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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

GENEVA

Associated Document
to the
General Introduction to the Examination
of Distinctness, Uniformity and Stability and the
Development of Harmonized Descriptions of New Varieties of Plants (document TG/1/3)

DOCUMENT TGP/12

"SPECIAL CHARACTERISTICS"

Section TGP/12 Section 1.2 Draft 4:
Characteristics Expressed in Response to External Factors:
Disease Resistance

Document prepared by experts from the Netherlands

to be considered by the
Technical Working Party for Agricultural Crops at its thirty-fourth session to be held in Christchurch, New Zealand, from October 31 to November 4, 2005

SECTION 1.2

CHARACTERISTICS EXPRESSED IN RESPONSE TO EXTERNAL FACTORS; DISEASE RESISTANCE

1. The breeding for resistance to pests and diseases is an important part of many breeding programs. In vegetables more than 50 % of the breeding effort is devoted to resistance.

2. For farmers, having to cope with strong pressure to reduce the use of crop protecting chemicals, the availability of varieties that can resist diseases without protection by chemicals is crucial.

3. The correct description of the resistance characteristics in variety descriptions, breeder's catalogues etc. is considered very important. In many cases problems and legal cases were caused by insufficient description of the resistance.

4. The decreasing input from science on the taxonomy of the diseases and of the strains of diseases around the world is compensated by the input of phytopathologists from DUS testing institutes and seed companies..

5. More and more the breeding industry joins forces to fill this gap by combining their recourses, usually under the International Seed Federation (ISF)

6. Disease resistance characteristics may be used as characteristics in the framework of the DUS test for Plant Breeders' Rights, provided a number of criteria are fulfilled;

(a) it must be capable of precise definition;
(b) it must produce constant and repeatable results for existing varieties;
(c) it must allow uniformity requirements to be fulfilled;
(d) it must be clearly defined in the observation and evaluation of the results;
(e) for inclusion in the Test Guidelines it must allow a clear differentiation to be made in the collection of the species concerned;
(f) it must not lead to easy plagiaristic practices.

7. In general these requirements can be fulfilled but a number of requirements pose specific problems:

8. Ad (a) it must be capable of precise definition
I. The definition of the disease itself usually does not create problems, for the proper denomination internationally accepted standards may be used such as the American Phytopathological Society (APS) for fungi and bacteria and the International Committee for Taxonomy of Viruses (ICTV).

9. Ad (a) it must be capable of precise definition
II. The definition and denomination of the races and strains per disease pose a specific, more complicated problem as almost no longer any scientific work is done on this subject. This can result in confusing situations where the same race / strain could be named differently

in Europe and the USA p.e. *Fusarium oxysporum* f.sp. *lycopersici* (Fol) in tomato where race 1 in the USA is identical to race 0 in Europe. Also different races / strains may have the same name p.e. *Fusarium oxysporum* f.sp. *lycopersici* (Fol) in tomato where race 2 in the USA is different from race 2 in Europe. At the moment a joint effort is made by ISF on this subject with the aim to create one clear system of definition and nomination. The core of this system is the precise definition of a set of host differential lines/varieties with which the races / strains can be determined. The seed industry is willing to cooperate by maintaining the necessary stocks of seed for this purpose.

10. In Annex I the definition of the various terms as developed and used by ISF is given. In Annex (II) a list of diseases where it is known that resistance breeding has been carried out. Comments on this list are welcome on the ISF web site.

11. Ad (a) The cooperation with breeders also results in better knowledge on the genetic background of the various forms of disease resistance. Knowing which genes are responsible for resistance and if it concerns a single gene or a combination of genes gives valuable information that will help to properly observe and evaluate the resistance.

12. Ad (b) it must produce constant and repeatable results for existing varieties.
Repeated tests and ring tests have shown that the stability of disease resistance, provided this was established on race / strain level is very good. In fact, as disease resistance is of crucial importance for the marketing of varieties, it is a primary selection criteria for companies to check the varietal stability.

13. Ad (c) it must allow uniformity requirements to be fulfilled.
Testing for disease resistance characteristics means introducing more variables in the trial; not only the development of the plants is subject to the environment, but also the quality of the inoculum, the inoculation and the interaction between symptom and development of the plant may cause variation within the trial. It has to be avoided that the heterogeneity introduced through the trial is blamed to the candidate variety.

