Guidelines
for the Conduct of Test for
Distinctiveness, Uniformity and Stability

On

Mandarin
(***Citrus reticulata*** **Blanco**)

Protection of Plant Varieties and Farmers Rights' Authority
(PPV & FRA)
Government of India

Mandarin (*Citrus reticulata* Blanco)

I. Subject

These test guidelines shall apply to all the varieties of mandarin (*Citrus reticulata* **Blanco**)

II. Materials required

1. The Protection of Plant Varieties and Farmers' Rights Authority (PPV & FRA) shall decide on the quantity and quality of the planting materials required for testing the varieties and where it is to be delivered for registration under the Protection of Plant Varieties and Farmers' Rights (PPV & FR) Act, 2001.
2. Applicants submitting such materials from a country other than India shall make sure that all customs and pre and post quarantine requirements stipulated under relevant national legislations and regulation are complied with.
3. The materials are to be raised by budding and a minimum of ten plants to be supplied by the applicants or his/her nominee during the month of June- July for each DUS Centre. Planting materials supplied shall be healthy and free from pests, diseases and mechanical injury. Age of the plants shall be above six months from the date of budding on region - specific standard rootstock (specify the rootstock) and raised in the black polythene bags 300 µ thickness UV stabilized (12cm x 7cm size) with potting mixture (soil, FYM and sand in 1 : 1: 1 ratio).
4. The plants should not have undergone any treatment which would affect the expression of the characters of the variety, unless the competent authority allows or requests for any such treatment.
5. The planting material shall not have undergone any chemical and bio-physical treatment unless the competent authority or applicant specifically request for such treatment. If it has been treated, full details of the treatment must be mentioned explicitly.

III. Conduct of test

1. The minimum duration of the DUS tests shall normally be at least for two independent identical fruiting seasons in different years.
2. The test should be carried out under conditions ensuring satisfactory growth for the expression of the relevant characteristics of the variety and for the conduct of the examination. In particular, it is essential that the tree produces a satisfactory crop of fruit in each of the fruiting seasons in two consecutive years. In case of any climatic vagaries data from third fruiting season may also be considered.

3. Test Design

The design of the tests should be such that plants or parts of the plant may be removed for measurement or counting without prejudice to the observations which may be made up to

the end of the vegetative /fruiting season as the case maybe. Unless otherwise indicated, all observations are to be recorded on five plants**.**

Additional Tests

Additional tests, for examining special characteristics, may be established by the PPV&FR Authority.

4. On- site testing :

The guidelines developed by PPV&FR Authority for on- site testing will be followed with the specific requirement for mandarin.

- The age of the plants for on-site shall be minimum of five years from the date of planting in the field.
- A minimum of two budded plants must be made available for field gene bank. For inspection and examination even single tree could be considered only for farmers' varieties. The trees should be healthy, free from pests and diseases and raised under standard management practices.
- On-site examination shallbe arranged during vegetative and fruiting seasons.

IV. Methods and observations

i. The characteristics described in the Table of Characteristics (see section VII) shall be used for the testing of candidate varieties.

ii. For the assessment of DUS characters, observations shall be made on five plants.

Observations

(a) Leaf: Observations on the leaf should be made on the fully expanded leaves of spring flush.

(b) Fruit: Observations on the fruit should be made at the stage of harvest maturity. Fruits should be sampled from the periphery of the trees.

(c) Fruit rind: Observations on the fruit rind (epicarp)thickness(mm) should be made at the middle, between the base and apex of the fruit.

V. Grouping of varieties

1. The candidate varieties of DUS testing shall be divided into groups to facilitate the assessment of distinctiveness. Characteristics, which are known from experience not to vary, or to vary only slightly within a variety and in which their various states are fairly evenly distributed across all thevarieties in the collection are suitable for grouping purpose.
2. Characteristics for grouping are those in which the documented states of expression, even when produced at different locations. These can be used, either individually or in combination with other such characteristics to (a) select varieties of common knowledge that can be excluded from the growing trials used for examination of distinctiveness; and (b) organize the growing trials so that similar varieties are grouped together.

