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SES

Standard Evaluation System for Rice

5th Edition

June 2013

IRRI

INTERNATIONAL RICE RESEARCH INSTITUTE

5th *th* edition

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Preface

The Standard Evaluation System (SES) for Rice is one of the most requested IRRI publications that is highly utilized by rice scientists worldwide. It provides a common nomenclature and standardized scales for assessing rice agronomic performance and classifying rice responses to biotic and abiotic stresses. First published in 1975, the SES has been revised four times. The last printed edition came out in 1996 and an online version was published in 2002 in The Rice Knowledge Bank (http://www.knowledgebank.irri.org/extension/index.php/ses).

Revision of the current edition took almost two years to complete. Initially, inputs of rice scientists from international and national rice research programs and the private sector were solicited. This resulted in improvements on the scoring procedures based on the state-of-the-art in the different disciplines. The ensuing drafts were then widely circulated for feedback before generating a final draft.

This 5th edition incorporates improved scoring systems for agronomic traits and morphological characteristics. It also redefined some terminologies like 'injury' instead of 'disease' for more clarity. With the increasing importance of plant variety protection, the 17 asterisked characters of the Test Guidelines for Rice of The International Union for the Protection of New Varieties of Plants (UPOV), which are important in testing for distinctness of new varieties, were also incorporated. Realizing that improvements may still be made in the future, users of this booklet are requested to send their comments and suggestions to me as INGER Coordinator at IRRI Headquarters for consideration and incorporation in the next edition.

To ensure worldwide dissemination, we are publishing this 5th edition in both print and electronic formats. The latter will be posted in the INGER website (http://inger. irri.org/).

The strong cooperation and significant contributions of scientists from national rice programs, international research centers, and the private sector, among other partners under the Global Rice Science Partnership (GRiSP; http://www.grisp.net/), are gratefully acknowledged.

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Explanation

Introduction

Identifying promising rice germplasm with useful traits is an important activity in rice improvement. The genetic potential of breeding materials, whether developed by conventional breeding or genetic engineering, is evaluated based on phenotypic expressions in target environments with the stress of interest. Thus, an accurate and precise yet rapid and practical assessment method should be utilized.

This Standard Evaluation System for Rice (SES) has been prepared to enable rice scientists from around the world to speak a common language on evaluation of rice characters. This booklet has two major functions. The first is to expedite data collection, processing and analysis of multi-environment trials (METs). Although the complexity of scale and method of scale assignment varies among rice characters, the SES remains the most popular method used in mass evaluation of breeding lines. The second purpose is to promote an interdisciplinary approach to rice improvement. Devising improved scales and assessment methods, and interpretation of evaluation results require joint efforts of scientists in different disciplines.

General scale

A scale is devised by dividing the total range of possible phenotypic expressions of rice characters into a number of defined classes. Visual grading usually progresses logarithmically. As the stimulus increases, discrimination decreases. The SES scale has been designed as a general purpose, computer compatible scale for recording various traits in rice. A general scale for SES is shown in Table 1. A few exceptions to these general rules have been made for reasons of logic, historical reasons, or both.

Table 1. General scale used in SES

		For stress		
Index Value	General description and desirability	Judgment	Severity of incidence (factual)[a]	Code symbol[b]
Blank	No data or missing point			Blank
0	Absence of trait, no visible symptom or injury		0%	HR
1	Trait expression is satisfactory (useful) from the plant breeder's point of view and the parent of variety can be used as a donor	Similar to best resistant check, good	Less than 5%	HR
2				R
3				MR
4	Trait expression is not as good as it should be, but may be acceptable under some circumstances (i.e. quantitative resistance under low or intermediate disease pressure)	Between resistant and susceptible check, fair	6-25%	MS
5				(Intermediate)
6				
7	Trait expression is unsatisfactory (not useful) in terms of commercial acceptability or genetic improvement of a crop	Similar to most susceptible check, poor	More than 25%	S
8				HS
9				

[a]Intensity may vary depending upon the type of stress. [b]HR = highly resistant reaction, R = resistant reaction, MR = moderately resistant reaction, MS= moderately susceptible reaction, S = susceptible reaction, HS = highly susceptible reaction.

Because the human eye cannot differentiate easily between 10 divisions of certain traits, only three (1, 5, 9) or five (1, 3, 5, 7, 9) digits are used. For descriptors of germplasm accessions or for detailed research, 10 units may be used if desired. Because the SES aims at universality, compromises and simplifications had to be accepted in developing a uniform scale for measuring plant injuries, some of which can be very complex.

Trait characterization

The following methods are used to describe various traits:

1. A descriptive code is used for traits that have more or less discontinuous genetic variation or for traits whose nature of expression is not easily translated into numerical units (e.g. leaf blade color).

2. Severity or incidence is the quantitative measurement of the intensity of injury caused by diseases, animal pests, or other stresses. ***Incidence*** refers to the number of plant tissue units such as plants, hills, tillers, or spikelets that are injured, relative to the total number of units assessed. ***Severity*** is the proportion (area or volume) of plant tissue that is injured, relative to the total plant tissue considered (Nutter et al., 1993).

Methods 1 and 2 are used separately or in combination for several different stresses (e.g. scale for leaf blast). With viral diseases and injuries caused by several physical stresses, severity with an arbitrary scale indicating the degree of whole-plant symptom development is commonly used. Note: tolerance is commonly used in a vague sense. Tolerance actually refers to the ability of a plant to sustain injury while maintaining the same level of performance (especially, its yield; Zadoks and Schein, 1979).

3. Comparative reaction of test entries is taken in relation to that of resistance and susceptible check varieties in making a final judgment on a varietal reaction to stress (e.g. elongation). If stress level is extremely low on susceptible checks, the trial will not be used for further analysis.

4. Actual measurement, counts or recording of dates for continuous traits (e.g. yield and plant height) and with characters that cannot necessarily be measured by a scale (e.g. flowering).

Use of SES scoring system

Some of the entries in the INGER nurseries that are still in the F_4 to F_6 generations may still be segregating for some traits. In recording trait expression, therefore, observations taken and data recorded should represent responses of the majority of plants in a plot or row. The researcher, however, must use his/her personal judgment in determining whether the particular line or plot is segregating (write SEG), or if it represents a non-uniform distribution of stress pressures. The most susceptible score observed should be kept on record.

The general procedures for SES scoring or giving each item of the sample the appropriate class value or code number, are as follows: The first step is to determine the presence or absence of stress as well as the injury level of known local check cultivars usually exhibiting intermediate or low levels of resistance/tolerance (susceptible reaction). If the intensity of injury is below the acceptable level, phenotypic differentiation of genetic resistance is difficult. The second step is to assess the intensity of injury by actual measurement or visual estimation. Visual estimation requires good training and experience in mental calibration of various injury intensities. Pictorial guides or standard diagrams are frequently used for consistent and precise evaluations. Proper evaluation techniques should be employed to assess injury intensity of an entry, plot or field.

Different levels of injury intensity are sometimes described verbally. Field key is a verbal and numerical description of disease severity class. This often combines incidence and severity for rapid visual assessment of a foliar disease on whole plants, in plots and in fields (Table 2). The description may vary according to major varietal types and conditions of cultivation.

For quantitative analysis, the actual measurement or visual estimation of injury intensity of test entries must be recorded, and later converted into scores for rapid grouping or selection. ***SES scales are mainly for mass evaluation of genetic traits in order to group or rank rice germplasm or breeding lines. Actual measurement of traits instead of SES scales should be used for detailed analysis.***

The following table, which provides a powerful scale for assessing leaf blast severity, illustrates the above point.

Table 2. Field key for visual assessment of leaf blast severity.[a]

Scale	Description	Diseased Leaf Area (%)
0	No typical susceptible lesion observed.	0
1	Rapid observation does not reveal leaf lesions, but careful scrutiny of each row reveals few lesions.	<0.3
2	Rapid detection detects a few lesions.	0.3-0.9
3	Several lesions are randomly scattered within a plot, and the lesion number on an infected leaf ranges from 1 to 4.	1-2
4	Upper leaves are uniformly dotted with blast lesions but without necrotic (brown) leaf tips. A few to several leaves are brown.	3-7
5	Several to many lower leaves become necrotic and few dead leaves are observed. Tips of several upper leaves show brown color and begin to fold.	8-14
6	Lower leaves are uniformly exhibiting brown color and several dead leaves are visible. Tip necrosis of upper leaves is predominant.	15-24
7	Tips of most upper leaves are curling. Middle and lower leaves are brown. Several plants or tillers are stunted or dead.	25-39
8	Extensive leaf curling and browning of upper and middle leaves are prevalent. Plants re generally stunted and many plants are dead.	40-65
9	Majority of plants are severely stunted, brown and dead. Only few to several plants have green leaves with heavy infection.	>65

[a]This scale is applicable to microplot, and can be used for plants less than 40 days old. (S. W. Ahn, IRRI, unpublished).

The above scale, which deals with a disease of rice, provides a good example of the issues associated with field assessment of injuries. For example, let us assume that three plots of the same genotype are assessed, and are classified 5, 7, and 2, respectively. This may happen because of a number of reasons: (1) the pathogen spreads, and may do so unevenly; (2) there is spatial heterogeneity in soil fertility that renders the considered genotype unevenly susceptible to the disease; or, (3) inter-plot interferences occur: the first plot is surrounded by genotypes with average susceptibility, while the second plot neighbors a very susceptible genotype, and the third is surrounded by genotypes that are not susceptible to blast.

The three ratings, 5, 7, and 2, correspond to median severity values of 11.0, 32.0, and 0.6%, respectively. The mean severity of the three plots (14.5%) would lead to categorize the considered genotype in class 6. One could however be tempted to consider the average of the three ratings (5, 7, 2), and thus erroneously categorize the genotype in class 4.

This example highlights a series of elements that must be considered:

- First comes the difference between 'assessment' (the assignment to a class) and 'measurement' (the quantification) of injuries. Assessment classes should not be considered as continuous variables. This prevents the calculation of means of such values, and even more so, of statistical analyses using the linear model such as analysis of variance or regression. These conventional methods however can be used, but only after back-transformation of the class value ***before*** the calculation of mean and other statistics. This, of course, is impossible for injuries caused by non-biological factors, such as, e.g., drought injury.

- Categorized variables are samples drawn from a frequency distribution. The latter can be summarized by its mode (that is, the class most frequently encountered in a sample; Porkess, 1988), and the lowest and highest classes observed.

- Field tests are conducted without control of a very large number of factors: the intensity of injuries may, for instance, vary from season to season and may be spatially heterogeneously distributed. This applies to both injuries caused by physical factors and by pathogens or animal pests. Therefore, one must bear in mind that these tests result, actually, in measurements of susceptibility and not of resistance. In other words, while high levels of injuries indicates susceptibility, observing low levels of injury in a given genotype cannot be considered a proof of resistance (Yuen and Forbes, 2009).

- Spatial heterogeneity of injuries further compounds the difficulty of field testing. While this may be addressed in formal experiments, simple tests where replications are few or absent – that is, where one assumes perfect homogeneity in space of the likelihood of injury – impose caution in data interpretation. This remark applies, too, to both physical factors and disease or animal pests.

