Descriptors for

Walnut

(Juglans spp.)
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Walnut

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# CONTENTS

PREFACE \hspace{5em} v

DEFINITIONS AND USE OF THE DESCRIPTORS \hspace{1em} 1

PASSPORT
1. Accession descriptors \hspace{1em} 5
2. Collecting descriptors \hspace{2em} 7

MANAGEMENT
3. Orchard management descriptors \hspace{1em} 12

ENVIRONMENT AND SITE
4. Site descriptors \hspace{2em} 14
5. Environment descriptors \hspace{2em} 16

CHARACTERIZATION
6. Plant descriptors \hspace{2em} 28

EVALUATION
7. Plant descriptors \hspace{2em} 41
8. Abiotic stress susceptibility \hspace{2em} 41
9. Biotic stress susceptibility \hspace{2em} 42
10. Biochemical composition \hspace{2em} 47
11. Cytological characters and identified genes \hspace{2em} 47

CONTRIBUTORS \hspace{5em} 48

REFERENCES \hspace{5em} 50

ACKNOWLEDGEMENTS \hspace{5em} 51
PREFACE

Descriptors for walnut (Juglans spp.) was developed by G.H. McGranahan, E. Germain, D.E. Ramos and K. Rigert with assistance from C.A. Leslie, C. Ingels and R. Gulcan and prepared in the IPGRI standard format. A draft version was subsequently sent to a number of experts for their comments and amendments. A full list of the names and addresses of those involved is given in ‘Contributors’.

IPGRI encourages the collection of data for descriptors on the first four categories of this list: Passport, Management, Environment and site, and Characterization; and endorses data in these categories as those that should be available for any one accession. However, the number of each of the site and environment descriptor types used will depend on the crop and their importance to the crop’s description. Descriptors listed under Evaluation allow for a more detailed description of the accession’s characters, but generally require replicated site and time trials.

Although the suggested coding should not be regarded as the definitive scheme, this format has the full backing of IPGRI and is promoted worldwide. This descriptor list is intended to be comprehensive for the descriptors that it contains. This approach assists with the standardization of descriptor definitions. IPGRI does not, however assume that each curator will characterize accessions of their collection utilizing all descriptors given. Those descriptors known to be highly discriminating descriptors are given in bold and marked with an asterisk. Descriptors should be used when they are useful to the curator for the management and maintenance of the collection and/or to the users of the plant genetic resources.

This descriptor list provides an international format and thereby produces a universally understood ‘language’ for plant genetic resources data. The adoption of this scheme for data encoding, or at least the production of a transformation method to convert other schemes to the IPGRI format, will produce a rapid, reliable, and efficient means for information storage, retrieval, and communication, and will assist with the utilization of germplasm. It is recommended, therefore, that information should be produced by closely following the descriptor list with regard to: ordering and numbering descriptors; using the descriptors specified; and using the descriptor states recommended.

Any suggestions on this descriptor list will be appreciated by IPGRI.
DEFINITIONS AND USE OF THE DESCRIPTORS

IPGRI now uses the following definitions for genetic resources data management:

(i) **Passport** descriptors: These provide the basic information used for the general management of the accession (including the registration at the genebank and other identification information) and describe parameters that should be observed when the accession is originally collected

(ii) **Management** descriptors: These provide the basis for the management of accessions in the genebank and assist with their multiplication and regeneration

(iii) **Environment and site** descriptors: These describe the environmental and site specific parameters that are important when characterization and evaluation trials are held. They can be important for the interpretation of the results of these trials. Germplasm collecting site descriptors are also included here

(iv) **Characterization** descriptors: These enable an easy and quick discrimination between phenotypes. They are generally highly heritable, can be easily seen by the eye and are equally expressed in all environments. In addition, these may include a limited number of additional traits thought desirable by a consensus of users of the particular crop

(v) **Evaluation** descriptors: Many descriptors in this category are susceptible to environmental differences but are generally useful in crop improvement. In addition, others may involve biochemical or molecular characterization. They include yield, agronomic performance, stress susceptibilities and biochemical and cytological traits

Characterization will normally be the responsibility of genebank curators, while evaluation will typically be carried out elsewhere (possibly by a multidisciplinary team of scientists). The evaluation data should be fed back to the genebank which will maintain a data file.

Minimum descriptors highly discriminating are in bold and marked with an asterisk.

The following internationally accepted norms for the scoring, coding, and recording of descriptor states should be followed as indicated below:

(a) the Système International d’Unités (SI system) is used. The units to be applied are given in square brackets following the descriptor name;

(b) standard colour charts, e.g. Royal Horticultural Society Colour Chart, Methuen Handbook of Colour, or Munsell Color Chart for Plant Tissues, are strongly recommended for all ungraded colour characters (the precise chart used should be specified in the section where it is used);
(c) many quantitative characters which are continuously variable are recorded on a 1-9 scale, where:

1  Very low  
2  Very low to low  
3  Low  
4  Low to intermediate  
5  Intermediate  
6  Intermediate to high  
7  High  
8  High to very high  
9  Very high

is the expression of a character. The authors of this list have sometimes described only a selection of the states, e.g. 3, 5, and 7 for such descriptors. Where this has occurred, the full range of codes is available for use by extension of the codes given or by interpolation between them - e.g. in Section 10 (Biotic stress susceptibility) 1 = very low susceptibility and 9 = very high susceptibility;

(d) (i) when a descriptor is scored using a 1-9 scale, such as in (c), '0' would be scored when the character is not expressed; and (ii) when a descriptor is inapplicable. In the following example, '0' will be recorded if an accession does not have a central leaf lobe:

Shape of central leaf lobe

3  Toothed  
5  Elliptic  
7  Linear

(e) absence/presence of characters are scored as in the following example:

Presence/absence of terminal leaflet

0  Absent  
1 (or +)  Present

(f) blanks are used for information not yet available;

(g) for accessions which are not generally uniform for a descriptor (e.g. mixed collection, genetic segregation), the mean and standard deviation could be reported where the descriptor is continuous, or where the descriptor is discontinuous up to three codes in the order of frequency could be recorded; or other publicized methods can be utilized, such as van Hintum (1993), that clearly states a method for scoring heterogeneous accessions;
(h) dates should be expressed numerically in the format DDMMYYYY, where

<table>
<thead>
<tr>
<th>DD</th>
<th>2 digits to represent the day</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>2 digits to represent the month</td>
</tr>
<tr>
<td>YYYY</td>
<td>4 digits to represent the year</td>
</tr>
</tbody>
</table>
PASSPORT