   The following characteristics are to be used for grouping of mandarin varieties :

(a) Tree growth habit (characteristic - 1)
(b) Fruit: diameter (characteristic - 5)
(c) Fruit: length (characteristic - 6)
(d) Fruit : rind(epicarp) colour (characteristic - 9)

VI. Characteristics and symbols

i. To assess Distinctiveness, Uniformity and Stability, the characteristics and their states as given in the Table of Characteristics (Section VII) shall be used.

ii. Notes (1 to 9) shall be given for each state of expression for different characteristics for the purpose of electronic data processing.

iii. Legend

(*) Characteristics that shall be observed during every growing season in all the varieties and shall always be included in the description of the variety. In exceptional cases wherein the state of expression of any of these characters is not recorded due to environmental vagaries, adequate explanation may be provided.

(+) See Explanation on the Table of characteristics in Section VIII. It is to be noted that for certain characteristics, the plant parts on which observations are to be taken are given in the explanation or figure (s) for clarity and not the colour variation.

4. A code number given in the sixth column of Table of Characteristics indicates the optimum stage for the observation of each characteristic during the growth and development ofthe plant. The relevant growth stages corresponding to these code numbers are described below:

Code for the growth stages :

Growth stage	**Code**
Full grown bearing tree	100
Fully expanded leaves of spring flush	30
Harvest maturity	95

(a) Observations on fully expanded leaf on the middle portion of the spring flush.

(b) The mature/ripe fruit refer to the fruit at the stage ready for consumption. This stage is reached when the segment is juicy and fruits have developed characteristic colour.

(c) The colour expression must be recorded using RHS colour chart

5. Type of assessment of characteristics indicated in column seven of Table of characteristics is as follows:

MG : Measurement by a single observation of a group of plants or parts of plants

MS : Measurement of a number of individual plants or parts of plants

VG : Visualassessment by a single observation of a group of plants or parts of plants

VS : Visualassessment by observation of individual plants or parts of plants

VII. Table of Characteristics

S. No	Characteristics	States	Note	Example varieties	Stage of observation (code)	Type of assessment
1	2	3	4	5	6	7
1 (+) (*)	Tree growth habit	Erect	1	Khasi Mandarin, Coorg Mandarin, Sikkim Mandarin	Full grown bearing tree (100)	VG
		Semi-erect	3	--		
		Spreading	5	Nagpur Mandarin, Darjeeling Mandarin, Mudkhed Seedless, Nagpur Seedless		
2 (*) (+)	Leaf length [mm]	Short (< 70)	3	-	Fully expanded leaves of spring flush (30)	MG
		Medium (70-80)	5	Sikkim Mandarin,		
		Long (>80)	7	Nagpur Mandarin, Khasi Mandarin, Coorg Mandarin, Darjeeling Mandarin, Mudkhed Seedless, Nagpur Seedless		
3. (+)	Leaf width [mm]	Narrow (<30)	3	-	Fully expanded leaves of spring flush (30)	MG
		Medium (30 - 40)	5	Nagpur Mandarin, Khasi Mandarin, Coorg Mandarin, Darjeeling Mandarin, Sikkim Mandarin.		
		Broad(>40)	7	Darjeeling Mandarin		
4	Fruit weight (g)	Light (<110)	3	--	Harvest maturity (95)	MS
		Medium (110 – 140)	5	Khasi Mandarin, Sikkim Mandarin Coorg Mandarin,		

				Darjeeling Mandarin,		
		Heavy (>140)	7	Nagpur Mandarin, Mudkhed Seedless, Nagpur Seedless		
5 (*) (+)	Fruit diameter (mm)	Small (<60)	3	--	Harvest maturity (95)	MS
		Medium(60 - 70)	5	Khasi Mandarin, Sikkim Mandarin		
		Large(>70)	7	Nagpur Mandarin, Coorg Mandarin, Darjeeling Mandarin, Mudkhed Seedless, Nagpur Seedless		
6 (+)	Fruit length (mm)	Short (<55)	3	-	Harvest maturity (95)	MS
		Medium(55 - 65)	5	Khasi Mandarin, Sikkim Mandarin, Coorg Mandarin,		
		Long(>65)	7	Nagpur Mandarin, Darjeeling Mandarin, Mudkhed Seedless, Nagpur Seedless		
7	Shape of fruit base	Truncate	3	Khasi Mandarin, Sikkim Mandarin,	Harvest maturity (95)	VG
		Concave	5	Coorg Mandarin, Darjeeling Mandarin, Mudkhed Seedless, Nagpur Seedless		
8 (+)	Shape of fruit apex	Truncate	3	Khasi Mandarin, Sikkim Mandarin,	Harvest maturity (95)	VG

