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Original Research Article

Distinctness, Uniformity and Stability Characterization of Turnip (*Brassica rapa* var. *rapifera* L.) Genotypes

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Keywords

Turnip, *Brassica rapa var. rapifera*, DUS characterization, Genotypes

A B S T R A C T

Turnip (*Brassica rapa* var. *rapifera* L.) (2n=2x=20) belongs to the family Brassicaceae. A study was carried out during *rabi* 2019 on DUS characterization of turnip genotypes to establish distinctness, uniformity and stability. Observations were recorded on ten DUS traits *viz*., leaf colour, leaf margins, colour of upper portion of root, colour of lower portion of root, flesh colour, root shape, core colour, pithiness, root branching and pungency as per guidelines of PPV & FR authority (PPV&FR, 2001). The genotypes used in the study, upon categorization showed variation with respect to vegetative and root characters. A wide range of variation was found among the genotypes for various morphological traits. Among various characters taken into consideration during the present study, traits *viz*., leaf colour, colour of upper portion of root, colour of lower portion of root, root shape and pungency showed maximum variation.

Introduction

Turnip (*Brassica rapa* var. *rapifera* L.) (2n=2x=20) belonging to family Brassicaceae, is a biennial root vegetable cultivated worldwide as vegetable and fodder (Rakow, 2004; Hammer *et al*., 2013). Brassica is a diverse genus that contains species used for oilseeds, leafy or root vegetables, and condiments (Persson *et al.*, 2001; Talebi *et al.*, 2010). One important food crop in this genus is "Turnip". It is said to have two centres of origin. The Mediterranean region is thought to be the primary centre of European types while as Eastern Afghanistan with adjoining area of Pakistan is considered to be another primary centre.

It is an important root vegetable grown as a summer crop in temperate climate and as a winter vegetable in subtropical places where the winter is not severe. It can be grown up to an elevation of 1500m above mean sea level or above but it is not suitable for growing in low lands of wet tropics (Thamburaj and

Singh 2018). In India it is cultivated in an area of 2500 ha with an annual production of 50,000 tonnes (Anonymous, 2017). Being signatory to the general agreement on trade and tariffs, Government of India has enacted its *sui generis* system of protection of Plant Varieties and Farmers Right Act (PPV&FR), 2001 for providing protection to plant varieties based on Distinctness, Uniformity and Stability (DUS) test apart from novelty. Therefore characterization of variety is a prerequisite. Identification of plant varieties of common knowledge is essential for protection of new plant varieties.

Article 15.3(b) of PPV&FR Act states that the new variety must be clearly distinguishable by one or more essential characters from any variety whose existence is a matter of common knowledge at the time of seeking protection. The uniqueness of a variety is to be established by a test called DUS. The Act has provision to compare the candidate variety with the varieties of common knowledge on a set of relevant characteristics prescribed in the 'Minimal descriptor of vegetable crops' for turnip (Srivastava *et al.*, 2001).

Characterization of variety is useful to identify and avoid duplication (Ramteke *et al.*, 2012). Qualitative characters being more stable over generations (Raut, 2003) are more reliable for characterization of varieties. Therefore the present study was planned to characterize the available turnip varieties for their traits.

Materials and Methods

Twenty eight turnip genotypes were grown in randomized complete block design (RCBD) with three replications for each genotype during *Rabi* 2019 at Vegetable Experimental field Division of Vegetable Science SKUAST, Shalimar Kashmir which is situated at 34°N latitude and 74.89°E longitude and at an altitude of 1685 meters above mean sea level.

The crop was grown in plots of 2m long and 0.75m wide plots at a spacing of 30cm row to row distance and 15cm plant to plant distance. The crop was grown according to recommended package of practices.

Observations on 10 different traits *viz*., leaf colour, leaf margins, colour of upper portion of skin, colour of lower portion of skin, core colour, flesh colour, root shape, root branching, pithiness and pungency were recorded as per stages mentioned by Minimal Descriptor of Vegetable Crops (Table 1).

Results and Discussion

To establish distinctness among the turnip genotypes DUS testing was done as per DUS testing guidelines of PPV& FR Authority (2001).Traits included in DUS testing are presented in Table.1.

Among the twenty eight turnip genotypes considerable variation was observed for various DUS traits (Table 2). In the present study, the leaf colour showed a wide variation ranging from light green to dark green.