1. ACCESSION DESCRIPTORS

1.1 ACCESSION NUMBER

This number serves as a unique identifier for accessions and is assigned when an accession is entered into the collection. Once assigned this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number is still not available for re-use. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession comes from the genebank at Bari, Italy; CGN indicates one accession comes from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system)

1.1.1 Local plant number

This identifies a single plant within a population of plants having the same accession number. It may be any combination of plot identity, row number, or tree position within the row

1.2 DONOR NAME

Name of institution or individual responsible for donating the germplasm

1.3 DONOR NUMBER

Number assigned to accession by the donor

1.4 COUNTRY WHERE MAINTAINED

Use the three letter abbreviations from the International Standard (ISO) Codes for the representation of names of countries, No. 3166, 1988. Copies of these are available from Beuth Verlag GmbH, Burggrafenstrasse 6, D-10772 Berlin 30, Germany; Tel. 30-2601-2320; Fax 30-2601-1231, Tlx. 1-84-273-din-d

1.5 SITE WHERE MAINTAINED

Name of institution in which collection is maintained
6 DESCRIPTORS FOR WALNUT

1.6 CURATOR’S NAME

Name of officer responsible for maintaining the genetic resources material held at the site specified in the descriptor SITE WHERE MAINTAINED, 1.10

1.7 OTHER NUMBER(S) ASSOCIATED WITH THE ACCESSION

Any other identification number known to exist in other collections for this accession, e.g. USDA Plant Inventory number (not COLLECTING NUMBER, see 2.3). Other numbers can be added as 1.7.3, etc.

1.7.1 Other number 1

1.7.2 Other number 2

1.8 SCIENTIFIC NAME

1.8.1 Genus

1.8.2 Species

For interspecific hybrids, the species should be designated as 'hybrid' and the parentage indicated in the descriptor PEDIGREE, 1.9

1.8.3 Subspecies

1.9 PEDIGREE

Parentage or nomenclature and designations assigned to breeders’ material

1.9.1 Female parent

1.9.2 Male parent

1.10 CULTIVAR NAME

Either a registered or other formal cultivar designation given to the accession

1.10.1 Cultivar name

1.10.2 Year of release of the cultivar/year of registration

1.10.3 Other designations assigned to breeder’s material
1.10.4 Literature citations

1.11 ACQUISITION DATE

Date on which the accession entered the collection (in the format DDMMYYYY)

1.12 TYPE OF MAINTENANCE

1. Vegetative in the field
2. Vegetative in tissue culture
3. Pollen
4. Seed
5. More than one type, specify in the descriptor NOTES, 1.14

1.13 ACCESSION SIZE

Number of trees of an accession or approximate number of seeds of an accession in the genebank

1.14 NOTES

Specify here any additional information

2. COLLECTING DESCRIPTORS

2.1 COLLECTING INSTITUTE(S)

Institute(s) and people collecting/sponsoring the sample collection

2.2 SITE NUMBER

Number assigned to the physical site by the collector

2.3 COLLECTING NUMBER

Original number assigned by the collector(s) of the sample, normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identifying duplicates held in different collections and should be unique and always accompany subsamples wherever they are sent

2.4 COLLECTING DATE OF ORIGINAL SAMPLE

(in the format DDMMYYYY)
2.5 COUNTRY OF COLLECTING

(See instructions in the descriptor COUNTRY WHERE MAINTAINED, 1.4)

2.6 PROVINCE/STATE

Name of the primary administrative subdivision of the country in which the sample was collected

2.7 DEPARTMENT/COUNTY

Name of the secondary administrative subdivision (within a Province/State) of the country in which the sample was collected

2.8 LOCATION OF COLLECTING SITE

Distance in kilometers and direction from the nearest town, village or map grid reference point (e.g. CURITIBA 7S means 7 km south of Curitiba) and the name of the farm or other location and the farmer or other individual on whose land the sample was collected

2.9 LATITUDE OF COLLECTING SITE

Degrees and minutes followed by N (North) or S (South) (e.g. 01030S)

2.10 LONGITUDE OF COLLECTING SITE

Degrees and minutes followed by E (East) or W (West) (e.g. 07625W)

2.11 ELEVATION OF COLLECTING SITE [m]

Altitude above sea level

2.12 COLLECTING SOURCE

1 Wild habitat
2 Farmer’s field or orchard
3 Farm store (road-side stand)
4 Backyard
5 Village market
6 Commercial market
7 Research organization
8 Other (specify in the descriptor COLLECTOR’S NOTES, 2.25)
2.13 TYPE OF SAMPLE

Form of sample collected. If different types of material were collected from the same source, each sample type should be designated with a unique collecting number and a corresponding unique accession number

1  Vegetative
2  Seed
3  Pollen
4  Tissue culture

2.14 STATUS OF SAMPLE

1  Wild
2  Weedy
3  Landrace/primitive cultivar
4  Advanced cultivar
5  Breeding line/genetic stock
6  Other (specify in the descriptor COLLECTOR’S NOTES, 2.25)

2.15 USES OF THE ACCESSION

1  Edible nut
2  Edible nut for the in-shell market
3  Edible nut for the shelled market
4  Medicinal
5  Ornamental
6  Forage
7  Wood/timber
8  Other (specify in the descriptor COLLECTOR’S NOTES, 2.25)

2.16 ETHNIC GROUP

Name of the tribe of the farmer donating the sample or of the people living in the area of collecting

2.17 LOCAL/VERNACULAR NAME

Name given by farmer to crop and cultivar/landrace. State language and dialect if the ethnic group is not provided
2.18 COLLECTING SITE POPULATION STRUCTURE

2.18.1 Number of trees sampled

2.18.2 Frequency of accession at collecting site

1 Rare
3 Occasional
5 Frequent
7 Abundant
9 Very abundant

2.18.3 Associated flora

Other dominant species, found at and around the collecting site

2.19 HERBARIUM SPECIMEN

Was a herbarium specimen collected? If so, provide an identification number in the descriptor COLLECTOR’S NOTES, 2.25

0 No
+ Yes

2.20 PHOTOGRAPH

Were photograph(s) taken of the accession or habitat at the time of collecting? If so, provide an identification number(s) in the descriptor COLLECTOR’S NOTES, 2.25

0 No
+ Yes

2.21 COLLECTING SOURCE ENVIRONMENT

Descriptor for Collecting Source Environment (2.21.1 - 2.21.26) are given in Section 5. These are numbered in Section 5 in the following manner 5.1.1 - 5.1.26, but should be used for this section. This has been done in order to reduce the repetition of descriptors in Sections 2 and 4
2.22 CULTURAL METHODS

