Guidelines

For the Conduct of Test for Distinctiveness, Uniformity & Stability on

Turnip
(*Brassica rapa* var. *rapa* L.)

Protection of Plant Varieties and Farmers' Rights Authority
(A Statutory Body created by an Act of Parliament)
Government of India, New Delhi

CONTENTS

I. Subject

These test guidelines shall apply to all varieties, parental lines and hybrids of Turnip (*Brassica rapa* var. *rapa* L.)

II. Planting Material Required

1. For all varieties, the planting materials are to be supplied in the form of seeds and should display all characteristics of the variety required for DUS testing. If, however, any material for DUS test has a specific requirement for the expression of characters, the same shall be specified by the applicant.

2. The Protection of Plant Varieties & Farmers' Rights Authority (PPVFRA) shall decide when, where and in what quantity and quality the seed material are required for testing of a variety denomination for registration under the Protection of Plant Varieties and Farmers' Rights (PPVFR) Act, 2001. Applicants submitting such seed material from a country other than India shall make sure that all customs and quarantine requirements stipulated under relevant national legislations and regulations are complied with.

3. The planting material (seed) supplied should be healthy, vigorous and free from pests and diseases. The seed should meet the minimum requirements for germination capacity (70%), moisture content (6%) and purity (98%) prescribed for certified seed in India.

4. The seed must not have been treated with any chemicals and bio-physical agents unless the competent authority allows or requests such treatment. If it has been treated, full details of the treatment must be provided along with the application.

5. The applicant should submit plant material having genetic purity and uniformity besides data on method of propagation/multiplication for raising variety.

6. The minimum quantity of seed to be provided by the applicant shall be as per the following:

   New varieties: 15 g divided equally in 10 packets

   Extant varieties

   a) Varieties notified under Seeds Act, 1966: 3 g divided equally in 2 packets.

   b) Varieties about which there is a common knowledge: 7.5 g divided equally in 5 packets.

c) Farmers' varieties: 7.5 g divided equally in 5 packets.

In case of hybrid, each of the parental lines is to be submitted as 3 g divided equally in 2 packets.

III. Conduct of tests

1. The minimum duration of the DUS test shall normally be as per following (sowing to harvest of seeds) with reference to the ecosystem of the candidate variety:

New varieties: Two seasons at two similar growing locations.

Varieties of common knowledge/ Farmers' varieties: One season at two locations.

2. The test shall normally be conducted at least at two test locations. If any essential characteristic of the candidate variety is not expressed for observation/measurement at these locations, the variety should be considered for further examination at another appropriate test site or under special test protocol on the request expressed by the applicant for which additional quantity of seeds shall be required.

3. The field test shall be carried out under conditions favoring normal growth and expression of all test characteristics. The size of the plot shall be such that the plants or the parts of plants could be removed for measurement and observation without prejudicing the observations on the standing plants until the end of the growing period. Each test should include a minimum of 150 plants, in the plot size and planting space specified below across three replications. Separate plots for observation and for measurement can only be used if they have been subjected to similar environmental conditions. All the replications shall be sharing similar environmental conditions of the test locations.

The test plot design shall be as follows-

Bed Size	**:**	1.8 m × 1.5 m
Number of rows	**:**	06
Row length	**:**	1.5 m
Row to row distance	**:**	30 cm
Plant to plant distance	**:**	15 cm
Number of replications	**:**	03

Design	:	RBD
Number of Locations	:	02
Number of plants per replication	:	60

(Observations not to be recorded on plants in border rows)

4. Additional test protocols for special test shall be established by the PPV&FR Authority.

IV. Methods and observations

1. The characteristics described in the Table of characteristics (Section VII) shall be used for the DUS testing of varieties.
2. For the assessment of distinctiveness and stability, observations should be made on 30 randomly selected plants or parts of 30 plants, which shall be equally divided among 3 replications (10 plants per replication).
3. For the assessment of uniformity of characteristics on the plot as a whole (visual assessment by a single observation on a group of plants or parts of plants), a population standard of 1% with an acceptance probability of at least 95% should be applied. In the case of a sample size of 150 plants, the number of off-types should not exceed 2.
4. All observations on the plant, root and leaf should be made on plants fully developed in the vegetative stage. All observations on the leaf should be made on the leaves of the middle whorls.
5. For the assessment of colour characteristics, the latest Royal Horticultural Society (RHS) colour chart shall be used.