		Depressed	5	Nagpur Mandarin, Coorg Mandarin, Darjeeling Mandarin, Mudkhed Seedless, Nagpur Seedless		
9 (*)	Fruit rind (epicarp) colour	Greenish Yellow	1	Nagpur Mandarin (Ambia crop), Mudkhed Seedless, Nagpur Seedless	Harvest maturity (95)	VS
		Light Orange	3	Coorg Mandarin		
		Orange	5	Nagpur Mandarin (Mrig crop)		
		Dark Orange	7	Khasi Mandarin, Darjeeling Mandarin, Sikkim Mandarin		
10	Fruit rind - peelability	Easy	3	Nagpur Mandarin,Coorg Mandarin, Darjeeling Mandarin	Harvest maturity (95)	**VG**
		Moderate	5	Khasi Mandarin, Sikkim Mandarin		
11	Fruit rind thickness (mm)	Thin (< 2)	3	-	Harvest maturity (95)	MS
		Moderately thick(2-3)	5	Khasi Mandarin, Coorg Mandarin, Darjeeling Mandarin, Sikkim Mandarin,		
		Thick (>3)	7	Nagpur Mandarin, Mudkhed Seedless, Nagpur Seedless		
12	Fruit juiciness	Low (<40)	3	-	Harvest	MS

	(%)	Medium(40 to 45)	5	Mudkhed Seedless, Nagpur Seedless	maturity (95)	
		High(>45)	7	Nagpur Mandarin, Khasi Mandarin, Coorg Mandarin, Darjeeling Mandarin, Sikkim Mandarin		
13 (+)	Total Soluble Solids (^{0} Brix)	Low (< 8)	3	-	Harvest maturity (95)	MS
		Medium (8 to 11)	5	Nagpur Mandarin,Mudkhed Seedless, Nagpur Seedless		
		High(> 11)	7	Khasi Mandarin, Coorg Mandarin, Darjeeling Mandarin, Sikkim Mandarin,		
14 (+)	Titratable acidity (% citric acid)	Low (< 0.5)	3	-	Harvest maturity (95)	MS
		Medium (0.5 to 0.7%	5	Khasi Mandarin, Coorg Mandarin, Darjeeling Mandarin, Sikkim Mandarin, Mudkhed Seedless, Nagpur Seedless		
		High (>0.7)	7	-		
15 (*)	Number of seeds per fruit	**< 5**	1	Mudkhed Seedless, Nagpur Seedless	Harvest maturity (95)	MS
		>5	2	Nagpur Mandarin, Khasi Mandarin, Coorg Mandarin, Darjeeling Mandarin, Sikkim Mandarin		

16	Seed boldness (weight of 20 seeds in g)	**<1.10**		Nagpur Mandarin,Mudkhed Seedless, Nagpur Seedless	Harvest maturity (95)	MS
		>1.10		Khasi Mandarin, Coorg Mandarin, Darjeeling Mandarin, Sikkim Mandarin		

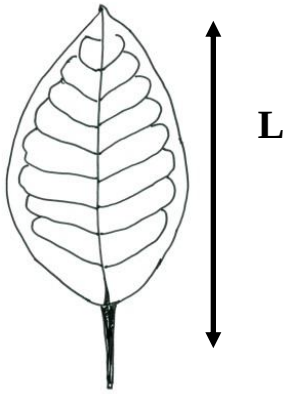
VIII. Explanation on the Table of Characteristics :

Characteristic 1. Tree growth habit Recorded on tree not less than 5 year of age in natural state just after fruit harvesting