2.22.1 Cropping system

1. Monoculture
2. Mixed with cereals (specify crop)
3. Mixed with legumes (specify crop)
4. Mixed with fruits or nuts (specify crop)
5. Mixed with other (specify crop)

2.22.2 Propagation method

Method used to produce trees

1. Seed
2. Grafted (note species and/or cultivar used as rootstock)
3. Rooted cutting
4. Tissue culture

2.22.3 Irrigation

1. Rainfed
2. Irrigated
3. Flooded
4. River banks
5. Other (specify in the descriptor COLLECTOR’S NOTES, 2.25)

2.23 PLANT POPULATION DENSITY

3. Low
5. Intermediate
7. High

2.24 PREVAILING STRESSES

Information on associated biotic and abiotic stresses. Indicate if disease indexing was done at the time of collecting

2.25 COLLECTOR’S NOTES

Additional information recorded by the collector or any specific information on any state in any of the above descriptors
MANAGEMENT

3. ORCHARD MANAGEMENT DESCRIPTORS

3.1 ACCESSION NUMBER

3.1.1 Local plant number

This identifies a single plant within a population of plants having the same accession number. It may be any combination of plot identity, row number, or tree position within the row.

3.2 ACCESSION ORCHARD LOCATION

Enter separate block designations, row numbers, and tree numbers within the row for each duplicate tree of each accession if each tree is not identified with a unique LOCAL PLANT NUMBER, 3.1.1.

3.2.1 Block designation

3.2.2 Row number

3.2.3 Tree number within the row

3.3 PROPAGATION METHOD

Method used to produce trees

1. Seed
2. Grafted
3. Rooted cutting
4. Tissue culture

3.4 ROOTSTOCK

Note rootstock used for grafted trees. All J. regia, including seedling trees, should be grafted onto a Blackline hypersensitive rootstock prior to establishment in the field to prevent the introduction of new strains of Cherry leafroll virus into the collecting
3.5 PLANTING YEAR

Specify year tree was planted in the orchard

3.6 REGENERATION YEAR

Year (estimate) tree should be repropagated for regeneration

3.7 DATE OF LAST REGENERATION OR MULTIPLICATION

Primary method of regeneration is repropagation of clonal material (in the format DDMMYYYYY)

3.8 NUMBER OF TIMES ACCESSION REGENERATED

Since the date of acquisition
ENVIRONMENT AND SITE

4. SITE DESCRIPTORS

4.1 COUNTRY OF CHARACTERIZATION AND/OR EVALUATION

(See instructions in the descriptor COUNTRY WHERE MAINTAINED, 1.4)

4.2 SITE (RESEARCH INSTITUTE)

4.2.1 Latitude

Degrees and minutes followed by N (North) or S (South) (e.g. 01030S)

4.2.2 Longitude

Degrees and minutes followed by E (East) or W (West) (e.g. 07625W)

4.2.3 Elevation [m]

Altitude above sea level

4.2.4 Name of farm or institute

4.3 EVALUATOR’S NAME AND ADDRESS

4.4 SOWING OR GRAFTING DATE

(in the format DDMMYYYY)

4.5 EVALUATION ENVIRONMENT

Environment in which characterization/evaluation was carried out

1 Field
2 Screenhouse
3 Glasshouse
4 Laboratory
5 Other (specify in the descriptor NOTES, 4.15)
4.6 CONDITION OF TREE

Choose the one condition that best fits the accession at the time of characterization/evaluation

1 Dying
2 Old - declining
3 Mature - diseased
4 Mature - non-vigorous
5 Mature - vigorous
6 Young (not yet bearing)
7 Healthy - cropping poorly
8 Healthy - cropping well

4.7 PERCENTAGE SEED GERMINATION [%]

Specify number of days over which germination is measured

4.8 PERCENTAGE FIELD ESTABLISHMENT [%]

4.9 NUMBER OF DAYS TO 50% FIELD EMERGENCE

4.10 SOWING SITE IN FIELD

Give block, strip and/or row/plot numbers as applicable

4.11 TREE SPACING

4.11.1 Distance between trees in a row [m]

4.11.2 Distance between rows [m]

4.12 FERTILIZER

(Specify names, doses, frequency of each, and method of application)

4.13 PLANT PROTECTION

(Specify pesticides used, doses, frequency of each, and method of application)
4.14 ENVIRONMENTAL CHARACTERISTICS OF SITE

Descriptors for the Environmental characteristics of site (4.14.1 - 4.14.26) are given in Section 5. These are numbered in Section 5 in the following manner 5.1.1 - 5.1.26, but should be used for this section. This has been done in order to reduce the repetition of descriptors in Sections 2 and 4.

4.15 NOTES

Note any other site-specific information.

5. ENVIRONMENT DESCRIPTORS

5.1 COLLECTING AND/OR CHARACTERIZATION/EVALUATION SITE ENVIRONMENT

5.1.1 Topography

This refers to the differences in elevation of the land surface on a broad scale.

The reference is:
FAO, 1990. In: Guidelines For Soil Profile Description, 3rd Edition (Revised), Rome, p.70

1 Flat 0 - 0.5%
2 Almost flat 0.6 - 2.9%
3 Gently undulating 3 - 5.9%
4 Undulating 6 - 10.9%
5 Rolling 11 - 15.9%
6 Hilly 16 - 30%
7 Steeply dissected >30%, moderate range of elevation
8 Mountainous >30%, great range of elevation (>300 m)
9 Other (specify in the appropriate Section's NOTES)

5.1.2 Higher level landform (General physiographic features)

The landform refers to the shape of the land surface in the area in which the collecting site is located (Adapted from FAO, 1990)

1 Plain 5 Upland
2 Basin 6 Hill
3 Valley 7 Mountain
4 Plateau
5.1.3 **Second level landform** (Adapted from *FAO, 1990*)

1. Alluvial plain  
   (A plain formed from the deposition of alluvium usually adjacent to a river that periodically overflows (aggraded valley plain, river plain, wash plain, waste plain))

2. Coastal plain

3. Lacustrine plain

4. Glacial plain

5. Peneplain  
   (Base-leveled plain) (Any land surface changed almost to a plain by subaerial erosion)

6. Pediment  
   (A piedmont slope formed from a combination of processes which are mainly erosional; the surface is chiefly bare rock but may have a covering veneer of alluvium or gravel (conoplain, piedmont interstream flat))