- Inter-plot interference (James et al., 1976), an old issue in field trials with diseases and animal pests, is another element the experimenter must bear in mind. When a large number of entries are being tested, chance may assign the individual position of a given genotype next to very susceptible entries. This will strongly increase the likelihood of injury on this entry to be higher than expected, and thus to overestimate its susceptibility (positive interference). If, on the other hand the same genotype is surrounded by resistant materials, the likelihood of injury on this genotype will be reduced, leading to underestimate its susceptibility. Inter-plot interference therefore can very strongly reduce the accuracy of assessment. Inter-plot interference will be very strong with highly mobile pathogens and animal pests (e.g., blast, brown spot, leaf hoppers), while it will be much weaker with pathogens and pests that disperse at small distances (e.g., sheath blight, mole cricket). Inter-plot interference may, in part, be reduced by increasing plot size, or establishing buffer between plots. Unfortunately, such options often may not be considered. Occurrence of inter-plot interference therefore is one additional element for caution in interpreting results.

Standard area diagram

Direct visual estimation, although less laborious, can be inaccurate (see below: precision and accuracy; James and Teng, 1979). Visual injury assessment should be done only after suitable training of observers using standard area diagrams or pictorial guides. Diagrammatic illustrations of the grades distinguished (Fig. 1-5) are useful tools and reference points for the "calibration" of the observer's eyes.

Figure 1 shows four leaf sizes each with black areas representing 1, 2, and 5% of the leaf area. These affected areas include the lesions and adjacent chlorotic or necrotic tissues associated with the lesions. Figures 2 and 3 show 1, 5, 25 and 50% of leaf areas affected by the lesions. Figures 4 and 5 are schematic drawings of the relative incidence in field conditions.

For effective use of the diagrams in evaluating whole plots, sampling techniques that optimize variance and cost are required. Estimates are assigned either to classes or to their means (class mean) which are multiplied with their frequencies to directly obtain the mean of the sample.

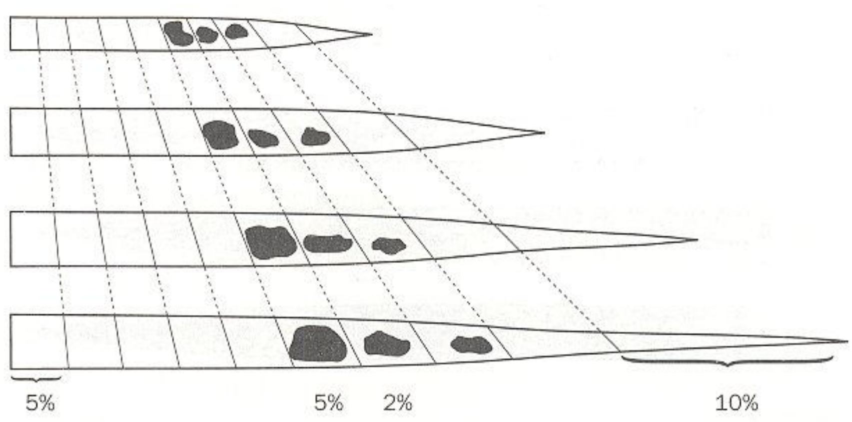

Figure 1. This key can be used in assessing the severity on leaves. Each of the 4 leaves have 10 divisions. The black areas represent 1, 2 and 5% of the leaf area. Reproduced from W.C. James, Canadian Plant Disease Survey, 51 (1971):39-64.

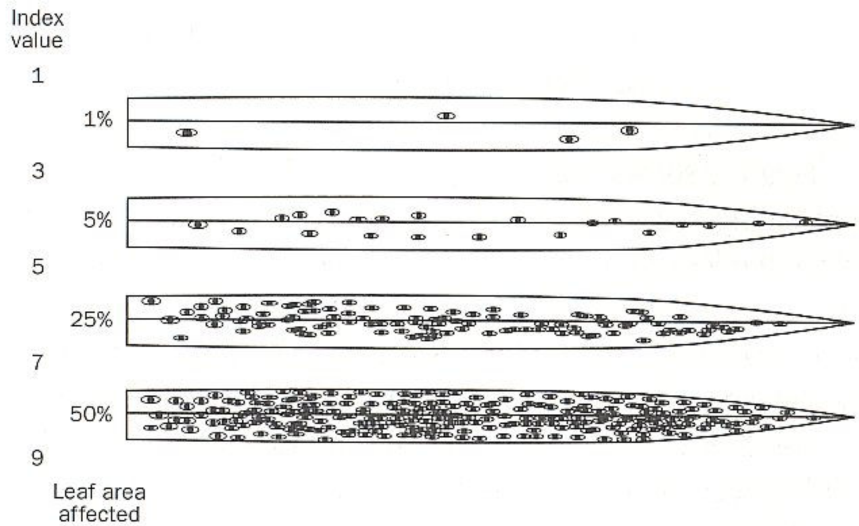

Figure 2. The index value and the corresponding levels of severity for a leaf spot disease (i.e. brown spot, blast).

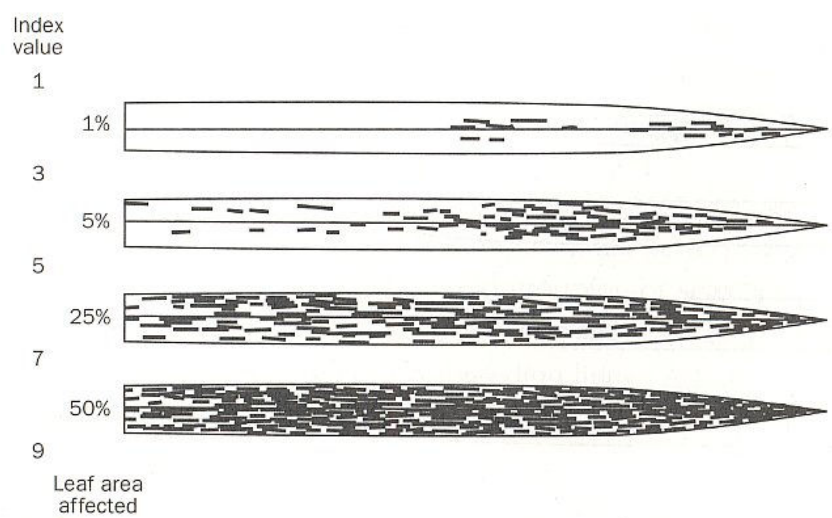

Figure 3. The index value and the corresponding levels of severity for a leaf streak disease (i.e. narrow brown leaf spot, bacterial leaf streak).

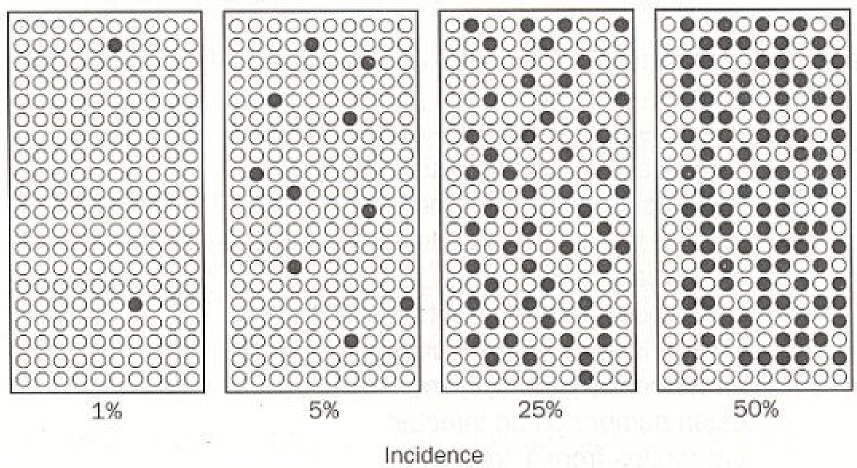

Figure 4. Schematic drawing showing percentage of plants in a field plot with 4 levels of incidence.

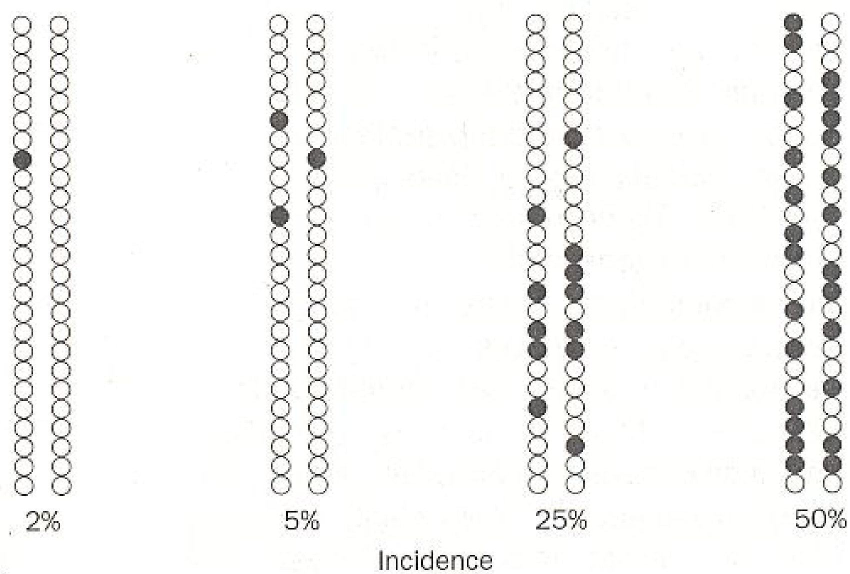

Figure 5. Schematic drawing showing percentage of plants in a 2-row field plot with 4 levels of incidence.

Considerations

There is a well-documented tendency to overestimate injuries (Zadoks and Schein, 1979), whether expressed as severity or incidence. Therefore, one must carefully assess severity or incidence before taking scores. Accuracy refers to the closeness of a sample estimate (i.e. mean) to the true value of the injury assessed. Precision refers to the repeatability of independent observations, and can be measured by, e.g., the coefficient of variation of repeated observations on the same sample. An ideal observation should both be accurate and precise. Very often, precision is (wrongly) over-emphasized on accuracy in observations: In practice, a good observation needs to be accurate, with a suitable level of precision. The reader is referred to Nutter et al, 1993 for additional detail.

Sampling and estimation are integral components of an assessment scheme. Sampling may not be a major concern if the area allotted to each entry is small enough and if the injury is uniformly distributed over space. For mass evaluation and quick selection, breeders often use simple comparisons such as better than, equal to, and worse than local check varieties or their mental image of standard or ideal cultivars grown under the same environmental conditions. Observers may be reluctant, or cannot afford, to spend much time in measuring injuries that are not their primary concern, or in assessing material that is not of their immediate interest. However, accurate and precise measurement through acceptable sampling and assessment procedures is critical for genotype by environment interaction studies in multi-environment trials (METs). Other information on genotype by environment should also be collected for better analysis and interpretation of evaluation results. These include soil and climatic data, cultural practices, and characterization of biological components of the environment such as pathogens, insect pests or nematodes.

The training for injury assessment is essential, particularly if several evaluators work in a joint program. Inter-evaluator reliability, that is, the overall agreement among evaluators, is generally low at an initial "training assessment" but increases substantially over repeated assessment practices.

DESCRIPTIONS and SCALES/CODES

Growth Stages of Rice Plants

When reporting results for specific characters, use this code to identify the stage of plant growth at which the observation was recorded.

Specific applications might be sequential data on disease reaction for a season's record of epidemic buildup (e.g. blast notes at growth stages 2, 3, 4, 5, 6, 7, 8).