V. Grouping characteristics

1. The candidate varieties for DUS testing should 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 which in their various states be fairly evenly distributed across all varieties in the collection are suitable for grouping purposes.
2. The following characteristics are proposed to be used for grouping Turnip varieties:
    a) Root: Shape in longitudinal section (Characteristic 14)
    b) Root: Colour of skin above ground (Characteristic 17)

c) Root: Colour of skin below ground (Characteristic 18)

d) Root: Colour of flesh (Characteristic 19)

e) Root: Shape of apex (Characteristic 21)

3. The applicant has to mention whether the candidate variety belongs to tropical/ subtropical or temperate group.

VI. Characteristics and Symbols

1. To assess Distinctiveness, Uniformity and Stability, the characteristics and their states as given in the Table of characteristics should be used.
2. Notes (1-9) shall be used to describe the state of each character for the purpose of digital data processing and these notes shall be given opposite the states of the different characteristics.
3. **Legend**

   (*) Characteristics that should be observed during every growing season on all varieties and shall always be included in the description of the variety, except when the state of expression of any of these characters is rendered impossible by a preceding phenological characteristic or by environmental conditions of the testing region. Under such exceptional situation, adequate explanation should be provided.

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

4. The optimum stage of plant growth for assessment of each characteristic is indicated in the sixth column of Table of Characteristics.

Description	**Code**
Seedling stage	10
Harvest maturity stage	40
Flowering (50% of plants have one open flower)	60

Characteristics containing the following key in the first column of the Table of characteristics shall be examined as indicated below:

QL: Qualitative characteristic

PQ: Pseudo qualitative characteristic

QN: Quantitative characteristic

QL: Qualitative characteristics are those that are expressed in discontinuous states (e.g. Root: Colour of skin above ground:- White (1), Yellow (2), Yellow-Green (3), Red Purple (6), Purple (7), Purple- Violet (8) and Others (9); Root: Colour of skin below ground:- White (1), Yellow (3), Purple (5), and Others (7), etc.). These states are self-explanatory and independently meaningful. All states are necessary to describe the full range of the characteristic and every form of expression can be described by a single state. As a rule, the characteristics are not influenced by environment.

PQ: In Pseudo-qualitative characteristics, the range of expression is at least partly continuous, but varies in more than one dimension (e.g. Root: Shape in longitudinal section:- Narrow oblate (2), Broad oblate (3), Circular (4), Broad oblong (5), Narrow obovate (8), Triangular (9)) and cannot be adequately described by just defining two ends of a linear range. In a similar way to qualitative (discontinuous) characteristics, each individual state of expression needs to be identified to adequately describe the range of the characteristic.

QN: Quantitative characteristics are those where the expression covers the full range of variation from one extreme to the other. The expression can be recorded on a one-dimensional, continuous or discrete, scale. The range of expression is divided into a number of states for the purpose of description (e.g. Leaf: Length:- Short (3), Medium (5) and Long(7)).

5. Type of assessment of characteristics indicated in column 7 of the 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 plant or part 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

VII. Table of Characteristics

S. No	**Characteristics**	**States**	**Note**	**Example varieties**	**Stage of observation**	**Type of assessment**
1. (+)	Seedling: Anthocyanin colouration of	Absent	1	Pusa Chandrima, Golden Ball	10	VG

(*) (QL)	hypocotyl	Present	9	Nigeen, PTWG		
2. (+) (QL)	Plant: Attitude of outer leaves	Erect	3	Pusa Swarnima, PTWG	40	VG
		Semi erect	5	Pusa Chandrima, IC-653928		
		Horizontal	7	IC-653934, IC-653939		
3. (QN)	Plant: Number of leaves	Few (< 9)	3	IC-653939	40	MS
		Medium (9-11)	5	Pusa Swarnima, Pusa Chandrima		
		Many (>11)	7	Golden Ball, IC-653940		
4. (*) (QL)	Leaf: Anthocyanin colouration of petiole	Absent	1	Pusa Chandrima, Nigeen	40	VG
		Present	9	IC-653939, IC-653940		
5. (+) (QN)	Leaf: Length (cm)	Short (< 30 cm)	3	Pusa Chandrima, Golden Ball	40	MS
		Medium (30-40 cm)	5	Pusa Swarnima, , PTWG		
		Long (> 40 cm)	7	IC-653943		
6. (+) (QN)	Leaf: Width (cm)	Narrow (< 13 cm)	3	Pusa Chandrima, PTWG	40	MS
		Medium (13-16 cm)	5	Pusa Swarnima, Golden Ball		
		Broad (> 16 cm)	7	IC-653938, IC-653943		
7. (*) (QN)	Leaf: Number of lobes	Few (< 5)	3	IC-653927	40	MS
		Medium (5-8)	5	Pusa Chandrima, Pusa Swarnima		
		Many (>8)	7	IC-653933, IC-653944		
8.	Leaf: Length of terminal lobe	Short (<12 cm)	3	Golden Ball, IC-653928	40	MS