7. Volcano

8. Dunefield

9. Delta

10. Tidal flat  
    (A marshy, sandy, or muddy nearly horizontal coastal flatland which is alternately covered and exposed as the tide rises and falls)

11. Playa  
    (A small, generally sandy land area at the mouth of a stream or along the shore of a bay)

12. Cay  
    (A flat coral island)

13. Other  
    (Specify in the appropriate Section’s NOTES)

5.1.4 **Land element and position**

Description of the geomorphology of the immediate surroundings of the collecting site (Adapted from *FAO, 1990*). See Fig. 1

1. Plain level  
   12. Caldera  
   23. Beach

2. Escarpment  
   13. Open depression  
   24. Beachridge

3. Interfluve  
   14. Closed depression  
   25. Rounded summit

4. Valley  
   15. Dune  
   26. Summit

5. Valley floor  
   16. Longitudinal dune  
   27. Coral atoll

6. Channel  
   17. Interdunal depression  
   28. Drainage line (bottom position in flat or almost flat terrain)

7. Levee  
   18. Mangrove  
   29. Coral reef

8. Terrace  
   19. Upper slope  
   30. Other (specify in the appropriate Section’s NOTES)

9. Floodplain  
   20. Mid slope

10. Lagoon  
    21. Lower slope

11. Pan  
    22. Ridge
Fig. 1 Land element and position
5.1.5 **Slope [°]**

Estimated slope of the collecting site

5.1.6 **Slope form**

It refers to the general shape of the slope in both the vertical and horizontal directions (*FAO, 1990*)

1. Straight
2. Concave
3. Convex
4. Terraced
5. Complex (Irregular)

5.1.7 **Slope aspect**

The direction that the slope on which the accession was collected faces. Describe the direction with symbols N, S, E, W (e.g. a slope that faces a southwestern direction has an aspect of SW)

5.1.8 **Crop agriculture** (*FAO, 1990*)

5.1.8.1 **Annual field cropping**

1. Shifting cultivation
2. Fallow system cultivation
3. Ley system cultivation
4. Rainfed arable cultivation
5. Wet rice cultivation
6. Irrigated cultivation

5.1.8.2 **Perennial field cropping**

1. Non-irrigated cultivation
2. Irrigated cultivation

5.1.8.3 **Tree and shrub cropping**

1. Non-irrigated tree crop cultivation
2. Irrigated tree crop cultivation
3. Non-irrigated shrub crop cultivation
4. Irrigated shrub crop cultivation
5.1.9 **Overall vegetation surrounding and at collecting site** *(FAO, 1990)*

1. Grassland (grasses, subordinate forbs, no woody species)
2. Forbland (herbaceous plants dominant)
3. Forest (continuous tree layer, crowns overlapping, large number of tree and shrub species in distinct layers)
4. Woodland (continuous tree layer, crowns usually not touching, understorey may be present)
5. Shrubland (continuous layer of shrubs, crowns touching)
6. Savanna (grasses with a discontinuous layer of trees or shrubs)

5.1.10 **Soil parent material** *(Adapted from FAO, 1990)*

Two lists of examples of parent material and rock are given below. The reliability of the geological information and the knowledge of the local lithology will determine whether a general or a specific definition of the parent material can be given. Saprolite is used if the *in situ* weathered material is thoroughly decomposed, clay-rich but still showing rock structure. Alluvial deposits and colluvium derived from a single rock type may be further specified by that rock type.

5.1.10.1 **Unconsolidated material**

1. Aeolian deposits (unspecified)
2. Aeolian sand
3. Littoral deposits
4. Lagoonal deposits
5. Marine deposits
6. Lacustrine deposits
7. Fluvial deposits
8. Alluvial deposits
9. Unconsolidated (unspecified)
10. Volcanic ash
11. Loess
12. Pyroclastic deposits
13. Glacial deposits
14. Organic deposits
15. Colluvial deposits
16. *In situ* weathered
17. Saprolite
5.1.10.2 Rock type

1 Acid igneous/metamorphic rock
2 Granite
3 Gneiss
4 Granite/Gneiss
5 Quartzite
6 Schist
7 Andesite
8 Diorite
9 Basic igneous/metamorphic rock
10 Ultra basic rock
11 Gabbro
12 Basalt
13 Dolerite
14 Volcanic rock
15 Sedimentary rock
16 Limestone
17 Dolomite
18 Sandstone
19 Quartzitic sandstone
20 Shale
21 Marl
22 Travertine
23 Conglomerate
24 Siltstone
25 Tuff
26 Pyroclastic rock
27 Evaporite
28 Gypsum rock
29 Not known

5.1.11 Stoniness/rockiness/hardpan/cementation

1 Tillage unaffected
2 Tillage affected
3 Tillage difficult
4 Tillage impossible
5 Essentially paved

5.1.12 Soil drainage (Adapted from FAO, 1990)

1 Very poorly drained
3 Poorly drained
5 Moderately drained
7 Well drained
9 Excessively drained
5.1.13 **Flooding** *(FAO, 1990)*

Flooding or temporary inundation is described according to its estimated frequency, duration and depth. Information may be obtained from records of past flooding or from local enquiry. The frequency and duration classes should give an indication of the average occurrence of inundation.

5.1.14 **Soil depth to groundwater table**  
(Adapted from *FAO, 1990*)

The depth to the groundwater table, if present, as well as an estimate of the approximate annual fluctuation, should be given. The maximum rise of the groundwater table can be inferred approximately from changes in profile colour in many, but not all, soils.

1. (0 - 25 cm)  
2. (25.1 - 50 cm)  
3. (50.1 - 100 cm)  
4. (100.1 - 150 cm)  
5. (>150 cm)

5.1.15 **Quality of the groundwater** *(FAO, 1990)*

1. Saline  
2. Brackish  
3. Fresh  
4. Polluted  
5. Oxygenated  
6. Stagnating

5.1.16 **Soil salinity**

1. (<160 ppm dissolved salts)  
2. (160-240 ppm)  
3. (241-480 ppm)  
4. (>480 ppm)
5.1.17 **Soil moisture** (*FAO, 1990*)

Moisture conditions prevailing in the soil at the time of collection should be given together with the depth. Attention should be paid to unusual moisture conditions caused by inseasional weather, prolonged exposure of the profile, flooding, etc.