The genotypes were grouped into three categories viz., Light Green (Nageen, SKAU-T-6, SKAU-T-14, SKAU-T-15, SKAU-T-17, SKAU-T-23 and SKAU-T-24), Green (SKAU-T-1, SKAU-T-2,SKAU-T-3,SKAU-T-5, SKAU-T-7, SKAU-T-9, SKAU-T-10, SKAU-T-11, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-18, SKAU-T-20, SKAU-T-21 and SKAU-T-26) and Dark Green (SKAU-T-4, SKAU-T-8, SKAU-T-16, SKAU-T-19, SKAU-T-22 and SKAU-T-25) (Fig. 1).

Table.1 Table of characteristics

S. No	Characteristic	state	Note	Stage of observation	Type of assessment
1	Leaf colour	Light green Green Dark green Red Dark red	1 2 3 4 5	Marketable root harvest stage	Visual
2	Leaf margins	Serrate Entire Dentate	1 2 3	Marketable root harvest stage	Visual
3	Colour of upper portion of root skin	White Creamy white Green Pink Light red	1 2 3 4 5	Marketable root harvest stage	Visual
4	Colour of lower portion of root skin	White Creamish yellow	1 2 3	Marketable root harvest stage	Visual
5	Flesh colour	White Creamy white Green Pink	1 2 3 4	Marketable root harvest stage	Visual
6	Root shape	Uniform Tapering Stump Others	1 2 3 99	Marketable root harvest stage	Visual
7	Core colour	White Creamy white Green Pink	1 2 3 4	Marketable root harvest stage	Visual
8	Pithiness	Absent Present	0 1	Marketable root harvest stage	Visual
9	Root branching	Absent Present	0 1	Marketable root harvest stage	Visual
10	Pungency	Absent Present	0 1	Marketable root harvest stage	Taste

Fig.1

Green

Dark Green

Light Green

Flattish Round

Round

Table.2 DUS Characterization of turnip (*Brassica rapa* var. *rapifera* L.) genotypes

S.NO	Characteristics	States	Genotypes
1	Leaf colour	Light green	Nageen, SKAU-T-6, SKAU-T-14, SKAU-T-15, SKAU-T-17, SKAU-T-23 and SKAU-T-24
		Green	SKAU-T-1, SKAU-T-2,SKAU-T-3,SKAU-T-5, SKAU-T-7, SKAU-T-9, SKAU-T-10, SKAU-T-11, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-18, SKAU-T-20, SKAU-T-21 and SKAU-T-26
		Dark green	SKAU-T-4, SKAU-T-8, SKAU-T-16, SKAU-T-19, SKAU-T-22 and SKAU-T-25
2	Leaf margins	Dentate	SKAU-T-1, SKAU-T-2, SKAU-T-3, SKAU-T-4, Nageen, SKAU-T-5, SKAU-T-6, SKAU-T-7, SKAU-T-8, SKAU-T-9, SKAU-T-10, SKAU-T-11, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-14, SKAU-T-15, SKAU-T-16, SKAU-T-17, SKAU-T-18, SKAU-T-19, SKAU-T-20, SKAU-T-21, SKAU-T-22, SKAU-T-23, SKAU-T-24, SKAU-T-25, SKAU-T-26
3	Colour of upper portion of root skin	Creamish	SKAU-T-1, SKAU-T-2, SKAU-T-4, SKAU-T-6, SKAU-T-20 and SKAU-T-23
		White	Nageen and SKAU-T-14
		Light green	SKAU-T-5 and SKAU-T-10
		Pink	SKAU-T-3, SKAU-T-9, SKAU-T-11 and SKAU-T-17
		Purple	SKAU-T-7, SKAU-T-8, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-15, SKAU-T-16,SKAU-T-18,SKAU-T-19,SKAU-T-21,SKAU-T-22, SKAU-T-24, SKAU-T-25 AND SKAU-T-26