CODE

1 Germination
2 Seedling
3 Tillering
4 Stem elongation
5 Booting
6 Heading
7 Milk stage
8 Dough stage
9 Mature grain

AGRONOMIC TRAITS

1

Seedling/Vegetative Vigor (Vg)

NOTE: Several factors may interact, influencing seedling vigor (e.g. tillering ability, plant height, leaf number, leaf area, leaf greenness, etc.). Use this scale for evaluating genetic material and varieties under stress and non-stress conditions.

At growth stage:

Seedling vigor: 2

Vegetative vigor: 3

SCALE

1 Extra vigorous (very fast growing; plants at 5-6 leaf stage have 2 or more tillers in majority of population)
3 Vigorous (fast growing; plants at 4-5 stage have 1-2 tillers in majority of population)
5 Normal (plant at 4-leaf stage)
7 Weak (plants somewhat stunted; 3-4 leaves; thin population; no tiller formation)
9 Very weak (stunted growth; yellowing of leaves)

2

Tillering Ability (Ti)

NOTE: Environmental factors, nutrient supply, and plant spacing can greatly influence the degree of tillering ability. The score should represent most plants within the plot.

At growth stage: 5

(Each plant should 20 x 20 cm hill spacing)

SCALE

1 Very high (more than 25 tillers/plant)
3 Good (20/25 tillers/plant)
5 Medium (10-19 tillers/plant)
7 Low (5-9 tillers/plant)
9 Very low (less than 5 tillers/plant)

3

Culm Strength (Cs)

NOTE: Culm strength is first rated after heading by gently pushing the tillers (30 cm from the ground) back and forth a few times. This test gives some indication of culm stiffness and resilience. Final observation at maturity is made to record standing position of plants.

At growth stage: 6-9

SCALE

1 Strong (no bending)
3 Moderately strong (most plants bending)
5 Intermediate (most plants moderately bending)
7 Weak (most plants nearly flat)
9 Very weak (all plants flat)

4

Lodging Incidence (Lg)

NOTE: Indicate% of plants that lodged.

At growth stage: 6-9

5

Plant Height (Ht)

NOTE: Use actual measurement (cm) from soil surface to tip of the tallest panicle (awns excluded). For height measurements at other growth stages, specify the stage. Record in whole numbers (do not use decimals).

At growth stage: 7-9

SCALE

1 Semidwarf (lowland: less than 110 cm; upland: less than 90 cm)
5 Intermediate (lowland: 110-130 cm; upland (90-125 cm)
9 Tall (lowland: more than 130 cm; upland: more than 125 cm)

6

Leaf Senescence (Sen)

Estimated by observing all leaves below the flag leaf for their retention of greenness.

At growth stage: 9 (at harvest)

SCALE

1 Very early (all leaves lost their green colour before grain maturity)
3 Early (all leaves have lost their green colour at harvest)
5 Intermediate (one leaf still green at harvest)
7 Late (two or more leaves still green at harvest)
9 Very late (all leaves still green at harvest)

7

Panicle Exsertion (Exs)

Extent to which the panicle is exserted above the flag leaf sheath.

At growth stage: 7-9 (near maturity)

SCALE

1 Enclosed (panicle is partly or entirely enclosed within the leaf

3 Partly exserted (panicle base is slightly beneath the collar of the flag leaf blade)

5 Just exserted (panicle base coincides with the collar of the flag leaf blade)

7 Moderately well exserted (panicle base is above the collar of the flag leaf blade)

9 Well exserted (panicle base appears well above the collar of the flag leaf blade)

8

Panicle Threshability (Thr)

NOTE: Evaluator should firmly grasp and pull with his/her hand over the panicle and estimate the percentage of shattered grains.

At growth stage: 9

SCALE

1 Difficult (less than 1%)

3 Moderately difficult (1-5%)

5 Intermediate (6-15%)

7 Loose (26-50%)

9 Easy (51-100%)

9

Spikelet Fertility (SpFert)

NOTE: Evaluator should identify fertile spikelets by pressing the spikelets with his/her fingers and noting those that do not have grains.

At growth stage: 9

SCALE

1 Highly fertile (>90%)

3 Fertile (75-89%)

5 Partly sterile (50-74%)

7 Highly sterile (<50% to trace)

9 0%

10

Phenotypic Acceptability (PAcp)

NOTE: Breeding objectives for each location vary. The score should reflect the overall acceptability of the variety in the location where it is being grown.

At growth stage: 9

SCALE

1 Excellent

3 Good

5 Fair

7 Poor

9 Unacceptable

11

Maturity (Mat)

NOTE: Use the number of days from seeding to grain ripening (85% of grains on panicle are mature).

At growth stage: 9

12
Grain Yield (Yld)

NOTE: Area harvested should not be less than 5 m2/plot (at least two border rows should be discarded). Report yield in kilogram per hectare on rough (paddy) rice at 14% moisture.

At growth stage: 9 on rough (paddy) rice

TRAITS FOR EVALUATION OF RICE HYBRIDS AND/OR PARENTAL LINES

20
Male Sterility Group

SCALE

1 Cytoplasmic-nuclear interaction type
2 Thermosensitive-genic type (TGMS)
3 Photoperiod-sensitive genic type (PGMS)
4 Thermo-photoperiod genic type (TPGMS)
5 Genetically engineered (transgenic type)
6 Nuclear type

21
Degree of Male Sterility of Male Sterile Lines
A. Pollen sterility

It is observed under the microscope under magnification 10 x 10 after staining pollen grains with 1% Iodine Potassium Iodide (IKI) solution. Samples for pollen are collected from at least ten florets from individual plants at growth stage 6 and fixed in 70% alcohol. Two to three anthers are extracted from five of the florets on a glass slide and pollen are squeezed out with a spear-shaped needle in a drop of IKI solution. At least three micro-scopic fields are used to count sterile pollen grains (viz., unstained withered, unstained spherical, and partially stained round) and fertile pollen grains (stained round); percentage pollen sterility is computed as follows:

$$\frac{\text{Number of (unstained withered + unstained spherical) + partially stained round)}}{\text{Total number of pollen grains (including fertile)}} \times 100$$

Scale	Description	Pollen Sterility (%)
1	Completely sterile	100
3	Highly sterile	99.0-99.9
5	Sterile	95.0-98.9
7	Partially sterile	70.0-94.9
9	Partially fertile to fertile	<70

B. Spikelet sterility

This trait of a male sterile line is monitored at growth stages 8 and 9. Two primary panicles of at least 50 plants of a male sterile line are bagged with glassine bags at growth stage 5-6 before their anthesis begins. Filled and unfilled spikelets of the bagged panicles are counted.

Scale	Description	Pollen Sterility (%)
1	Completely sterile	100
3	Highly sterile	99.0-99.9
5	Sterile	95.0-98.9
7	Partially sterile	70.0-94.9
9	Partially fertile to fertile	<70

A male sterile line is considered sterile if its pollen and/or spikelet sterility ranges from scale 1 to 3. Otherwise, it is considered unstable.

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Abortion Pattern of Male Sterile Lines

It can be monitored at growth stage 5-6. Florets are collected and fixed in 3:1 Acetic acid: alcohol solution. Pollen grains are squeezed out from some anthers in Acetocarmine stain and observations are made on their staining behavior and number of nuclei visible in most of the pollen grains.

Scale	Description	Pollen Sterility (%)
1	Pollen free	TGMS line Norin PL12
3	Abortion at uni-nucleate stage of pollen	"CMS-WA" type
5	Abortion at binucleate stage of pollen	"CMS-HL" type
7	Abortion at trinucleate stage of pollen	"CMS-boro" type
9	Abortion at later stage and pollen looks like a fertile pollen	518A (*O. nivara cytoplasm)*

23

Extent of Outcrossing on Male Sterile Lines

This trait is monitored at growth stages 8-9 of a male sterile line grown in the field where pollen supply at its flowering time is abundant. Seed set on the out-pollinated primary panicles is observed.

Scale	Seed set (%) on out-pollinated primary panicles
1	Above 30
3	20-29.9
5	10-19.9
7	5-9.9
9	0-4.9

24

Panicle Exsertion of Male Sterile Lines

This trait is monitored at growth stage 6 by observing the extent of coverage of panicles by the flagleaf sheath.

Scale	Extent of coverage (%) of panicle by flagleaf sheath
1	0
3	1-10
5	11-25
7	26-40
9	Above 40

25

Stigma Exsertion of Male Sterile Lines

This trait is monitored at growth stage 6-7 by counting number of florets which have completed anthesis on a given day and the number of florets showing exserted stigma on one or both sides of the florets and expressed as percent stigma exsertion.

Scale	Stigma exsertion
1	Above 70
3	41-70
5	21-40
7	11-20
9	0-10

26

Opening of Glume of Male Sterile Lines

This trait is monitored at growth stage 6 during the time (9:00AM - 12:00Noon) when rice florets are blooming. Between 5-10 blooming florets of a male sterile line are collected from different plants and angle of opening of glumes (viz., lemma and palea) is measured on each floret. Following scale is used to classify male sterile lines on the basis of mean angle of glume opening:

Scale	Angle of glume opening (^{o})
1	50 above
3	40-49
5	30-39
7	20-29
9	Below 20

27

Fertility Restoration in F1 Hybrids

This trait is monitored at growth stage 6 for pollen fertility and growth stage 8-9 for spikelet fertility.

Pollen fertility is measured using 1% IKI solution and following the technique described for evaluating male sterile lines. However, in this case, emphasis is one extent of fertile pollen percentage. Spikelet fertility is monitored by counting the number of filled grains and total spikelets per panicle and converted into percentage.

Scale	Pollen Sterility (%)	Spikelet Fertility (%)
1	90 and above	90 and above
2	80-89	90 and above
3	90 and above	75-89
4	80-89	75-89
5	70-79	75-89
6	70-79	60-74
7	60-69	60-74
9	<60	<60

INJURIES CAUSED BY DISEASES

30

Leaf Blast (Bl)

Causal agent:

Magnaporthe grisea (Pyricularia oryzae)[1]

NOTE: Use this scale only for the nursery. Actual estimation of blast affected leaf area (%) is recommended for field assessment of blast disease together with predominant lesion type (see coding system for lesion type).

Entries with scores 4-9 may also have lesions of scale 1 or 2. In cases where the lesion develops only on the collar, joint of the leaf sheath and the leaf blade, causing the leaf blade to drop off, a scale unit of 4 is to be given.

Entries with consistent rating, between 4 and 6 with overall average not higher than 5.5 may have a good level of quantitative resistance.

At growth stage: 2-3

SCALE (for blast nursery)

0 No lesions observed
1 Small brown specks of pin-point size or larger brown specks without sporulating center
2 Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin. Lesions are mostly found on the lower leaves.
3 Lesion type is the same as in scale 2, but a significant number of lesions are on the upper leaves
4 Typical susceptible blast lesions[2] 3 mm or longer, infecting less than 4% of the leaf area
5 Typical blast lesions infecting 4-10% of the leaf area
6 Typical blast lesions infection 11-25% of the leaf area
7 Typical blast lesions infection 26-50% of the leaf area
8 Typical blast lesions infection 51-75% of the leaf area and many leaves are dead
9 More than 75% leaf area affected

[1] The imperfect (anamorphic) stage name.

[2] *Lesion type 5, 7, 9 (see code for predominant lesion type.)*

At growth stage: 2-3 (field or greenhouse)

NOTE: Lesion types 5, 7 and 9 are considered typical susceptible lesions.