14. Ad (d) it must be clearly defined in the observation and evaluation of the results.
Following the provided explanations in the test protocols, ring tests have shown to give deviating results. These deviations were caused by variation in the climatic conditions under which the trials were carried out. Also different interpretation of the symptoms by different observers was noted. The conclusion of these trials was that only if a correct set of standards was included in the trial, the observations and evaluation of the results was harmonized. It was however observed that slight differences in the standards (between lot differences) could cause problems. The advise here is to develop a centralized set of standards per disease or per strain to avoid problems. The seed industry is willing to cooperate by maintaining the necessary stocks of seed for this purpose.

15. Ad (e) it must allow a clear differentiation to be made in the collection of the species concerned.
Disease resistance characteristics, properly tested, give per definition a clear differentiation in the variety collections. Therefore disease resistance characteristics are often used as grouping characteristics. The differentiation usually may take place even on race / strain level as many collections of varieties are known to show different resistance reactions to different races / strains of the disease. Also on race / strain level grouping may be done, provided the races / strains are properly identified. A specific problem are those diseases or race / strains of diseases, where the difference between susceptible and resistant is not discontinuous, but in

fact a scale of resistance can be observed ranging from absent to very weak to very strong. In practice however, it is not yet possible to define the different levels using example varieties, so in the guidelines diseases that show this phenomenon are usually treated as discontinuous by defining a threshold dividing susceptible from resistant. The threshold is clearly defined using example varieties. It may be expected that in future this practice will be replaced by a more precise description of the different levels of resistance. These levels have to be defined precisely and standards will have to be included in the tests to enable the differentiation between the different levels.

16. Ad (f) it must not lead to easy plagiaristic practices.
The breeding effort necessary to cross resistance in a susceptible variety is usually a complicated and time consuming job.

17. As additional points for consideration the following has to be taken into account:
(g) the availability of reliable inoculum and host differential set
(h) quarantine regulations
(i) the costs involved in disease resistance testing

18. Ad (g) the availability of reliable inoculum.
In general a few institutes are still maintaining stocks of inoculum of most of the diseases that are used in breeding programs. In the explanation of the methods in the guidelines, the available information on these sources will have to be indicated. If inoculum from another source is used, a defined host differential set will have to be used to clearly identify the inoculum.

19. Ad (h) quarantine regulations.
With a world wide organization as UPOV it is unavoidable that diseases that are of importance in a certain area, are unknown to cause problems in another part of the world and are there considered as quarantine diseases. Usually this means that the import of inoculum and the test itself is not possible. A good way to solve this kind of problems is to contact a DUS test authority elsewhere and ask them to carry out the test.

20. Ad (i) The costs and technical requirements of disease tests are for some DUS testing authorities impassable barriers to carry out these tests. Two options may be considered to overcome these problems:

- Another DUS testing authority may be asked to perform the necessary disease test(s).

- The applicant / breeder may be requested to carry out a blind disease test with coded samples including the candidate variety and a number of also coded control samples as susceptible and resistant controls on the basis of a clear control.

21. In order to take into account the given points of consideration, the explanation of the disease resistance characteristics, included in the guidelines have to be extended with the necessary information on
- the address(es) where inoculum may be obtained,
- the host differential set of varieties / lines to use to check the inoculum on correctness regarding the races / strains used,
- the address(es) where the differential set may be obtained
- the race / strain specific standard varieties to be included in the test
- the address(es) where the set of standard varieties may be obtained

Annex I Terminology in Disease Resistance

Definition of the Terms Describing the Reaction of Plants to Pests or Pathogens and to Abiotic Stresses

1. Preamble

Differing degrees of specificity exist in the relations between plants and pests or pathogens. Identification of such specificity generally requires the use of highly elaborate analytical methods. Recognizing whether a plant is subject to a pest or pathogen or not may depend on the analytical method employed. It is important, in general, to stress that the specificity of pests or pathogens may vary over time and space, depends on environmental factors, and that new pest biotypes or new pathogen races capable of overcoming resistance may emerge.

2. Definitions

Immunity: Not subject to attack or infection by a specified pest or pathogen.

Resistance is the ability of a plant variety to restrict the growth and development of a specified pest or pathogen and/or the damage they cause when compared to susceptible plant varieties under similar environmental conditions and pest or pathogen pressure. Resistant varieties may exhibit some disease symptoms or damage under heavy pest or pathogen pressure.

Susceptibility is the inability of a plant variety to restrict the growth and development of a specified pest or pathogen.

The Vegetable Section of ISF recommends, as it pertains to biotic stress, that its members use the terms immunity, high/standard or moderate/intermediate resistance and susceptibility and to avoid the term tolerance in communications with their customers.

Tolerance is the ability of a plant variety to endure abiotic stress without serious consequences for growth, appearance and yield. Vegetable companies will continue to use tolerance for abiotic stress.

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