(+) (QN)	(cm)	Medium (12-16 cm)	5	PTWG, Nigeen		
		Long (>16 cm)	7	Pusa Swarnima, Pusa Chandrima		
9. (+) (QN)	Leaf: Width of terminal lobe (cm)	Narrow (<10 cm)	3	Golden Ball IC-653930	40	MS
		Medium (10-15 cm)	5	Pusa Chandrima, PTWG		
		Broad (>15 cm)	7	Pusa Swarnima, IC-653927		
10. (QL)	Leaf: Hairiness	Sparse	3	Golden Ball, IC-653930	40	VG
		Medium	5	Pusa Chandrima, PTWG		
		Dense	7	Pusa Swarnima, IC-653927		
11. (+) (QL)	Leaf: Margin	Crenate	3	Pusa Swarnima, Pusa Chandrima	40	VG
		Dentate	5	IC-653936		
		Lobed	7	IC-653933, IC-653934		
		Others	9	-		
12. (+) (QL)	Leaf: Undulation of margin	Weak	3	Pusa Swarnima, Pusa Chandrima	40	VG
		Medium	5	PTWG, Nigeen		
		Strong	7	IC-653928, IC-653940		
13. (+) (QL)	Leaf: Degree of curvature of leaf apex	Weak	3	Golden Ball, IC-653928	40	VG
		Medium	5	Pusa Chandrima, PTWG		
		Strong	7	Pusa Swarnima, Nigeen		
14. (*)	Root: Shape in longitudinal	Narrow Oblate	2	IC-653928, IC-653933	40	VG

(+) (PQ)	section	Broad Oblate	3	Pusa Swarnima, PTWG		
		Circular	4	Pusa Chandrima, Golden Ball		
		Broad Oblong	5	IC-653940, IC-653941		
		Narrow Obovate	8	IC-653934		
		Triangular	9	IC-653929, IC-653944		
15. (+) (QN)	Root: Length (cm)	Short (< 8 cm)	3	Pusa Chandrima, Pusa Swarnima	40	MS
		Medium (8-12 cm)	5	PTWG, IC-653927		
		Long (> 12 cm)	7	IC-653929		
16. (*) (+) (QN)	Root: Diameter (cm)	Small (< 7 cm)	3	IC-653941, IC-653942	40	MS
		Medium (7-9 cm)	5	Pusa Chandrima, Golden Ball		
		Large (> 9 cm)	7	Pusa Swarnima, PTWG		
17. (+) (*) (QL)	Root: Colour of skin above ground	White (NN155)	1	Pusa Chandrima, Nigeen	40	VG
		Yellow (8D, 10D, 13D)	2	Pusa Swarnima, Golden Ball		
		Yellow-Green (N144C, 149D)	3	IC-653934, IC-653938		
		Red Purple (70A, 72B)	6	IC-653933		
		Purple (76A, 77B, N78D, 79D)	7	PTWG, IC-653936		
		Purple-Violet (N82B, 83C)	8	IC-653929, IC-653940		

		Others	9	-		
18. (+) (*) (QL)	Root: Colour of skin below ground	White (NN155, N155A)	1	Pusa Chandrima, PTWG	40	VG
		Yellow (8D, 10D, 13D)	3	Pusa Swarnima, Golden Ball		
		Purple (N82A)	5	IC-653936		
		Others	7	-		
19. (*) (QL)	Root: Colour of flesh	White (NN155, NN155A)	1	Pusa Chandrima, PTWG	40	VG
		Yellow (5D, 8D)	3	Pusa Swarnima, Golden Ball		
		Others	5	-		
20. (*) (+) (QL)	Root: Shape of collar	Raised	3	Pusa Swarnima, Pusa Chandrima	40	VG
		Flat	5	Nigeen, IC-653933		
		Depressed	7	IC-653934, IC-653939		
		Others	9	-		
21. (*) (+) (QL)	Root: Shape of apex	Acute	1	IC-653929, IC-653944	40	VG
		Obtuse	3	Golden Ball, IC-653940		
		Round	5	Pusa Chandrima, PTWG		
		Truncate	7	IC-653933, IC-653938		
		Others	9	-		
22. (QN)	Harvest Maturity	Early (<50 days)	3	Pusa Chandrima, Golden Ball	40	MS
		Medium (50-60 days)	5	Pusa Swarnima, IC-653928		
		Late (>60 days)	7	PTWG, Nigeen		