3 Dry  
5 Slightly moist  
7 Moist  
9 Wet

5.1.18 **Soil matrix colour** (Adapted from *FAO, 1990*)

The colour of the soil matrix material in the root zone around the accession is recorded in the moist condition (or both dry and moist condition, if possible) using the notation for hue, value and chroma as given in the Munsell Soil Color Charts (Munsell, 1975). If there is no dominant soil matrix colour, the horizon is described as mottled and two or more colours are given and should be registered under uniform conditions. Early morning and late evening readings are not accurate. Provide depth of measurement [cm]. If colour chart is not available, the following categories may be used:

1 White  
2 Red  
3 Reddish  
4 Yellowish red  
5 Brown  
6 Brownish  
7 Reddish brown  
8 Yellowish brown  
9 Yellow  
10 Reddish yellow  
11 Greenish, green  
12 Grey  
13 Greyish  
14 Blue  
15 Bluish-black  
16 Black

5.1.19 **Soil pH**

Actual value of the soil within the following root depths around the accession:

5.1.19.1 *pH at 10-15 cm*

5.1.19.2 *pH at 30-60 cm*

5.1.19.3 *pH at 60-90 cm*
5.1.20 Soil organic matter content

1 Nil (as on arid zones)
3 Low (as in long-term cultivation in a tropical setting)
5 Medium (as in recently cultivated but not yet much depleted)
7 High (as in never cultivated, and in recently cleared from forest)
9 Peaty

5.1.21 Rock fragments

Large rock and mineral fragments (>2 mm) are described according to abundance (Adapted from FAO, 1990)

1 (0) - 2%
2 (2.1) - 5%
3 (5.1) - 15%
4 (15.1) - 40%
5 (40.1) - 80%
6 (>80%)

5.1.22 Soil texture classes (Adapted from FAO, 1990)

For convenience in determining the texture classes of the following list and the particle size classes are given for each of the fine earth fraction below. See Fig. 2

1 Clay
2 Loam
3 Clay loam
4 Silt
5 Silty clay
6 Silty clay loam
7 Silt loam
8 Sandy clay
9 Sandy clay loam
10 Sandy loam
11 Fine sandy loam
12 Coarse sandy loam
13 Loamy sand
14 Loamy very fine sand
15 Loamy fine sand
16 Loamy coarse sand
17 Very fine sand
18 Fine sand
19 Medium sand
20 Coarse sand
21 Sand, unsorted
22 Sand, unspecified
Soil particle size classes (Adapted from FAO, 1990)

1. Clay        < 2 μm
2. Fine silt   3 - 20 μm
3. Coarse silt 21 - 63 μm
4. Very fine sand 64 - 125 μm
5. Fine sand   126 - 200 μm
6. Medium sand 201 - 630 μm
7. Coarse sand 631 - 1250 μm
8. Very coarse sand 1251 - 2000 μm

Fig. 2 Soil texture classes

5.1.23 Soil taxonomic classification

As detailed a classification as possible should be given. This may be taken from a soil survey map. State class (e.g., Alfisols, Spodosols, Vertisols etc.)
5.1.24 Water availability

1  Rainfed
2  Irrigated
3  Flooded
4  River banks
5  Sea coast
6  Other (specify in the appropriate Section’s NOTES)

5.1.25 Soil fertility

3  Low
5  Moderate
7  High

5.1.26 Climate of collecting site

Should be assessed as close to the collecting site as possible

5.1.26.1 Temperature range [°C]

Provide either the diurnal (mean, maximum, minimum) or the seasonal (mean, maximum, minimum). Specify which one is used

5.1.26.2 Rainfall range [mm]

Annual average (state number of recorded years)

5.1.26.3 Wind [km s⁻¹]

Annual average (state number of years recorded)

5.1.26.3.1 Frequency of typhoons or hurricane force winds

5.1.26.3.2 Date of most recent typhoons or hurricane force winds

(in the format DDMMYYYY)

5.1.26.3.3 Annual maximum wind velocity [km s⁻¹]
5.1.26.4  **Frost**

5.1.26.4.1  **Date of most recent frost**

(in the format DDMMYYYY)

5.1.26.4.2  **Length of growing season**

Number of days from last to first frost

5.1.26.4.3  **Lowest temperature**

Specify seasonal average and minimum survived

5.1.26.4.4  **Number of chill units [h]**

Estimated number of hours annually below 7°C

5.1.26.5  **Relative humidity**

5.1.26.5.1  **Relative humidity diurnal range [%]**

5.1.26.5.2  **Relative humidity seasonal range [%]**

5.1.26.6  **Light**

3  Shady
7  Sunny

5.1.27  **Other** (specify in the appropriate Section’s NOTES)
CHARACTERIZATION

6. PLANT DESCRIPTORS

Average of at least two years data

6.1 PHENOLOGY DESCRIPTORS

* 6.1.1 Reference standard

Indicate which cultivar has been used for the following descriptors where applicable

1  Payne (generally regarded as phenologically early)
2  Hartley (generally regarded as mid season)
3  Franquette (generally regarded as late season)
4  Other (specify in the NOTES descriptor, 6.6)

* 6.1.2 Date of bud break

When over 50% of terminal buds have enlarged and the bud scales have split exposing the green of the leaves inside (in the format DDMMYYYY)

* 6.1.2.1 Days before (-) or after (+) reference standard

For the flowering phenology, avoid reporting aberrant conditions such as a single, unopened catkin remaining after pollen shedding has ceased or a bloom which is receptive well ahead of the first flush of pistillate flowers. Peak bloom dates are usually when about half the catkins (or blooms) are beyond shedding (or receptivity) and half are not yet opened

1/ The University of California commonly uses 'leafing date' which is similar except that one leaf must be unfolding, and thus the date is several days later
* **6.1.3 First male bloom date**

When first pollen shedding occurs (in the format DDMMYYYY)

* **6.1.4 Peak male bloom date**

When maximum pollen shedding occurs (in the format DDMMYYYY)

  * **6.1.4.1 Days before (-) or after (+) reference standard**

* **6.1.5 Last male bloom date**

When last pollen shedding occurs (in the format DDMMYYYY)

* **6.1.6 First female bloom date**

Date of initial pistillate flower receptivity (in the format DDMMYYYY)

* **6.1.7 Peak female bloom date**

Date of maximum pistillate flower receptivity (in the format DDMMYYYY)

  * **6.1.7.1 Days before (-) or after (+) reference standard**

* **6.1.8 Last female bloom date**

Date of last pistillate flower receptivity (in the format DDMMYYYY)

* **6.1.9 Harvest date**

When nuts are harvestable. Take a random sample which is representative of entire tree (in the format DDMMYYYY)