CODE (Predominant lesion type)

0 No lesions observed

1 Small brown specks of pinpoint size or larger brown specks without sporulating center

3 Small, roundish to slightly elongated necrotic sporulating spots, about 1-2 mm in diameter with a distinct brown margin or yellow halo

5 Narrow or slightly elliptical lesions, 1-2 mm in breadth, more than 3 mm long with a brown margin

7 Broad spindle-shaped lesion with yellow, brown, or purple margin

9 Rapidly coalescing small, whitish, grayish, or bluish lesions without distinct margins

31

Panicle Blast (PB)

Causal agent:
Magnaporthe grisea (Pyricularia oryzae)

Symptoms
Dark, necrotic lesions cover partially or completely around the panicle base (node) or the uppermost internode or the lower part of panicle axis. The panicles are greyish and have either partially filled or unfilled grains.

NOTE: Based on the number of panicles with each scale, compute panicle blast severity (PBS) as follows

$$PBS = \frac{(10xN_1)+(20 \text{ x } N_3)+(40xN_5) + (70xN_7)+(100xN_9)}{\text{Total no. of panicles observed}}$$

where N_1-N_9 are the number of panicles with score 1-9.
At growth stage: 8
(20-25 days after heading).

SCALE (based on symptoms)

0 No visible lesion or observed lesions on only a few pedicels

1 Lesions on several pedicels or secondary branches

3 Lesions on a few primary branches or the middle part of panicle axis

5 Lesion partially around the base (node) or the uppermost internode or the lower part of panicle axis near the base

7 Lesion completely around panicle base or uppermost internode[3] *or panicle axis near base with more than 30% of filled grains*

9 Lesion completely around panicle base or uppermost internode or the panicle axis near the base with less than 30% of filled grains.

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[3] *Infection is also found on the lower part of the internode, which is covered by the leaf sheath.*

NOTE: For the mass evaluation of panicle blast incidence count only the number of panicles with lesions covering completely around the node, neck or lower part of the panicle axis (symptom type 7-9).

At growth stage: 8-9

[3]Infection is also found on the lower part of the internode, which is covered by the leaf sheath.

SCALE (Incidence of infected panicles)

0 No disease observed
1 Less than 5%
3 5-10%
5 11-25%
7 26-50%
9 More than 50%

32

Brown Spot (BS)

Causal agent:

Cochliobolus miyabeanus (Bipolaris oryzae, Drechslera oryzae).

Symptoms:

Typical leaf spots are small, oval or circular and dark brown. Larger lesions usually have the same color on the edges but have a pale, usually grayish center. Most spots have a light yellow halo around the outer edge.

Note: This scale may be used for eyespot disease caused by *Drechslera gigantea*.

SCALE (Severity: % leaf area diseased)

0 No disease observed
1 Less than 1%
2 1-3%
3 4-5%
4 6-10%
5 11-15%
6 16-25%
7 26-50%
8 51-75%
9 76-100%

33

Narrow Brown Leaf Spot (NBLS)

Causal agent:

Sphaerulina oryzina (Cercospora janseana)

SCALE (Severity: % leaf area diseased)

0 No disease observed
1 Less than 1%
3 1-5%
5 6-25%
7 26-50%
9 51-100%

Bacterial Leaf Streak (BLS)

Causal agent:

Xanthomonas oryzae pv. oryzicola

Symptoms

Linear lesions with small bacterial exudates evident.

At growth stage: 3-6

NOTE: This scale may also be used for leaf smut caused by *Entyloma oryzae.*

SCALE (Affected leaf area)

0 No lesions observed
1 Small brown specks of pin-point size or larger brown specks without sporulating center
3 Lesion type is the same as in scale 2, but a significant number of lesions are on the upper leaves
5 Typical blast lesions infecting 4-10% of the leaf area
7 Typical blast lesions infection 26-50% of
9 More than 75% leaf area affected

34

Leaf Scald (Ls)

Causal agent:

Monographella albescens
(Microdochium oryzae)

Symptoms
The lesions occurs mostly near leaf tips, but sometimes starts at the margin of the blade and develops into large ellipsoid areas encircled by dark-brown, narrow bands accompanied by a light-brown halo.

At growth stage: 5-8

SCALE (Severity: % leaf area diseased)

0 No disease observed
1 Less than 1% (apical lesions)
3 1-5% (apical lesions)
5 6-25% (apical and some marginal lesions)
7 26-50% (apical and marginal lesions)
9 51-100% (apical and marginal lesions)

35

Bacterial Blight (BB)

Causal agent:
Xanthomonas oryzae pv. oryzae.

Symptoms Lesions usually start near the leaf tips or leaf margins or both, and extend down the outer edge(s). Young lesions are pale green to grayish green, later turning yellow to gray (dead) with time. In very susceptible varieties, lesions may extend to the entire leaf length into the leaf sheath. Kresek or seedling blight causes wilting and death of the plants.

SCALE (greenhouse test, severity: % leaf area diseased)

1 No disease observed
2 Less than 1%
3 1-3%
4 4-5%
5 11-15%
6 16-25%
7 26-50%
8 51-75%
9 76-100%

At growth stage:
3-4 kresek, (greenhouse evaluation of leaf blight)
5-8 (leaf blight)

SCALE (field test, severity: % leaf area diseased)

1 1-5%
3 6-12%
5 13-25%
7 26-50%
9 51-100%

NOTE: In both seedling and field tests, folded young leaves should not be inoculated. Old or leaves with symptom of nutrient deficiency or other diseases should also be avoided for inoculation.

36

Rice Diseases caused by Viruses and Mycoplasma-like Organisms (MLO)

The reaction of a certain genotype to rice virus infection can be assessed by a skilled worker based on visible symptoms after inoculation under natural conditions (in a field), or under controlled conditions (in a greenhouse). The factors needed for a successful test are the presence of virus sources and insect vectors, inoculation at the susceptible growth stage of the test plants and favorable environmental conditions.

SCALE (Incidence: % plants or hills showing symptoms)

0 No symptom observed
1 1-10%
3 11-30%
5 31-50%
7 51-70%
9 71-100%

Field test:

Screening of test materials, notably breeding lines, can be done in the field and their reaction to virus infection can be assessed on a scale of 0-9 based on the percentage of infection observed.

Greenhouse test:

Field tests generally select vector resistance and are not appropriate for selecting virus resistance. Resistance to the virus can be assessed in the greenhouse where factors needed for infection can be manipulated. Inoculation using a high number of vectors is desired and the susceptible check would be also useful as a reference for measuring plant height. Since some fertilizers might affect symptoms, it is recommended not to use any during the experiment. A disease index (DI) for the genotype, which would represent both disease incidence and symptom severity, can be used as an indicator for virus resistance in a greenhouse test. DI can be calculated as:

$$DI = \frac{n(3) + n(5) + n(7) + n(9)}{tn}$$

Where: n(3), n(5), n(7), and n(9) = number of plants showing a reaction in a scale (3), (5), (7), and (9) respectively.

tn = total number of plants scored

The resulting DI can be classified as:

DI	REACTION
0-3	Resistant/tolerant
4-6	Moderate
7-9	Susceptible

For further confirmation, test materials with DI rating of 0-3 may be tested by forced inoculation using different number of vectors, at different plant growth stages, and may be assayed serologically to differentiate between virus resistance and tolerance.

Rice Tungro Disease

Causal agent:

Rice tungro bacilliform virus (RTBV) and rice tungro spherical virus (RTSV)

Symptoms:

Yellow to yellow orange leaves, stunting, and slightly reduced tillering.

At growth stages:

2 (for the greenhouse)

3-5 (for the field)

Score and calculate DI at 4 weeks after inoculation in the greenhouse.

SCALE

1 No symptom observed

3 1-10% height reduction, no distinct yellow to yellow orange leaf discoloration

5 11-30% height reduction, no distinct yellow to yellow orange leaf discoloration

7 31-50% height reduction, with distinct yellow to yellow orange leaf discoloration

9 More than 50% height reduction, with distinct yellow to yellow orange discoloration

Rice Grassy Stunt 1 and 2 Disease

Causal agent:

Rice grassy stunt virus 1 (RGSV1) and rice grassy stunt virus 2 (RGSV2)

Symptoms

RGSV1 - Severe stunting, excessive tillering, pale green to yellow and narrow leaves with small rusty spots.

RGSV2-Severe stunting, excessive tillering, yellow to orange and narrow leaves with small and rusty spots.

At growth stages:

2-3 (for the greenhouse)
4-6 (for the field)

Score and calculate DI at 5 weeks after inoculation in the greenhouse.

SCALE (RGSV1)

1 No symptom observed

3 Pale green and slightly narrow leaves, no height reduction and with few small tillers

5 Pale green and slightly narrow leaves, 1-10% height reduction, and with numerous small tillers

7 Pale green to yellow and narrow leaves with some rusty spots, 11-30% height reduction, and with numerous small tillers

9 Pale green to yellow and narrow leaves with numerous rusty spots, more than 30% height reduction and with numerous small tillers

SCALE (RGSV2)

1 No symptom observed

3 Pale yellow and slightly narrow leaves, no height reduction, and with numerous small tillers.

5 Distinct yellow and narrow leaves, 1-10% height reduction, and with numerous small tillers.

7 Yellow to orange and narrow leaves with some rusty spots, 11-30% height reduction, and with few small tillers.

9 Yellow to orange and narrow leaves with numerous rusty spots, >30% height reduction and with few small tillers.

Rice Ragged Stunt Disease

Causal agent:

Rice ragged stunt virus (RRSV)

Symptoms:

Plants are stunted but remain dark green. Leaves are ragged and twisted. Vein swelling on leaf collar, leaf blades and leaf sheaths.

At growth stages:

2-3 (for the greenhouse)
4-6 (for the field)

Score and calculate DI at 5 weeks after inoculation in the greenhouse.

SCALE

1 No symptom observed
3 0-10% height reduction, no ragged/twisted leaf, small and very few vein swelling usually on leaf collar
5 0-10% height reduction, 1-2 leaves have ragged/twisted symptoms, very few vein swelling on leaf collar
7 11-30% height reduction, 3-4 leaves have ragged/twisted symptoms, more vein swelling on leaf collar, and some on leaf blades and leaf sheaths
9 More than 30% height reduction, most leaves have ragged/twisted leaf symptoms, vein swelling common on leaf sheaths and leaf blades

Yellow Dwarf (YD)

Causal agent:

Mycoplasma

Symptoms:

Pale yellow, droopy leaves, excessive tillering and stunting.

At growth stage:

4-6 (greenhouse, on secondary growth after cutting at the base)

On ratoon (fields)

SCALE (Severity)

1 None to few leaves slightly yellow; tillering, height and flowering not affected
3 Leaves slightly yellow; plants slightly stunted; flowering slightly delayed
5 Leaves yellow; plants moderately stunted; flowering delayed
7 Leaves yellow or orange yellow; plants moderately stunted; flowering very much delayed
9 Leaves orange yellow or orange; plants severely stunted, sometimes dead; flowering very much delayed

Rice Yellow Mottle (RYM)

Causal agent:

Rice yellow mottle virus

Stunting, reduced tillering, mottling and yellowish streaking of the leaves, delayed flowering or incomplete emergence of the panicles; in extreme cases, death of plants.