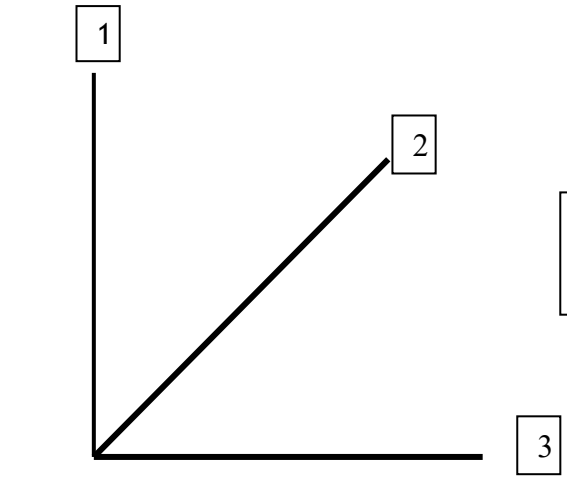
23. (+) (QN)	Flowering: Days to 50% flowering	Early (<115 days)	3	Pusa Chandrima, PTWG	60	MG
		Medium (115-125 days)	5	Pusa Swarnima, Golden Ball		
		Late (>125 days)	7	Nigeen, IC-653934		

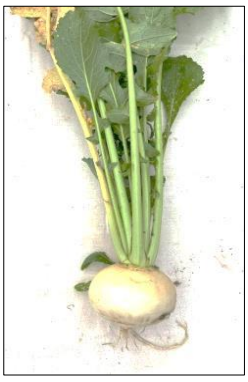
VIII. Explanations for the Table of Characteristics

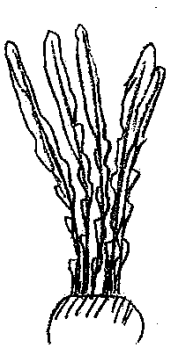
1. Seedling: Anthocyanin colouration of hypocotyl

(To be observed after 3-4 days of germination)

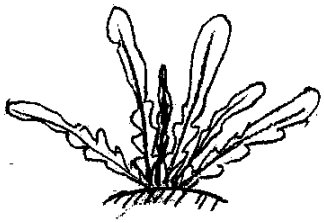
2.Plant: Attitude of outer leaves



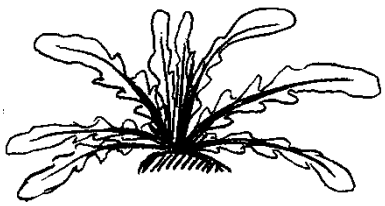




Erect (3)



Semi erect (5)



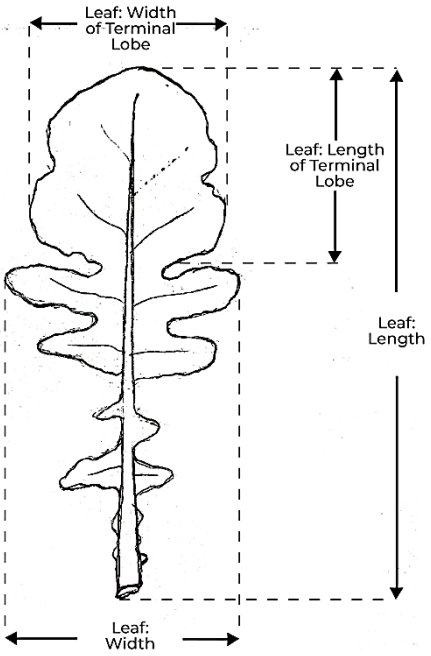
Horizontal (7)

5.Leaf: Length

6.Leaf: Width (To be measured at the broadest part of the leaf)

8.Leaf: Length of terminal lobe

9.Leaf: Width of terminal lobe (To be measured at the broadest part of the terminal lobe of leaf)



7.Leaf: Number of lobes

The part of the leaf blade is considered to be a lobe if:

1. It has minimum length of 1 cm, and
2. When folded back to the midrib, the folded part meets the midrib.

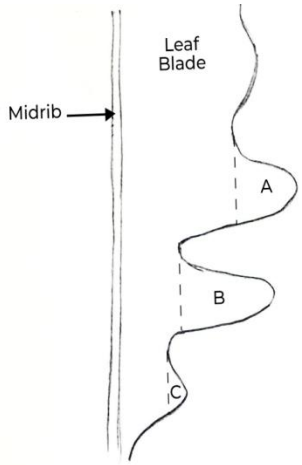


Figure 1

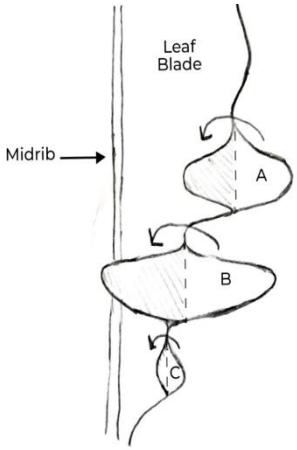
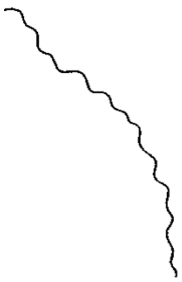


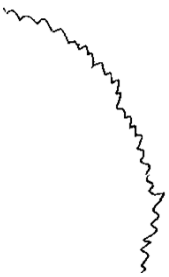
Figure 2

In the above given figures

1. A is not a lobe as it does not meet the midrib when folded.
2. B is a lobe as it meets the midrib when folded.
3. C is not a lobe as it does not meet the midrib when folded and is less than 1 cm length.

11. Leaf: Margin





Crenate (3) Dentate (5) Lobed (7)

12. Leaf: Undulation of margin

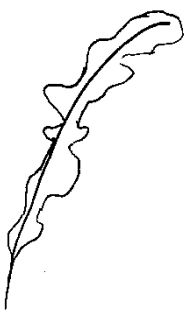
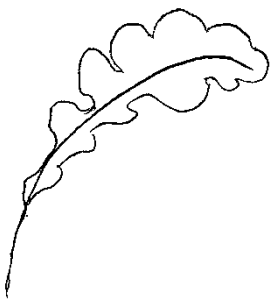
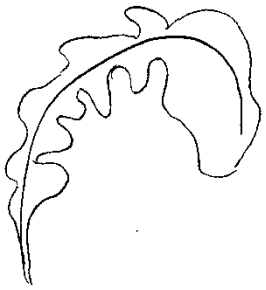





Weak (3) Medium (5) Strong (7)

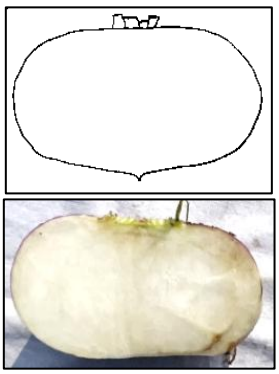
13. Leaf: Degree of curvature of leaf apex



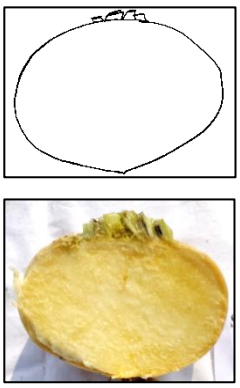





Weak (3) Medium (5) Strong (7)

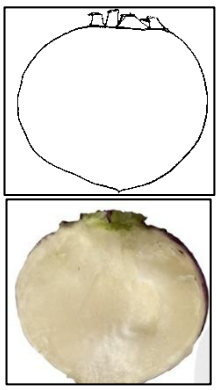
14. Root: Shape in longitudinal section



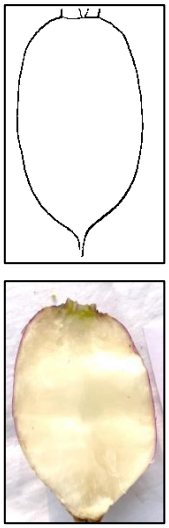
Narrow Oblate (2)



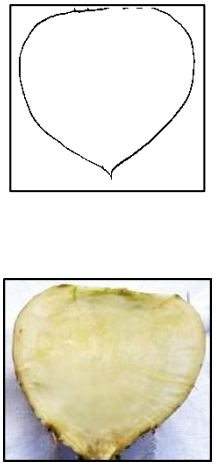
Broad Oblate (3)



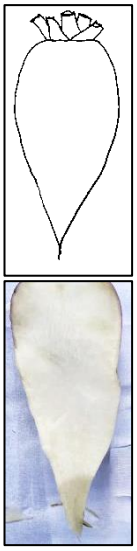
Circular (4)



Broad Oblong
(5)