  * **6.1.9.1 Days before (-) or after (+) reference standard**

* **6.1.10 Defoliation date**

(in the format DDMMYYYY)

  * **6.1.10.1 Days before (-) or after (+) reference standard**
6.2 GROWTH DESCRIPTORS

6.2.1 Seedling vigour

Rate of growth of juvenile seedling tree based on height and stem diameter

3 Low
5 Intermediate
7 High

6.2.2 Tree vigour

3 Low
5 Intermediate
7 High

6.2.3 Growth habit

Uprightness of vigourous current season’s shoots (>1 m) of graft trees. See Fig. 3

1 Erect
2 Semi-erect
3 Spreading

6.2.4 Branching

Relative degree of branching

3 Sparse
5 Intermediate
7 Dense

6.3 LEAF DESCRIPTORS

For the following descriptors, average of 10 fully expanded representative leaves. Do not select leaves that are out of the ordinary due to pruning and excessive vigour

6.3.1 Leaf length [cm]

Measured from the base of petiole to the tip of terminal leaflet
Fig. 3 Growth habit

6.3.2 Leaf width [cm]

Measured at the widest part

6.3.3 Number of leaflets

6.3.4 Leaflet length [cm]

Measured from the point of attachment to the tip. Give range average of shortest/longest leaflets

6.3.5 Leaflet width [cm]

Measured at the widest part. Give range average as above

6.3.6 Leaflet shape

See Fig. 4

1 Narrow elliptic
2 Elliptic
3 Broad elliptic
32 DESCRIPTORS FOR WALNUT

1 Narrow elliptic
2 Elliptic
3 Broad elliptic

Fig. 4 Leaflet shape

6.3.7 Leaflet margin (See Fig. 5)

1 Entire
2 Serrate
3 Dentate (toothed)

1 Entire
2 Serrate
3 Dentate

Fig. 5 Leaflet margin
6.3.8 **Leaf colour**

3  Light green
5  Green
7  Dark green

6.3.9 **Rachis colour**

3  Green
5  Yellow
7  Red

6.3.10 **Shoot pubescence**

1  Glabrous
2  Slightly pubescent
3  Pubescent

6.3.11 **Shoot colour**

3  Green
5  Brown
7  Black

6.3.12 **Leaf and rachis pubescence**

1  Glabrous
2  Slightly pubescent
3  Pubescent

6.3.13 **Leaf and/or rachis persistance**

3  Few remain attached to stem
5  Intermediate
7  Many remain attached to stem

6.4 **INFLORESCENCE AND FRUITING HABIT**

6.4.1 **Dichogamy**

1  Protandrous
2  Protogynous
3  Unknown
6.4.2 **Duration of female bloom overlapped by the staminate bloom [%]**

6.4.3 **First catkin-bearing year**

Number of years from seed or graft to first catkin bearing year, (i.e. 6s indicates that the first catkin was produced six years from seed germination, or seventh leaf)

6.4.4 **Catkin abundance**

Rate in relation to age and volume of tree

3 Light
5 Intermediate
7 Heavy

6.4.5 **Alternate bearing**

3 Slight
5 Moderate
7 Significant

6.4.6 **Flowering precocity**

* 6.4.6.1 **Years from seed or graft to first female flower**

Specify number of years (i.e. 3s indicates first flower produced 3 years from seed germination)

6.4.6.2 **Years from seed or graft to first yield**

Of 300 nuts. Specify number of years as above

* 6.4.7 **Lateral bud flowering [%]**

Percentage current season lateral shoots with female flowers in young trees (age 5-7 years) (e.g., Franquette = <10%; Payne = >90%). This trait is not apparent in old trees
6.4.8 Female flower abundance

Rate in relation to age and volume of tree

3 Light
5 Intermediate
7 Heavy

* 6.4.9 Flowers per inflorescence

Most frequent number of flowers recorded in 10 terminal inflorescences

6.4.10 Pistillate flower abscission

3 Slight
5 Moderate
7 Significant

6.4.11 Stigma colour

3 Green
5 Yellow
7 Red

6.4.12 Hull persistance after nut fall

3 Slight
5 Moderate
7 Significant

* 6.4.13 Hull dehiscence

1 Non-dehiscent  
2 Slightly dehiscent  
3 Dehiscent  

J. nigra
J. regia

6.5 NUT AND KERNEL

Average of 20 sound nuts (except for descriptors 6.5.20 and 6.5.21)
6.5.1 **Nut shape**

Longitudinal and perpendicular to suture. (See Fig. 6)

1 Round  
2 Triangular  
3 Broad ovate  
4 Ovate  
5 Short trapezoid  
6 Long trapezoid  
7 Broad elliptic  
8 Elliptic  
9 Cordate

6.5.2 **Nut diameter [mm]**

Face to face

6.5.3 **Nut length [mm]**

6.5.4 **Shell texture**

1 Very smooth  
3 Smooth  
5 Medium  
7 Rough  
9 Very rough  

*J. ailantifolia var. cordiformis*

6.5.5 **Shell colour**

1 Very light  
3 Light  
5 Medium  
7 Dark  
9 Very dark  

*J. manshurica, J. cinerea*

6.5.6 **Shell seal**

1 Open or very weak  
3 Weak  
5 Intermediate  
7 Strong  
9 Very strong  

*Hartley*

*J. regia, Verdot, Grosvert*

*J. hindsii*

*J. cinerea*

*Franquette*

*Corne*
Fig. 6  Nut shape
6.5.7 Shell strength

1 Paper
3 Weak
5 Intermediate
7 Strong

6.5.8 Shell integrity

1 Incomplete shell (>50% missing)
2 Intermediate (<50% missing)
3 Complete shell, no holes

6.5.9 Shell thickness [mm]

Near center of half shell

6.5.10 Packing tissue brown date

When the packing tissue in 80% of the nuts have completed browning (in the format DDMMYYYY)

6.5.10.1 Days before (-) or after (+) reference standard

6.5.11 Packing tissue thickness

1 Very thin and sparse
3 Thin
5 Medium
7 Thick
9 Very thick

6.5.12 Inshell nut weight [g]

6.5.13 Kernel weight [g]

Average of 20 sound kernels

6.5.14 Kernel percentage

Kernel weight/nut weight x 100
6.5.15 Kernel veins [%]