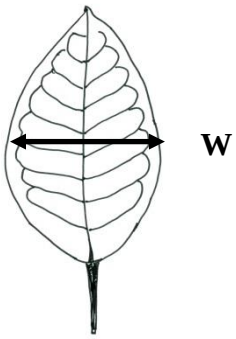
1
Erect

2
Spreading

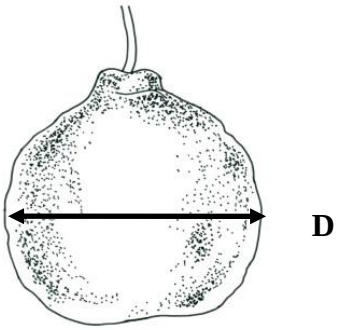
Characteristic 2 : Leaf length [mm] Recorded from petiole base to lamina tip



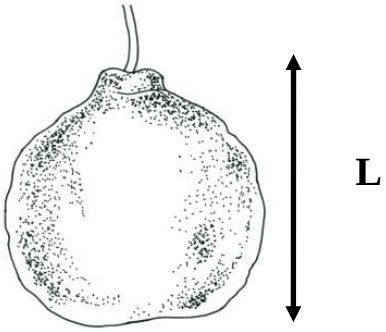
Characteristic 2 : Leaf width [mm]



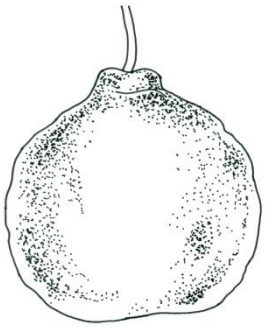
Characteristic 5 : Fruit diameter [mm]



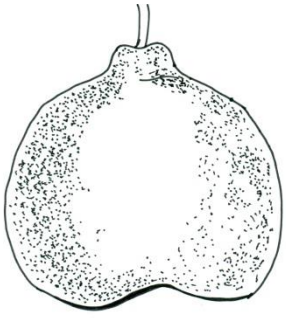
Characteristic 6 : Fruit length [mm]



Characteristic 8. Shape of fruit apex



3
Truncate



5
Depressed

Characteristic 13. Fruit juice total soluble solids **(^{0}Brix)**

The fruit samples were harvested as per maturity standard. The juice will be extracted by juicer or electronic juicer machine and total soluble solids **(**TSS) determined. The hand held/ digital refractometer should be used to measure the TSS ^{0}brix in juice sample. One or two drops of the juice should be placed on refractometer and per cent TSS on the scale should be recorded. The reading are to be taken at room temperatures.

Characteristic 14. Fruit juice acidity (citric acid **(%)**

The acid content in juice of the samples should be recorded by visual titration method as suggested by Ranganna (1986). The titration sample prepared with 5ml of juice mixed with 20 ml of distilled water put in volumetric flask to makeup the volume to 25 ml. Thereafter, 5 ml mixed sample should be taken for further titration using phenolphthalein as an indicator against 0.1 N sodium hydroxide. The titrated acidity is expressed as percentage citric acid as under.

$$\text{Acidity (\%)} = \frac{\text{Titre value x Normality of alkali x Volume made up x Equivalent weight of acid (i.e. 64 x100)}}{\text{Volume of aliquottaken for estimation x Weight or volume of sample taken x1000}}$$

Characteristic 16. Seed boldness (weight of 20 seeds in g) : Freshly extracted seeds after washing in water should be kept in shade for drying for one day and weight of the 20 seeds should be recorded next day.

IX. Literature :

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- **Ranganna, S.** (**1986).** Manual for Analysis of Fruit and Vegetable Products. Tata McGraw Hill Pub. Co., New Delhi.
- **Singh, I.P. and Singh, Shyam (2003)**. Exploration, Collection and Mapping of Citrus Genetic Diversity in India. *Technical Bulletin No. 7*, NRC for Citrus, Nagpur, Maharashtra, pp.230.
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- **Singh, I.P. and Singh, Shyam (2006).** Citrus Monograph. *Monograph No.1*, NRCC, Nagpur, pp.96.
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X. Working Group details

The Test Guidelines developed by the NRC for Citrus, Nagpur was finalized by the Task Force (1/2013) constituted by the PPV & FR Authority.

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IX. DUS testing centers

Nodal DUS Test Centre	**Other DUS Test Centres**
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