At growth stage: 4-6 (field)

SCALE (for field test)

1 No symptom observed
3 Leaves green but with sparse dots or streaks and less than 5% of height reduction
5 Leaves green or pale green with mottling and 6% to 25% of height reduction, flowering slightly delayed
7 Leaves pale yellow or yellow and 26-75% of height reduction, flowering delayed
9 Leaves turn yellow or orange, more than 75% of height reduction, no flowering or some plants dead

Rice Hoja Blanca (RHBV)

Causal agent:
Rice hoja blanca virus

Symptoms:
Cream colored to yellow spots, elongating and coalescing to form longitudinal yellowish green to pals green striations. Streaks may coalesce to cover the whole leaf. Brown and sterile glumes with typical "parrot beak" shape of deformation.

At growth stages: 2-4 (leaf)
7-8 (panicle)

NOTE: To determine the degree of resistance in fixed lines under field conditions, susceptible check should have at least more than 50% infection.

SCALE (Incidence: % plants or hills showing symptoms)

0 No symptom observed
1 Less than 1%
3 1-10%
5 11-30%
7 31-60%
9 61-100%

37

Sheat Blight (ShB)

Causal agent:
Thanethoporus cucumeris (Rhizoctonia solani)

Symptoms:
Grayish-green lesions may enlarge and coalesce with other lesions, mostly on lower leaf sheaths, but occasionally on the leaves.

NOTE: The relative lesion height is the average vertical height of the uppermost lesion on leaf or sheath expressed as a percentage of the average plant height.

At growth stage: 7-8

SCALE (relative lesion height: disease progress relative to plant height; Ahn and Mew, 1986)

0 No infection observed
1 Lesions limited to lower 20% of the plant height
3 20-30%
5 31-45%
7 46-65%
9 More than 65%

38

Sheath Rot (ShR)

Causal agent:

Sarocladium oryzae

Symptoms
Oblong or irregular brown to grey lesions on the leaf sheath near panicle; sometimes coalescing to prevent emergence of panicle.

At growth stage: 7-9

SCALE (Incidence: % diseased tillers)

0 No disease observed
1 Less than 1%
3 1-5%
5 6-25%
7 26-50%
9 51-100%

39

Grain Discoloration (Gd)

Causal agents:

Species of *Sarocladium, Bipolaris, Alternaria, Gerlachia, Fusarium, Phoma, Curvularia, Trichoconiella, and Pseudomonas.*

Symptoms:

Darkening of glumes of spikelets, brown color to black including rotten glumes caused by one or more pathogens. Intensity ranges from sporadic discoloration to discoloration of the whole glume.

At growth stage: 8-9

NOTE: Severity of grain discoloration can be estimated by counting grains with more than 25% of glume surface affected.

SCALE (Grains with discolored glumes)

0 No incidence
1 Less than 1%
3 1-5%
5 6-25%
7 26-50%
9 51-100%

40

False Smut (FSm)

Causal agent:

Ustilaginoidea virens

Symptoms:

Infected grains are transformed into yellow-greenish or greenish-black velvety-looking spore balls.

At growth stage: 9

SCALE (Incidence: percentage of infected florets)

0 No disease observed
1 Less than 1%
3 1-5%
5 6-25%
7 26-50%
9 51-100%

Kernel Smut (KSm)

Causal agent:

Tilletia barclayana

Symptoms:

Infected grains show minute black pustules or streaks bursting through the glumes. In severe infection, the rupturing glumes produce short beak-like or spur-like growths.

At growth stage: 9

41
Udbatta Disease (UDb)

Causal agent:
Balansia oryzae-sativae (Ephelis oryzae)

Symptoms: A white mycelial mat ties the panicle branches together so that they emerge as single, small, cylindrical rods.

SCALE (Incidence: percent infected tillers)

0	No disease observed
1	Less than1%
5	1-25%
9	26-100%

Bakanae Disease (Bak)
Causal agent:

Giberella fujikuroi

Symptoms:

The plant elongates abnormally, has few tillers, and usually dies before producing grains.

At growth stage: 3-6

42
Stem Rot (SR)

Causal agent:

Magnaporthe salvinii (Nakatea sigmoidea, Sclerotium oryzae[4]) and Helminthosporium sigmoideum var. irregulare

Symptoms:
Dark lesions develop on the stems near the water line. Small, dark bodies (sclerotia) develop, weaken the stem and cause lodging.

At growth stage: 7-9

SCALE (Incidence: percentage of infected tillers)

0	No disease observed
1	Less than 1%
3	1-5%
5	6-25%
7	26-50%
9	51-100%

43
Ufra (U)
Causal agent:

The stem nematode *Ditylenchus angustus*

Symptom:s:
A leaf mottling or chlorotic discoloration in a splash pattern at base of young leaves in stem elongation or mid-tillering stage; brown stains may develop on leaves and sheaths which later intensify to a dark brown color. A characteristic distortion consisting of twisting and withering of young leaves. A distortion of panicles which either remain enclosed within a swollen sheath, partially emerge but are twisted and with unfilled grains, or emerge completely but with unfilled grains and resembling a whitehead.

At growth stage: 6-7

SCALE (Incidence: percentage of infected tillers)

		Symptoms
0	0%	(may or may not be visible)
1	1-2%	(visible symptoms)
3	21-40%	(visible symptoms)
5	41-60%	(visible symptoms)
7	61-80%	(visible symptoms)
9	81-100%	(visible symptoms)

[4]*The sclerotial anamorph*

INJURIES CAUSED BY RODENTS AND BIRDS

50

Rat Injury (RD)

Symptoms:

The tiller is cut at a 45° angle. Damage is typically heavier in the center of a crop (stadium effect). A tiller cut through by a rodent is likely to regrow; if this is after maxi mum tillering then the regrown tiller is unlikely to produce panicles prior to harvest.Often the regrown, but non productive, tillers are not scored as rodent damage.

Note: Since there is no genetic resistance to rats, the damage can be quantified as it does not represent resistance.

SCALE (Incidence: percentage of injured plants)

0 No injury observed

1 Less than 5%

5 6-25%

9 26-100%

51

Bird Injury (BD)

NOTE: Since there is no genetic resistance to birds, the injury can be quantified as it does not represent resistance.

SCALE (Incidence: percentage of injured panicles)

0 No injury observed

1 Less than 5%

5 6-25%

9 26-100%

INJURIES CAUSED BY INSECTS[5]

60

Brown Planthopper (BPH)

Causal agent:

Nilaparvata lugens

Symptoms:
Partial to pronouncedyellowing and increasing severity ofstunting. Extreme signs are wilting todeath of plants. Infested areas in thefield may be patchy.

At growth stage:
2 (greenhouse)
3-9 (field)

SCALE (For greenhouse test)

0 No injury

1 Very slight injury

3 First and 2nd leaves of most plants partially yellowing

5 Pronounced yellowing and stunting or about 10 to 25% of the plants wilting or dead and remaining plants severely stunted or dying

7 More than half of the plants

9 All plants dead

[5]Detailed procedures for the evaluation for insect resistance in rice could be found in “Genetic Evaluation for Insect Resistance in Rice” by E. A. Heinrichs, *et al.* (1985), IRRI.

Test evaluation for resistance can be considered valid if hopper population is uniformly distributed at a high level across the screening box or field. For field screening, a minimum of the following hopper density on susceptible check is necessary:

a. 10 hoppers/hill at 10-15 days after transplanting
b. 25 hoppers/hill at maximum tillering
c. 100 hoppers/hill at early booting stage

SCALE (For field test)

0 No injury
1 Slight yellowing of a few plants
3 Leaves partially yellow but with no hopperburn
5 Leaves with pronounced yellowing and stunting or wilting and 10-25% of plants with hopperburn, remaining plants severely stunted
7 More than half the plants wilting or with hopperburn, remaining plants severely stunted
9 All plants dead

61

Green Leafhopper (GLH)

Causal agent:

Nephotettix spp.

Symptoms: Partial to pronounced yellowing and increasing severity of stunting. Extreme signs are wilting to death of plants. Infested areas in the field may be patchy.

At growth stage: 2 (greenhouse)
3-9 (field)

SCALE

0 No injury
1 Very slight injury
3 First and 2nd leaves yellowing
5 All leaves yellow; pronounced stunting or both
7 More than half the plants dead; stunting or both remaining plants wilting; severely stunted
9 All plants dead

62

Whitebacked Planthopper (WBPH)

Causal agent:

Sogatella furcifera

Symptoms

Partial to pronounced yellowing and increasing severity of stunting. Extreme signs are wilting and death of plants. Infested areas in the field may be patchy.

At growth stage: 2 (greenhouse)
3-9 (field)

SCALE

0 No injury
1 Very slight injury
3 First and 2nd leaves with orange tips; slight stunting
5 More than half the leaves with yellow-orange tips; pronounced stunting
7 More than half of plants dead; remaining plants severely stunted and wilted
9 All plants dead

Rice Delphacid (RDel)

Causal agent:

Tagosodes orizicolus

Symptoms

Similar to WBPHNOTE: The scale is based on symptoms. Incidence of dead plants could be considered for final evaluation.

At growth stage: 2 (greenhouse)2-6 (field)

SCALE (for field test)

0 No injury
1 Very slight injury/leaf discoloration
Very slight injury/leaf discoloration
5 Pronounced yellowing of leaves and stunting, less than 50% of plants dead
7 Strong yellowing of leaves and pronounced stunting, greater than 50% of plants dead
9 All plants dead

63

Stem Borers (SB)

Causal agent:

Chilo suppressalis, (striped); C. polychrysus (dark headed); Rupela albinella (South American white); Scirpophaga incertulas (yellow); S. Innotata (white); Sesamia inferens (pink); Maliarpha separatella (African whiteheads); Diopsis macrophthalma (Stalked-eyed fly); and several other species.

At growth stage: 3-5 (deadhearts)
· 8-9 (whiteheads)

Deadhearts and whiteheads in the susceptible check should average more than 20 and 10%, respectively, of infested tillers for the test to be considered valid. Percentage of susceptible check should be recorded. Percentage of deadhearts and 5 11-15% whiteheads is based on tiller count and productive tillers (panicles), respectively. For *Diopsis* spp., *i*t is not necessary to estimate whiteheads since infestation occurs usually at growth stages 2-4.

NOTE: Stem dissections from 10 hills of susceptible checks are necessary at maximum tillering, panicle initiation and late ripening, in order to identify SB species and to assess more accurately the actual incidence of stem injury.

SCALE (Deadhearts)

0 No injury
1 1-10%
3 11-20%
5 21-30%
7 31-60%
9 61% and above

For *Maliarpha separatella,* however, stem dissection is the only way to accurately estimate both the injury and incidence. Ten to 50 hills are dissected and percentage infested tillers are rated in accordance with the scale for deadhearts. Unlike whiteheads, infested tillers do produce some panicles and so the relationships between whiteheads/infested tillers and yield are not quite the same.

For deepwater rice, make dissections of 20 or more tillers per plot or row at growth stages 6-8 and count the numbers of infested (or injured) tillers. Apply the above index using the numbers of infested tillers in place of the numbers of deadhearts. Scoring for whiteheads is of little value in deepwater rice.