Of sample with conspicuous veins

6.5.16 Kernel flavour

1 Satisfactory
2 Unsatisfactory

6.5.17 Kernel fill

3 Poor
5 Moderate
7 Well

6.5.18 Kernel plumpness

3 Thin
5 Moderate
7 Plump Sunland

6.5.19 Ease of removal of kernel halves

1 Very easy Chandler
3 Easy Franquette
5 Moderate Chico, Corne
7 Difficult J. ailantifolia
9 Very difficult J. hindsii, J. nigra and most
other species

6.5.20 Kernel shrivel

Based on 20 randomly selected nuts

6.5.20.1 Kernels exhibiting tip shrivel [%]

6.5.20.2 Kernels exhibiting <50% shrivel [%]

6.5.20.3 Kernels exhibiting 50% or more shrivel [%]

6.5.20.4 Kernels blank [%]
40  DESCRIPTORS FOR WALNUT

*  6.5.21  Kernel colour

Based on 20 randomly selected nuts. Use 'Walnut Color Chart' to determine classification

The reference is:

Walnut Color Chart. DFA of California (Dried Fruit Association). P.O. Box 270-A, Santa Clara, California 95052

6.5.21.1 Extra light [%]

6.5.21.2 Light [%]

6.5.21.3 Light amber [%]

6.5.21.4 Amber [%]

6.6  NOTES

Any additional information, especially in the category of 'other' under various descriptors above, may be specified here
EVALUATION

7. PLANT DESCRIPTORS

7.1 YIELD

7.1.1 Cropping efficiency [g cm\(^{-2}\)]

Yield per unit trunk cross sectional area. Trunk measurement 20 cm above graft union in grafted tree or 40 cm above ground level in seedling tree

* 7.1.2 Estimated yield

Rate in relation to age and volume of tree

3 Low
5 Intermediate
7 High

7.2 NUT AND KERNEL

7.2.1 Kernel protein [%]

7.2.2 Kernel rancidity potential [%]

Polyunsaturated fatty acids

7.2.3 Kernel oil content [%]

8. ABIOTIC STRESS SUSCEPTIBILITY

Scored under artificial and/or natural conditions, which should be clearly specified. These are coded on a susceptibility scale from 1 to 9 viz.:

1 Very low or no visible sign of susceptibility
3 Low
5 Intermediate
7 High
9 Very high
8.1 LOW TEMPERATURES
   8.1.1 Susceptibility to cold in fall
   8.1.2 Susceptibility to mid winter cold
   8.1.3 Susceptibility to frost damage in spring

8.2 HIGH TEMPERATURES
   8.2.1 Sunburn susceptibility of hull
   8.2.2 Sunburn susceptibility of kernel
   8.2.3 Sunburn susceptibility of trunk

8.3 SALINITY

8.4 MINERAL DEFICIENCIES

8.5 MINERAL TOXICITIES

8.6 WATERLOGGING

8.7 DROUGHT

9. BIOTIC STRESS SUSCEPTIBILITY

In each case, it is important to state the origin of the infestation or infection, i.e., natural, controlled infestation/inoculation, or laboratory. Record such information in the NOTES descriptor, 9.5. These are coded on a susceptibility scale from 0 to 9 viz.:

0 No sign of susceptibility (i.e. non-host response)
1 Very low or almost no visible sign of susceptibility
3 Low
5 Intermediate
7 High
9 Very high
9.1 MAJOR INSECT PESTS

<table>
<thead>
<tr>
<th>Causal organism</th>
<th>Pest or common name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Amyelois transitella</em>&lt;br&gt;Determine percentage infested nuts at harvest&lt;br&gt;(100 nuts/tree)</td>
<td>Navel orangeworm</td>
</tr>
<tr>
<td><em>Callaphis juglandis</em>&lt;br&gt;Determine percentage infested leaflets (20 leaflets/tree)</td>
<td>Dusky-veined aphid</td>
</tr>
<tr>
<td><em>Cydia pomonella</em>&lt;br&gt;Determine percentage infested nuts at harvest&lt;br&gt;(100 nuts/tree)</td>
<td>Codling moth</td>
</tr>
<tr>
<td><em>Epidiaspis leperii</em>&lt;br&gt;Determine percentage infested of major scaffold limb or trunk (10-25 cm length/tree)</td>
<td>Italian pear scale</td>
</tr>
<tr>
<td><em>Panonychus ulmi</em>&lt;br&gt;Determine percentage infested leaflets (20 leaflets/tree)</td>
<td>European red mite</td>
</tr>
<tr>
<td><em>Pseudaulacaspis pentagona</em>&lt;br&gt;Determine percentage infested of 2 to 3-year-old-wood&lt;br&gt;(10-25 cm length/tree)</td>
<td>White peach scale</td>
</tr>
<tr>
<td><em>Rhagoletis completa</em>&lt;br&gt;Determine percentage infested husks just prior to husk split (100 husks/tree)</td>
<td>Walnut husk fly</td>
</tr>
<tr>
<td><em>Vasates unguiculatus</em>&lt;br&gt;Determine percentage infested leaves (50 leaves/tree)</td>
<td>Walnut gall mite</td>
</tr>
</tbody>
</table>