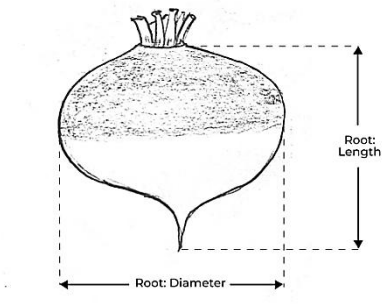
Narrow Obovate
(8)



Triangular
(9)

15. Root: Length

16. Root: Diameter (To be measured at the broadest part of the root)



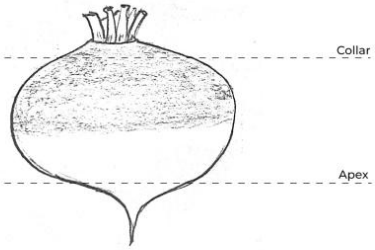
17. Root: Colour of skin above ground

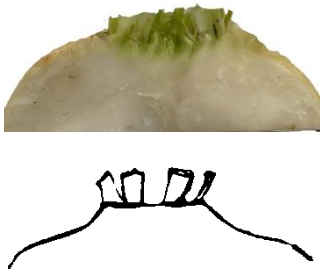
(To be recorded based on the colour occupying the maximum portion)

18. Root: Colour of skin below ground

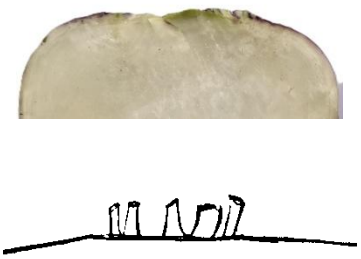
(To be recorded based on the colour occupying the maximum portion)

20.Root: Shape of collar

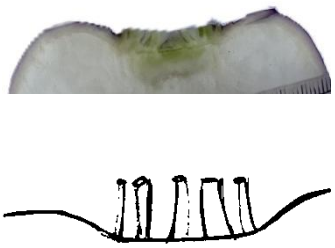




Raised (3)

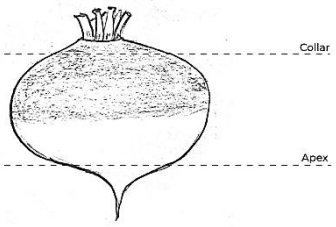


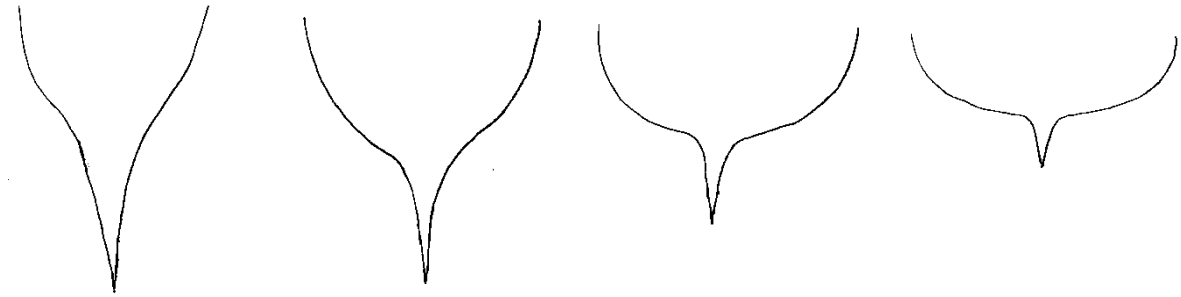
Flat (5)



Depressed (7)

21. Tuber: Shape of apex





Acute (1) Obtuse (3) Round (5) Truncate (7)

23. Flowering: Days to 50% flowering

Duration from date of replanting to the date when 50% plants in the population have at least one open flower.

IX. Working Group details

The DUS test guidelines have been developed by the project team and refined by the Task Force constituted by the PPV & FR Authority for Turnip (*Brassica rapa* var. *rapa* L.)

Task Force Members

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2.	Dr. Javid Iqbal Mir Senior Scientist (Plant Biotechnology) ICAR- Central Institute of Temperate Horticulture, Old Air Field, Rangreth, Srinagar-191132 (J&K) M: 9419067788/ 9906602101 email: javidiqbal1234@gmail.com	Member

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5.	Dr. Baseerat Afroza Professor/ PI Division of Vegetable Science, SKUAST-K, Shalimar, Srinagar-190025 M-9419083024 bafroza@gmail.com	Member
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Nodal persons

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X. Name of DUS Test Centre

Nodal center

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