SCALE (Whiteheads)
0 No injury
1 1-5%
3 6-10%
5 11-15%
7 16-25%
9 26% and above

64
Leaffolder (LF)
Causal agent:
Cnaphalocrosis medinalis, Marasmia patnalis

Symptoms:
Larvae consume the leaf tissue except the epidermis, causing typical white streaks. They create a leaf tube during later stages of feeding. Note: Plant a susceptible and resistant check (if available) after every 10 test entries. Replicate test entries three times if seed is available. Determine the percentage of injured and folded leaves. Injured leaves of the susceptible check should average at least 40% for the test to be considered valid. Use the following scale on the basis of the converted figures to place percentage of injured

SCALE (Injured plants)
0 No injury
1 1-10%
3 11-20%
5 21-35%
7 36-50%
9 51-100%

At growth stage: 2-3 (greenhouse)
· · 3-9 (field)

Greenhouse screening
For greenhouse screening, consider both the % of leaves with injury and the extent of injury on each leaf. For each entry, first examine all of the leaves and rate each one from 0-3 as based on the extent of injury.

Grade	Injury
0	No injury
1	Up to 1/3 of leaf area scraped
2	1/3 to 1/2 of leaf area scraped
3	More than 1/2 of leaf area scraped

Based on the number of leaves with each injury grade, compute as follows:

$$\%\ \text{Rating (R)} = \frac{\text{(No of leaves with injury grade of 1 x 100)1}}{\text{Total no. of leaves observed}} + \frac{\text{(No of leaves with injury grade of 2 x 100)2}}{\text{Total no. of leaves observed}} + \frac{\text{(No of leaves with injury grade of 3 x 100)3}}{\text{Total no. of leaves observed}} + 6$$

Calculate as above for each test entry and the susceptible check. Then adjust for extent of injury in the susceptible check by:

$$\text{Adjusted \% injury (D) rating} = \frac{\text{R of test entry}}{\text{R of susc. check}} \times 100$$

The overall injury rating (D) is converted to a 0-9 scale.

Scale	**% Injury Rating (D)**
0	No injury
1	1-10
3	11-30
5	31-50
7	51-75
9	more than 75

65

Gall Midge (GM)

Causal agent:

Orseolia oryzae

NOTE: For the field test to be valid more than 60% of the plants should be affected with not less than 15% silver shoot in the susceptible check. Similarly, 60% of the plants in susceptible check should show silver shoots under greenhouse tests.

If any of the test entry in field evaluation exhibits its injury less than 10% on plant basis, rate it in “0” category, since such injury could be due to other reasons.

At growth stage: 2-5

SCALE (Infected tillers in field test)

0	No injury
1	Less than 1%
3	1-5%
5	6-10%
7	11-25%
9	More than 25%

SCALE (Plants with silver shoots in greenhouse test)

0	No injury
1	Less than 5%
3	6-10%
5	11-20%
7	21-50%
9	More than 50%

66

Caseworm (CW)

Causal agent:

Nymphula depunctalis

Symptoms:

Larvae feed on leaf tissue, leaving only the papery upper epidermis.

SCALE (Scraping index)

0	No scraping
1	Less than 1%
3	1-10%
5	11-25%
7	26-50%
8	51-100%

67

Rice Whorl Maggot (RWM)

Causal agent:

Hydrellia philippina

Symptoms:

Leaf margin feeding causes conspicuous injury and sometimes stunting of plants.

At growth stage: 3

SCALE (for field test)

0	No injury
1	Less than 2 leaves/hill injured
3	2 or more leaves/hill but less than 1/3 of leaves injured
5	1/3 to 1/2 of leaves injured
7	More than 1/2 of the leaves injured with no broken leaves
9	More than 1/2 of the leaves injured with some broken leaves

68

Rice Bug (RB)

Causal agent:

Leptocorisa oratorius

At growth stage: 7-9

SCALE Injured grains per panicle (%)

0	No injury
1	Less than 3
3	4-7
5	8-15
7	12-25
9	26-100

69

Thrips

Causal agent:

Stenchaetothrips biformis

At growth stage: 2-3

SCALE

1	Rolling of terminal 1/3 area of 1st leaf
3	Rolling of terminal 1/3-1/2 area of 1st and 2nd leaves
5	Rolling of terminal 1/2 area of 1st, 2nd, and 3rd leaves; yellowing of leaf tips
7	Rolling of entire length of all leaves; pronounced yellowing
9	Complete plant wilting, followed by severe yellowing and scorching

Problem Soils

70-71
Alkali Injury (Alk) and Salt Injury (Sal)

NOTE: Observe general growth conditions in relation to standard resistant and susceptible checks. Since some soil problems are very heterogeneous in the field, several replications may be needed to obtain precise reading.

At growth stage: 3-4

SCALE (Alkali and salt injury)

1 Growth and tillering nearly normal
3 Growth nearly normal but there is some reduction in tillering and some leaves discolored[6] (alkali)/ whitish and rolled (salt)
5 Growth and tillering reduced; most leaves discolored (alkali)/ whitish and rolled (salt); only a few elongating
7 Growth completely ceases; most leaves dry; some plants dying
9 Almost all plants dead or dying

72
Iron Toxicity (FeTox)

At growth stage: 2-5

SCALE (Injured panicles)

0 Growth and tillering nearly normal
1 Growth and tillering nearly normal; reddish-brown spots or orange discoloration on tips of older leaves
3 Growth and tillering nearly normal; older leaves reddish-brown, purple, or orange yellow
5 Growth and tillering retarded; many leaves discolored
7 Growth and tillering ceases; most leaves discolored or dead
9 Almost all plants dead or dying

73
Phosphorus Deficiency (PDef)

At growth stage: 2-5

SCALE (Relative tillers)

1 80-100%
3 60-79%
5 40-59%
7 20-39%
9 0-19%

[6] Leaf is counted as discolored or dead if more than half of its area is discolored or dead.

Greenhouse (use the following equation):

$$\frac{\text{No. of tillers in 0.5 ppm P culture solution}}{\text{No of tillers in 10 ppm P culture solution}} \times 100$$

Field (use the following equation):

$$\frac{\text{No. of tillers with no P}}{\text{No of tillers with 25 kgP/ha}} \times 100$$

73
Zinc Deficiency (ZDef)

At growth stage: 2-4

SCALE

1 Growth and tillering nearly normal; healthy
2 Growth and tillering nearly normal; basal leaves slightly discolored
3 Stunting slight, tillering decreased, some basal leaves brown or yellow
5 Growth and tillering severely retarded, about half of all leaves brown or yellow
7 Growth and tillering ceases, most leaves brown or yellow
9 Almost all plants dead or dying

TEMPERATURE

75
Cold Tolerance (Ctol)

NOTE: Observe differences in vigor along with subtle changes in leaf color. The optimum time to make observations would be the seedling, tillering, flowering, and mature stages.

At growth stage: 1(seeding); 3-4 (vegetative); 5-9 (reproductive)

SCALE (for seedlings) **Temp:10°C±1**

0-1 No damage to leaves, normal leaf color (strongly tolerant)
2-3 Tip of leaves slightly dried, folded and light green (tolerant)
4-5 Some seedlings moderately folded and wilted, 30-50% seedlings dried, pale green to yellowish leaves (Moderately tolerant)
6-7 Seedlings severely rolled and dried; reddish-brown leaves (Sensitive)
8-9 Most seedlings dead and dying. (Highly sensitive)

SCALE (vegetative) **Temp:17-18°C±1**

1-3 All leaves normal color (Tolerant)
4-6 Pale green leaves (moderately tolerant)
7-9 Yellowing of leaves and stunted growth (sensitive)

SCALE (reproductive/booting)

Temp:17-18°C±1

- 1-3 Normal growth, spikelet fertility (>70%) (tolerant)
- 4-6 Heading delay, spikelet fertility (11-69%) (moderately tolerant)
- 7-9 Reduced plant height, delayed heading, high sterility (<10%) (sensitive)

76
Heat Tolerance (Htol)

Note: Based on Spikelet Fertility (%)

At growth stage: 7-9

SCALE (Spikelet fertility)

- 1 More than 80%
- 3 61-80%
- 5 41-60%
- 7 11-40%
- 9 Less than 11%

DROUGHT

80
Drought Sensitivity (DRS)

NOTE: Drought sensitivity is highly interactive with crop phenology, plant growth prior to stress, and timing, duration, and intensity of drought stress.

For many soils, it takes at least 2 rainless weeks to cause marked differences in drought sensitivity during the vegetative stage and at least 7 rainless days during the reproductive stage to cause severe drought injury.

Leaf rolling precedes leaf drying during drought. Repeated ratings are recommended through progress of the drought. Record the stage of plant growth when the stress occurred and the number of stress days.

SCALE (leaf rolling at vegetative stage)

- 0 Leaves healthy
- 1 Leaves start to fold (shallow)
- 3 Leaves folding (deep V-shape)
- 5 Leaves fully cupped (U-shape)
- 7 Leaf margins touching (0-shape)
- 9 Leaves tightly rolled

Leaves tightly rolled

SCALE (leaf drying at vegetative stage)

- 0 No symptoms
- 1 Slight tip drying
- 3 Tip drying extended up to ¼ length in most leaves
- 5 One-fourth to 1/2 of all leaves dried
- 7 More than 2/3 of all leaves fully dried
- 9 All plants apparently dead.

SCALE (spikelet fertility)

1 More than 80%
3 61-80%
5 41-60%
7 11-40%
9 Less than 11%

Recovery (DRR)
NOTE: Scores are taken after 10 days following soaking rain or watering. Indicate the degree of stress before recovery.

SCALE (plants recovered)

1 90-100%
3 70-89%
5 40-69%
7 20-39%
9 0-19%

DEEPWATER

85
Elongation (Elon)

NOTE: Some rice can elongate and grow in areas annually flooded to varying depths. The scale is based on the performance of check varieties. Specify water depth under which the data was

At growth stage: 5-6

Elongation in deepwater

Scale	Description	Biological check
1	Best elongation response	Best local floating variety (i.e. Leb Mue Nahng 111)
3	Response better than that of elongating semidwarf, but not as good as that of the best local floating variety	
5	Response similar to that of Elongating semidwarf	Elongating semidwarf (i.e. IR11141-6-1-4)
7	Response better than that of the nonelongating semidwarf, but not as good as that of elongating semidwarf	
9	Poorest elongation, or none	Non-elongating semidwarf (i.e. IR42)

86

Submergence Tolerance (Sub)

Greenhouse screening

For greenhouse screening count or % survival (S) of test entries and resistant control entry such as FR13A. Compute for % comparative survival value as follows:

$$\frac{\text{\% S of entry}}{\text{\% S of control}} \times 100$$

At growth stage: 2

Field evaluation

The period of submergence varies and often is not under full experimental control. Record actual % of plants that survived.

SCALE (% comparative survival)

1 100
3 95-99
5 75-94
7 50-74
9 0-49

87

Kneeing Ability (KnA)

SCALE

1 Tiller angle greater than 45° for 50% of tillers
3 Tiller angle greater than 45° for 25% of tillers
5 Maximum tiller angle is less than 45° for 50% of tillers (Tiller angle greater than 45° for 1 or 2 tillers)
7 Maximum tiller angle is less than 45° for 50% of tillers (Tiller angle greater than 45° for 1 or 2 tillers)
9 No kneeing

MORPHOLOGICAL CHARACTERS

90

Variety Group

Code

1 Indica
2 Temperate japonica (equivalent to old japonica)
3 Tropical japonica (equivalent to old javanica)
4 Aus
5 Aromatic (basmati-type)
6 Deepwater
7 Indica-Aus intermediates
8 Japonica intermediates
9 Japonica-aromatic intermediates
10 Other intermediates

[7]*The methodology described in this section is based on Descriptors of Rice Oryza sativa L. (IBPGR-IRRI Advisory Committee, IRRI, 1980). Presence of different traits should be recorded as "x" indicating mixture.*

91

Seedling Height (SH)
NOTE: Enter actual measurements of 10 seedlings in centimeters, from the base of the shoot to the tip of the tallest leaf blade.