9.2 MINOR INSECT PESTS

<table>
<thead>
<tr>
<th>Causal organism</th>
<th>Pest or common name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acrobasis demotella</em>&lt;br&gt;Determine percentage infested shoots in early spring&lt;br&gt;(50 shoots/tree). A pest of <em>Juglans nigra</em></td>
<td>Walnut shoot moth</td>
</tr>
<tr>
<td>Causal organism</td>
<td>Pest or common name</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td><strong>9.2.2 Acrobaseis juglandis</strong></td>
<td>Pecan leaf casebearer</td>
</tr>
<tr>
<td>Determine percentage infested leaves (50 leaves/tree). A pest of Juglans nigra</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.3 Caloptilia rospcpinnella</strong></td>
<td>Walnut tree moth</td>
</tr>
<tr>
<td>Determine percentage infested leaves (50 leaves/tree)</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.4 Chromaphis juglandicola</strong></td>
<td>Walnut aphid</td>
</tr>
<tr>
<td>Determine percentage infested leaflets (20 leaflets/tree)</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.5 Chrysobothris mali</strong></td>
<td>Pacific flatheaded borer</td>
</tr>
<tr>
<td>Determine percentage infested major scaffold limb and trunk (whole tree)</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.6 Conotrachelus retentus</strong></td>
<td>Walnut curculio</td>
</tr>
<tr>
<td>Determine percentage infested nuts 2-3 months after bloom before nut drop (50 nuts/tree). A pest of Juglans nigra</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.7 Datana integerrima</strong></td>
<td>Walnut caterpillar</td>
</tr>
<tr>
<td>Determine number infested branches with colonies (whole tree). A pest of Juglans nigra</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.8 Eriophyes erineus (Nalepa)</strong></td>
<td>Walnut leaf gall mite</td>
</tr>
<tr>
<td><strong>9.2.9 Hyphantria cunea</strong></td>
<td>Fall webworm</td>
</tr>
<tr>
<td>Determine percentage branches with colony (whole tree)</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.10 Lecanium corni</strong></td>
<td>European fruit lecanium</td>
</tr>
<tr>
<td>Determine percentage infested of 2- to 3-year old wood (10-25 cm length/tree)</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.11 Lepidosaphes pruinoseum</strong></td>
<td>Frosted scale</td>
</tr>
<tr>
<td>Determine percentage infested of 2- to 3-year old wood (10-25 cm length tree)</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.12 Lepidosaphes ulmi</strong></td>
<td>Oystershell scale</td>
</tr>
<tr>
<td>Determine percentage infested of major scaffold limb (10-25 cm length/tree)</td>
<td></td>
</tr>
<tr>
<td><strong>9.2.13 Nysius raphanus</strong></td>
<td>False chinch bug</td>
</tr>
<tr>
<td>Determine percentage infested trees (whole tree)</td>
<td></td>
</tr>
<tr>
<td>Causal organism</td>
<td>Pest or common name</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>9.2.14 <em>Panonychus ulmi</em></td>
<td>European red mite</td>
</tr>
<tr>
<td>Determine percentage infested leaflets (20 leaflets/tree)</td>
<td></td>
</tr>
<tr>
<td>9.2.15 <em>Quadraspidiotus juglansregiae</em></td>
<td>Walnut scale</td>
</tr>
<tr>
<td>Determine percentage infested of major scaffold limb (10-25 cm length/tree)</td>
<td></td>
</tr>
<tr>
<td>9.2.16 <em>Quadraspidiotus perniciosus</em></td>
<td>San Jose scale</td>
</tr>
<tr>
<td>Determine percentage infested of 2- to 3-year old wood (10-25 cm length/tree)</td>
<td></td>
</tr>
<tr>
<td>9.2.17 <em>Schizura concinna</em></td>
<td>Red-humped caterpillar</td>
</tr>
<tr>
<td>Determine percentage infested branches (whole tree)</td>
<td></td>
</tr>
<tr>
<td>9.2.18 <em>Tetranychus pacificus</em></td>
<td>Pacific spider mite</td>
</tr>
<tr>
<td>Determine percentage infested leaflets (20 leaflets/tree)</td>
<td></td>
</tr>
<tr>
<td>9.2.19 <em>Tetranychus urticae</em></td>
<td>Two-spotted spider mite</td>
</tr>
<tr>
<td>Determine percentage infested leaflets (20 leaflets/tree)</td>
<td></td>
</tr>
<tr>
<td>9.2.20 <em>Xylosandrus germanus</em></td>
<td>Ambrosia beetle</td>
</tr>
<tr>
<td>Determine percentage infested (shot holes) of trunk and small low-hanging branches (whole tree). A pest of Juglans nigra</td>
<td></td>
</tr>
</tbody>
</table>

9.3 NEMATODES

<table>
<thead>
<tr>
<th>Nematode</th>
<th>Pest or common name</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.3.1 <em>Cacopaurus pestis</em></td>
<td>Pin nematode</td>
</tr>
<tr>
<td>9.3.2 <em>Criconemella xenoplax</em></td>
<td>Ring nematode</td>
</tr>
<tr>
<td>9.3.3 <em>Helicotylenchus sp.</em></td>
<td>Spiral nematode</td>
</tr>
<tr>
<td>9.3.4 <em>Longidorus spp.</em> (Transmits virus)</td>
<td>Needle nematode</td>
</tr>
<tr>
<td>9.3.5 <em>Meloidogyne spp.</em></td>
<td>Root knot nematode</td>
</tr>
</tbody>
</table>
### Causal organism

<table>
<thead>
<tr>
<th>Causal organism</th>
<th>Pest or common name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pratylenchus vulnus</em></td>
<td>Root lesion nematode</td>
</tr>
<tr>
<td><em>Xiphinema spp.</em></td>
<td>Dagger nematode</td>
</tr>
</tbody>
</table>

### 9.4 DISEASES

<table>
<thead>
<tr>
<th>Disease or common name</th>
<th>Causal organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown gall</td>
<td><em>Agrobacterium tumefaciens</em></td>
</tr>
<tr>
<td>Armillaria root and crown rot</td>
<td><em>Armillaria mellea</em></td>
</tr>
<tr>
<td>Blackline disease</td>
<td>Cherry leafroll virus</td>
</tr>
<tr>
<td>Damping off/Root rot</td>
<td><em>Cylindrocladium spp.</em>&lt;br&gt; A pest of <em>Juglans nigra</em></td>
</tr>
<tr>
<td>Shallow bark canker</td>
<td><em>Erwinia nigrifluens</em></td>
</tr>
<tr>
<td>Deep bark canker</td>
<td><em>Erwinia rubrifaciens</em></td>
</tr>
<tr>
<td>Walnut bunch disease</td>
<td><em>Gnomonia leptostyla</em></td>
</tr>
<tr>
<td>Branch wilt</td>
<td><em>Hendersonula toruloidea</em></td>
</tr>
<tr>
<td>Walnut bunch disease</td>
<td><em>Mycoplasma</em></td>
</tr>
<tr>
<td>Phytophthora root and crown rot</td>
<td><em>Phytophthora spp.</em></td>
</tr>
<tr>
<td>Butternut canker</td>
<td><em>Sirococcus clavigignenti-juglandacearum</em></td>
</tr>
<tr>
<td>Blight</td>
<td><em>Xanthomonas campestris</em></td>
</tr>
</tbody>
</table>

### 9.5 NOTES

Specify here any additional information
10. BIOCHEMICAL COMPOSITION

10.1 PROTEIN CHARACTERIZATION

10.2 ALLOZYME COMPOSITION

10.3 DNA FINGERPRINTING (RFLP/RAPD)

11. CYTOLOGICAL CHARACTERS AND IDENTIFIED GENES

11.1 2n CHROMOSOME NUMBER

11.2 PLOIDY LEVEL
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Walnut Color Chart. DFA of California (Dried Fruit Association). P.O. Box 270-A, Santa Clara, California 95052, USA
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