.

The first leaf of each seedling is examined and allocated to one of the infection types.

Assessment Scale for Mildew

Infection type 1-9	0-4	Mycelium	Sporulation	Resistant/Susceptible
1	0	none	none	
3	1	low	none/low	RESISTANT
5	2	Moderate	low	
7	3	abundant	moderate	SUSCEPTIBLE
9	4	abundant	abundant	

Comment: Necrosis/Chlorosis is useful for the identification of certain types of resistance.

Assessment Scale for Rust

Infection type 1-9	i-IV	Pustules/Sporulation	Necrosis/Chlorosis	Resistant/Susceptible
-	i	no reaction	no reaction	
1	0	no pustules	small areas of necrosis or chlorosis	RESISTANT
3	I	few pustules low sporulation	with necrosis with chlorosis	
5	II	pustules of low/ moderate sporulation	with necrosis with chlorosis	
-	II-green	pustules of low to moderate sporulation	without chlorosis	

7	III	pustules with high sporulation	without necrosis with chlorosis	SUSCEPTIBLE
9	IV	pustules with high sporulation	without necrosis without chlorosis	

Differential Varieties

The differential varieties should be relevant to the national pathogen population. It would be an advantage if some common nomenclature system for resistance could be developed.

Nomenclature System

Some system of nomenclature is needed to describe the host resistance possessed by varieties and the pathogen virulence possessed by isolates.

Comprehensive nomenclature systems have been developed over a period of years for a number of cereal pathogens; for instance, cereal varieties are classified according to their specific resistance, which interacts with pathogen isolates possessing corresponding specific virulence.

The agreed system should be useful not only for DUS purposes.

It was established that different nomenclature systems were in use in various member States.

The systems in use for barley mildew resistance are:

(a) the resistance gene nomenclature system, using Ml symbols (Ref. Barley Genetics Newsletter 1983, Vol. 13, pp. 152-160);

(b) the resistance factor and virulence factor system, using BMR and BMV symbols (Ref. UKCPVS Annual Reports).

It was agreed that the two systems were readily inter-translatable.

The systems used for yellow rust on wheat are:

(a) World and European system for nomenclature of physiological races (Ref. Johnson et al. (1972), Transactions of the British Mycological Society, 58, 475-480);

(b) the resistance factor and virulence factor system, using WYR and WYV symbols (Ref. UKCPVS Annual Reports).

It should be possible to translate from one system to the other, although the correspondence is less close than for the barley mildew systems.

It was agreed that more work was needed to produce a translation between the various nomenclature systems for other rust diseases.

Possibilities of Cooperation

(1) The question was raised whether bilateral agreements and centralized tests, agreed for the time being for the usual morphological DUS tests, could cover disease tests as well. Another possibility could consist in taking over each other's results, as is being considered for morphological tests. In that case the question arises whether results can be taken over for a variety that has been found distinct on the basis of a disease race that has no importance or is unknown in the requesting country.

(2) The opinion was expressed that the best cooperation would consist in exchanging information on disease resistance.

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(3) A list should be compiled of institutes and departments responsible for DUS disease testing in each member State, to enable individual contact to be made between the relevant specialists.

The specialists responsible for DUS disease tests in each member State should receive the lists of varieties under test in all States.

(4) As a pilot exercise in the exchange of information, the specialist in each country would send a list of barley varieties and their identified specific mildew resistance to the Chairman of the Subgroup, who would arrange for a summary to be produced. The varieties would comprise those on the national list of the country, together with other varieties of special significance. The specialist in each country would be responsible for distributing the final summary to breeders and other interested parties in his country.

This exercise should enable the Subgroup to assess the usefulness of such a register of specific resistance.

Development of Methods Using Adult Plants

Most of the disease tests to date have examined host/pathogen relationships depending upon specific resistance to named pathotypes that are effective at the seedling stage. It is not difficult to test this type of resistance using seedlings in a controlled environment, provided the appropriate pathotype is available.

Many breeders have now developed varieties with non-specific or adult plant resistance, which is of high agricultural value and may be a major achievement of the breeder in improving a crop.

The first adult plant distinctness test has now been completed in the United Kingdom. The test involved three varieties of winter wheat which could not be distinguished on the basis of morphological characters. Test plants were grown in a Polythene tunnel and were inoculated with an isolate of Puccinia recondita.

The results clearly demonstrated that infection levels on Brigand were substantially and significantly greater than on the other two varieties.

The test had proved expensive in manpower and resources, and not more than one test could be undertaken in any one year with resources at their present level.

The test is being repeated in 1984 to check that consistent results are obtained.

Since the test takes a full growing season (9 months) to complete, its use may delay decisions on the varieties concerned.

It may be possible in the future to develop more suitable methods of showing differences in adult plant resistance between varieties for distinctness purposes.

Future Program

It was agreed that there was no immediate need for a further meeting of the Subgroup. There might be new problems with cereals in the future, and a further meeting could be convened then.

The following were suggested as possible topics for future discussion:

(1) Rye/Triticale;
(2) Use of horizontal resistance for DUS purposes;
(3) Disease assessment methods in the field;
(4) Other cereal diseases;
(5) Resistance to nematodes.

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