At growth stage: 2-3 (5-leaf stage)

92

Leaf Length (LL)
NOTE: Enter actual measurements, in centimeters of the leaf just below the flag leaf.

At growth stage: 6

93

Leaf Width (LW)
NOTE: Enter actual measurements, in centimeters of the widest portion of the leaf blade just below the flag leaf.

At growth stage: 6

94

Leaf Blade Pubescence (LBP)
Methodology: Aside from ocular inspection, rub fingers from the tip down on the leaf surface. Presence of hairs on the blade surface are classified.

Code
1 Glabrous
2 Intermediate
3 Pubescent

At growth stage: 5-6

95

Leaf Blade Color (LBC)
At growth stage: 4-6

Code
1 Light green
2 Green
3 Dark Green
4 Purple tips
5 Purple margins
6 Purple blotch (purple mixed with green)
7 Purple

96

Basal Leaf Sheath Color (BLSC)

At growth stage: 3-5 early to late vegetative stage.

Code

1 Green
2 Purple lines
3 Light purple
4 Purple

97

Leaf Angle/Attitude (LA)

NOTE: The angle of openness of the blade tip is measured against the culm of the leaf below the flag leaf.

At growth stage: 4-5

Code

1 Erect
5 Horizontal
9 Drooping

98

Flag Leaf Angle (FLA)

NOTE: Leaf angle is measured near the collar as the angle of attachment between the flag leaf blade and the main panicle axis.

Sample size = 5

At growth stage: 4-5

Code

1 Erect
3 Intermediate
5 Horizontal
7 Descending

99

Ligule Length (LgL)

NOTE: Enter actual measurement of ligules measured in millimeters from the base of the collar to the tip.

Sample size = 5

At growth stage: 4-5

100

Ligule Color (LgC)

At growth stage: 4-5

Code

0 Absent (liguleless)
1 White
2 Purple lines
3 Purple

101

Ligule Shape (LS)

At growth stage: 3-4

Code

0 Absent
1 Acute to acuminate
2 Cleft
3 Truncate

102

Collar Color (CC)

At growth stage: 4-5

Code
- 0 Absent (collarless)
- 1 Light Green
- 2 Green
- 3 Purple

103

Auricle Color (AC)

At growth stage: 4-5

Code
- 0 Absent (no auricles)
- 1 Light green
- 2 Purple

104

Culm Length (CL)

NOTE: Measure from soil surface to panicle base in centimeters.

Sample size = 5

At growth stage: 7-9

105

Culm Number (CmN)

NOTE: Enter actual count of the total number of tillers on 5 plants after full heading. Specify if per plant, hill or area.

At growth stage: 6-9

106

Culm Angle (CmA)

At growth stage: 7-9

Code
- 1 Erect (<30°)
- 3 Intermediate (~45°)
- 5 Open (~60°)
- 7 Spreading (>60°)
- 9 Procumbent (the culm or its lower part rests on ground surface)

107

Diameter of Basal Internode (DBI)

NOTE: Enter actual measurements in millimeters from the outer diameter of the culms at the basal portion of the main culm.

Sample size = 3

At growth stage: 7-9

108
Culm Internode Color (CmIC)
NOTE: The outer surface of the internodes on the culm is recorded.

At growth stage: 7-9

Code
1 Green
2 Light gold
3 Purple lines
4 Purple

109
Panicle Length (PnL)
NOTE: Enter actual measurements in centimeters from panicle base to tip.

At growth stage: 8

110
Panicle Type (PnT)
NOTE: Panicles are classified according to their mode of branching, angle of primary branches, and spikelet density.

At growth stage: 8

Code
1 Compact
2 Intermediate
3 Open

111
Secondary Branching of Panicles (PnBr)
At growth stage: 8

Code
0 Absent
1 Light
2 Heavy
3 Clustered

112
Panicle Axis (PnA)
At growth stage: 7-9

Code
1 Straight
2 Droopy

113
Awning (An)
At growth stage: 7-9

Code
0 Absent
1 Short and partly awned
5 Short and fully awned
7 Long and partly awned
9 Long and fully awned

114
Awn Color (AnC)
At growth stage: 6

Code
0 Awnless
1 Straw
2 Gold
3 Brown (tawny)
4 Red
5 Purple
6 Black

115
Apiculus Color (ApC)
At growth stage: 7-9

Code
1 White
2 Straw
3 Brown (tawny)
4 Red
5 Red apex
6 Purple
7 Purple apex

116
Stigma Color (SgC)
NOTE: Stigma color is determined from blooming spikelets (between 9 a.m. to 2 p.m.) with the aid of a hand lens.

At growth stage: 6

Code
1 White
2 Light green
3 Yellow
4 Light purple
5 Purple

117
Lemma and Palea Color (LmPC)
At growth stage: 9

Code
0 Straw
1 Gold and gold furrows on straw background
2 Brown spots on straw
3 Brown furrows on straw
4 Brown (tawny)
5 Reddish to light purple
6 Purple spots on straw
7 Purple furrows on straw
8 Purple
9 Black
10 White

118
Lemma and Palea Pubescence (LmPb)
At growth stage: 7-9

Code
1 Glabrous
2 Hairs on lemma keel
3 Hairs on upper portion
4 Short hairs
5 Long hairs (velvety)

119
Sterile Lemma Color (SLmc)
At growth stage: 9

Code
1 Straw (yellow)
2 Gold
3 Red
4 Purple

120
Sterile Lemma Length (SLmL)
NOTE: Measurement is made on each of the two sterile lemmas. The classification is based on 5-grain sample.

At growth stage: 9

Code
0 Absent
1 Short (not longer than 1.5mm)
3 Medium (1.6-2.5 mm)
5 Long (longer than 2.5 mm but shorter than the lemma)
7 Extra long (equal to or longer than the lemma)
9 Asymmetrical

121

Grain Length (GrL)

NOTE: Enter the mean length in millimeters as the distance from the base of the lowermost sterile lemma to the tip (apiculus) of the fertile lemma or palea. In the case of awned varieties, the grain is measured to a point comparable to the tip of the apiculus.

Sample size = 10

At growth stage: 9

122

Grain Width (GrW)

NOTE: Enter the actual measurement of width in millimeters as the distance across the fertile lemma and the palea at the widest point.

Sample size = 10

At growth stage: 9

GRAIN QUALITY

123

Endosperm Type (End)

NOTE: Classification is based on the staining reaction of the cut surface of endosperm to weak KI-I solution. Waxy starch stains brown; non-waxy, blue black.

CODE

1 Non-glutinous (non-waxy)
2 Glutinous (waxy)
3 Indeterminate

Sample size: 5

At growth stage: 9

124

Chalkiness of Endosperm (Clk)

NOTE: Evaluate a representative milled sample for the degree (extent) of chalkiness that will best describe the sample with respect to (a) white belly, (b) white center, (c) white back.

SCALE (% of kernel area)

0 None
1 Small (less than 10%)
5 Medium (11% to 20%)
9 Large (more than 20%)

At growth stage: 9

125

Brown Rice Length (Len)

At growth stage: 9 (after dehulling, before milling)

SCALE (Length)

1 Extra long (more than 7.5 mm)

3 Long (6.6 to 7.5 mm)

5 Medium (5.51 to 6.6 mm)

7 Short (5.5mm or less)

126

Brown Rice Shape (BrS)

(length-width ratio)

NOTE: Kernel shape can be easily estimated by this method (avoid broken samples).

At growth stage: 9 (after harvesting, cleaning and dehulling)

Scale	Shape	Ratio
1	Slender	Over 3.0
3	Medium	2.1 to 3.0
5	Bold	1.1 to 2.0
9	Round	Less than 1.1

127

100-grain Weight (GW)

NOTE: Enter measurements in grams of 100 well-developed whole grains, dried to 13% moisture content, weighed on a precision balance.

At growth stage: 9

128

Seed Coat (bran) Color (SCC)

At growth stage: 9

Code

1 White

2 Light brown

3 Speckled brown

4 Brown

5 Red

6 Variable purple

7 Purple

129

Scent (Sct)

At growth stage: 6-9

Code (At flowering stage or at maturity - by cooking test)

0 Unscented

1 Lightly scented

2 Scented

130

Amylose Content of the Grain (Amy)

NOTE: Use standard laboratory procedure to determine amylose content. Give amylose content in actual percentage.

131

Alkali Digestion (AlkD)

(as an indication of gelatinization temperature)

NOTE: Place six milled-rice kernels in 10 ml 1.7% KOH in a shallow container and arrange them so that they do not touch. Let it stand for 23 hours at 30°C and score for spreading.

At growth stage: 9 (after milling)

Code	Alkali Digestion	Gelatinization Temperature
1-Not affected but chalky 2-Swollen	Low	High
3-Swollen with collar incomplete or narrow	Low or intermediate	High or intermediate
4-Swollen with collar complete and wide 5-Split or segmented with collar complete and wide	Intermediate	Intermediate
6-Dispersed merging with collar 7-Completely dispersed and cleared	High	Low

132

Gel Consistency (GelC)

NOTE: Use standard laboratory procedures to determine the gel consistency.

At growth stage: 9 (after milling)

	Scale (mm)	Gel Consistency type
1	80-100	Soft
3	61-80	Soft
5	41-60	Medium
7	36-40	Hard
9	Less than 35	Hard

133

Brown Rice Protein (Prt)

Percent of total brown rice weight (at 14% moisture) to one decimal place.

At growth stage: 9 (after dehulling)

UPOV DUST ASTERISKED CHARACTERS

The UPOV Test Guidelines for Rice (TGR) is being used by UPOV members in conducting Distinctness, Uniformity and Stability Test (DUST), whose results serve as the basis for granting plant variety protection. Distinctness is one of the requirements for granting protection to a new variety.

Of the 65 UPOV characters, 17 are important for the international harmonization of variety descriptions (asterisked characters) and should always be examined for DUS Testing.

The recommended method of observing the characters is indicated by the following keys:

MG	single measurement of a group of plants or parts of plants
MS	measurement of a number of individual plants or parts of plants
VG	visual assessment by a single observation of a group of plants or parts of plants
VS	visual assessment by observation of individual plants or parts of plants

Note: The number that appears before each trait is the UPOV DUST Guideline characteristic number.

9

Leaf anthocyanin coloration of auricles (VS)

Measured at the beginning of booting stage

SCALE

1 absent

9 present

15

Flag leaf: attitude of blade (VG)

(early observation)

Measured at the beginning of anthesis

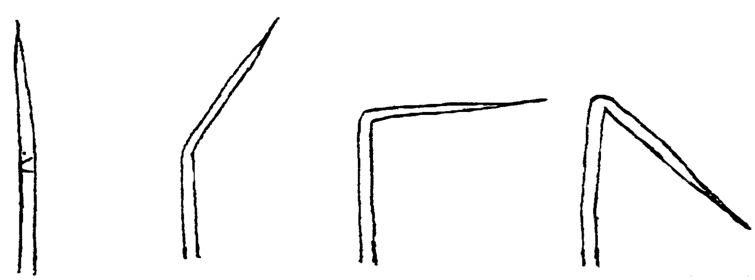
SCALE

1 erect

3 semi-erect

5 horizontal

7 recurved



1	3	5	7
erect	semi-erect	horizontal	recurved

16

Flag leaf: attitude of blade (VG)

(late observation)

Measured at the stage wherein terminal spikelets have already ripened.

SCALE

1 erect

3 semi-erect

5 horizontal

7 recurved

19

Time of heading (number of days from seeding to 50% flowering) (VG)

Measured when 50% of inflorescence have already emerged.

SCALE

1 very early

3 early

5 medium

7 late

23

Lemma: anthocyanin coloration of apex (VS)

(early observation)

Measured when anthesis is halfway through.

SCALE

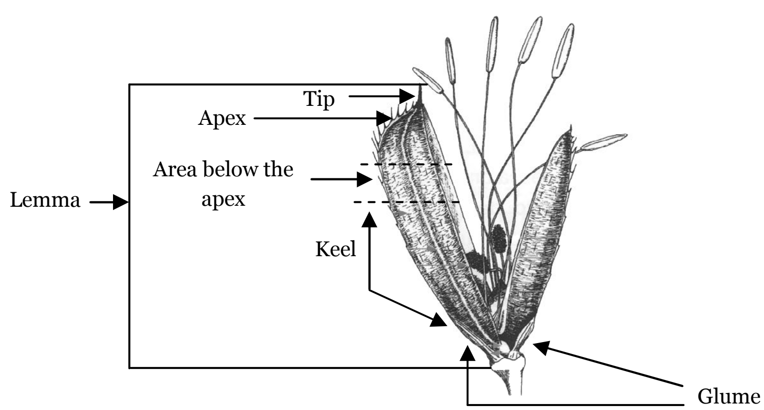
1 absent or very weak

3 weak

5 medium

7 strong

9 very strong



24

Spikelet: color of stigma (VS)

Measured when anthesis is halfway through.

SCALE

1 white
2 light green
3 yellow
4 light purple
5 purple

26

Non prostrate varieties only: Stem length (excluding panicle) (VS)

Measured at the beginning of milk development. Measure (in cm) from ground level to base of panicle.

SCALE

1 very short
3 short
5 medium
7 long
9 very long

27

Stem: anthocyanin coloration of nodes (VS)

Measured at the beginning of milk development.

SCALE

1 absent
9 present

30

Panicle: length of main axis (MS)

Measured during the beginning of milk development to ripening stage. Measure form the base up to the tip of the panicle.

SCALE

3 short
5 medium
7 long

34

Panicle: distribution of awns (VS)

Measured during the beginning of milk development to ripening stage.

SCALE

1 tip only
3 upper half only
5 whole length

36

Spikelet: pubescence of lemma (VS)

Measured at the beginning of anthesis to dough development.

SCALE

1 absent or very weak
3 weak
5 medium
7 strong
9 very strong

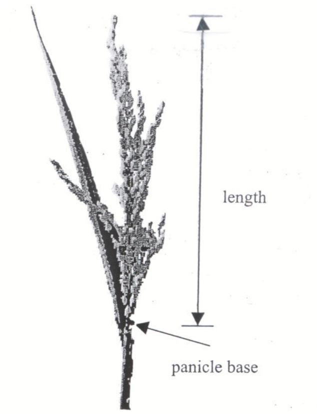
39

Panicle: curvature of main axis (VG)

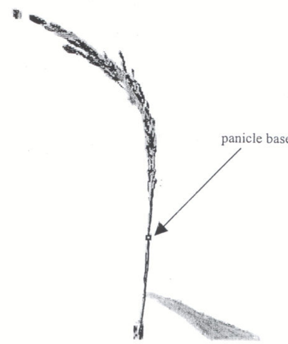
Measured at the stage wherein terminal spikelets have already ripened.

SCALE

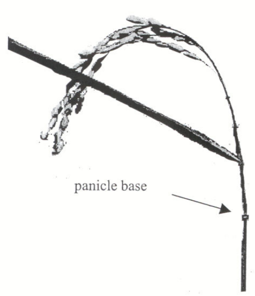
1 upright
3 semi-upright
5 slightly drooping
7 strongly drooping



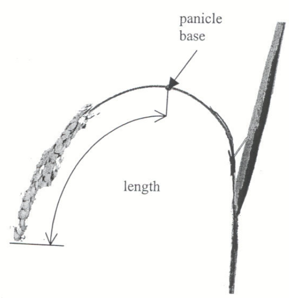
1
upright



3
semi-upright



5
slightly drooping



7
strongly drooping

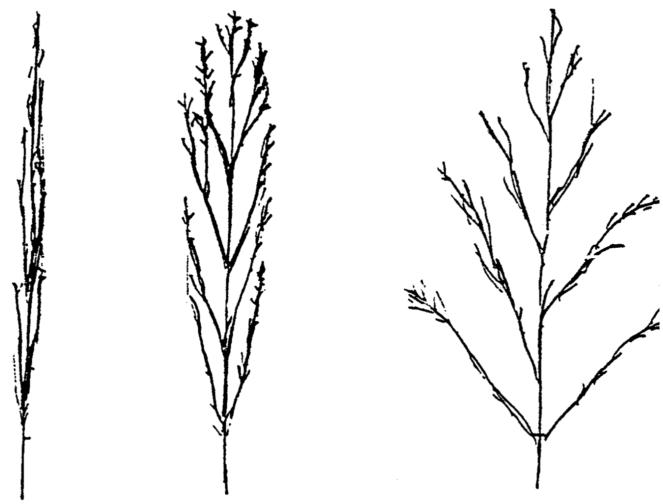
42

Panicle: attitude of branches (VS)

Measured at stage wherein terminal spikelets have already ripened. Samples are to be observed on a flat, horizontal surface.

SCALE

1 erect
3 semi-erect
5 spreading



1	3	5
erect	semi-erect	spreading

58

Decorticated grain: length (MS)

Measured at ripening, when the caryopsis is hard (can no longer be dented by thumbnail). Measurements (in mm) should be done on dehulled grains using a caliper. Record measurement up to two decimal places.

SCALE

3 short
5 medium
7 long

60

Decorticated grain: shape (VS)

Measured at ripening, when the caryopsis is hard (can no longer be dented by thumbnail). Length and width of dehulled or decorticated unpolished grains are measured (in mm) using a caliper and the ratio of the length over the width is computed and is categorized as round, semi-round; half-spindle; spindle; long spindle or mixture.

SCALE

1 round
2 semi-round
3 half spindle-shaped
4 spindle-shaped
5 long spindle-shaped

61

Decorticated grain: color (VS)

Measured at ripening, when the caryopsis is hard (can no longer be dented by thumbnail). Observe the color of dehulled grains.

SCALE

1 white
2 light brown
3 variegated brown
4 dark brown
5 light red
6 red
7 variegated purple
8 purple
9 dark purple/black

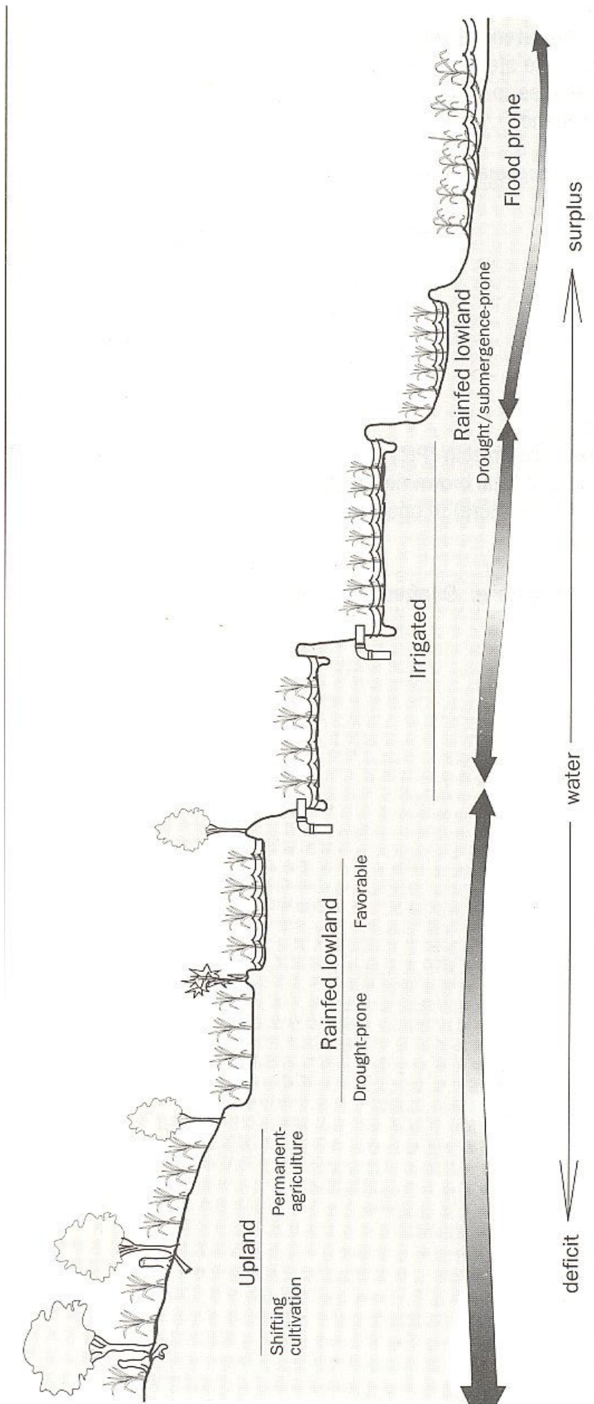
65

Decorticated grain: aroma (MG)

Measured at ripening, when the caryopsis is hard (can no longer be dented by thumbnail). The main component of aroma in rice is the 2-acetyl-1pirroline (AcPy). To vaporize this chemical, 10 ml of 1.7% solution of KOH should be added to 2 g of decorticated grains. The aroma, which is similar to that in popcorn, is released within 10 minutes. The level of expression is determined by comparison with other varieties being evaluated.

SCALE

1 absent or vry weak
2 weak
3 strong



Upland
Shifting cultivation
Permanent-agriculture
Rainfed lowland
Drought-prone
Favorable
Irrigated
Rainfed lowland
Drought/submergence-prone
Flood prone
deficit
water
surplus

Upland	Rainfed lowland	Irrigated	Flood-prone
Level to steeply sloping fields; rarely flooded, aerobic soil; rice directly seeded on plowed dry soil or dibbled in wet non-puddled soil	Level to slightly sloping, bunded fields; noncontinuous flooding of variable depth and duration; water level not exceeding 50 cm for more than 10 consecutive days; rice transplanted in puddle soil or direct seeded on puddled or plowed dry soil; alternating aerobic to anaerobic soil of variable frequency and duration.	Leveled, bunded fields with water control; rice transplanted or direct seeded on puddled soil; shallow, flooded with anaerobic soil during crop growth.	Level to slightly sloping or depressed fields; more than 10 consecutive days of medium to very deep flooding (50 to more than 300 cm) during crop growth; rice transplanted in puddled soil or direct seeded on plowed dry soil; aerobic to anaerobic soil; soil salinity or toxicity in tidal areas .

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