4	Colour of lower portion of root skin	White Pink Purple	SKAU-T-1, SKAU-T-2, SKAU-T-4,Nageen, SKAU-T-5, SKAU-T-6, SKAU-T-8, SKAU-T-10, PTWG, SKAU-T-13, SKAU-T-14, 15, SKAU-T-20, SKAU-T-23 and SKAU-T-26 SKAU-T-3, SKAU-T-9, SKAU-T-11 and SKAU-T-17 SKAU-T-7, SKAU-T-12, SKAU-T-16, SKAU-T-18, SKAU-T-19, SKAU-T-21, SKAU-T-22, SKAU-T-24 and SKAU-T-25
5	Flesh colour	White	SKAU-T-1, SKAU-T-2, SKAU-T-3, SKAU-T-4, Nageen, SKAU-T-5, SKAU-T-6, SKAU-T-7, SKAU-T-8, SKAU-T-9, SKAU-T-10, SKAU-T-11, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-14, SKAU-T-15, SKAU-T-16, SKAU-T-17, SKAU-T-18, SKAU-T-19, SKAU-T-20, SKAU-T-21, SKAU-T-22, SKAU-T-23, SKAU-T-24, SKAU-T-25, SKAU-T-26
6	Root shape	Round Flattish round	SKAU-T-1, SKAU-T-2, SKAU-T-4, Nageen, SKAU-T-7, PTWG, SKAU-T-15, SKAU-T-20 and SKAU-T-26 SKAU-T-3, SKAU-T-5, SKAU-T-6, SKAU-T-8, SKAU-T-9, SKAU-T-10, SKAU-T-11, SKAU-T-12, SKAU-T-13,SKAU-T-14, SKAU-T-16, SKAU-T-17, SKAU-T-18, SKAU-T-19, SKAU-T-21, SKAU-T-22, SKAU-T-23, SKAU-T-24 and SKAU-T-25
7	Core colour	White	SKAU-T-1, SKAU-T-2, SKAU-T-3, SKAU-T-4, Nageen, SKAU-T-5, SKAU-T-6, SKAU-T-7, SKAU-T-8, SKAU-T-9, SKAU-T-10, SKAU-T-11, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-14, SKAU-T-15, SKAU-T-16, SKAU-T-17, SKAU-T-18, SKAU-T-19, SKAU-T-20, SKAU-T-21, SKAU-T-22, SKAU-T-23, SKAU-T-24, SKAU-T-25, SKAU-T-26
8	Pithiness	Absent	SKAU-T-1, SKAU-T-2, SKAU-T-3, SKAU-T-4, Nageen, SKAU-T-5, SKAU-T-6, SKAU-T-7, SKAU-T-8, SKAU-T-9, SKAU-T-10, SKAU-T-11, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-14, SKAU-T-15, SKAU-T-16, SKAU-T-17, SKAU-T-18, SKAU-T-19, SKAU-T-20, SKAU-T-21, SKAU-T-22, SKAU-T-23, SKAU-T-24, SKAU-T-25, SKAU-T-26

		Present	___
9	Root branching	Absent	SKAU-T-1, SKAU-T-2, SKAU-T-3, SKAU-T-4, Nageen, SKAU-T-5, SKAU-T-6, SKAU-T-7, SKAU-T-8, SKAU-T-9, SKAU-T-10, SKAU-T-11, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-14, SKAU-T-15, SKAU-T-16, SKAU-T-17, SKAU-T-18, SKAU-T-19, SKAU-T-20, SKAU-T-21, SKAU-T-22, SKAU-T-23, SKAU-T-24, SKAU-T-25, SKAU-T-26
		Present	____
10	Pungency	Absent	SKAU-T-1, SKAU-T-2, SKAU-T-3, SKAU-T-4, Nageen, SKAU-T-5, SKAU-T-8, SKAU-T-10, SKAU-T-11, SKAU-T-13, SKAU-T-14, SKAU-T-15, SKAU-T-16, SKAU-T-18, SKAU-T-19, SKAU-T-20, SKAU-T-21, SKAU-T-23, SKAU-T-24, SKAU-T-25, SKAU-T-26
		Present	SKAU-T-6, SKAU-T-7 SKAU-T-9, PTWG, SKAU-T-12, SKAU-T-17, SKAU-T-22

On the basis of leaf margins, all the twenty eight genotypes (SKAU-T-1, SKAU-T-2, SKAU-T-3, SKAU-T-4, Nageen, SKAU-T-5, SKAU-T-6, SKAU-T-7, SKAU-T-8, SKAU-T-9, SKAU-T-10, SKAU-T-11, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-14, SKAU-T-15, SKAU-T-16, SKAU-T-17, SKAU-T-18, SKAU-T-19, SKAU-T-20, SKAU-T-21, SKAU-T-22, SKAU-T-23, SKAU-T-24, SKAU-T-25, SKAU-T-26) showed Dentate leaf margins. The colour of upper portion of root skin also showed variation of different colours and the genotypes were grouped into 5 categories *viz*., Creamish (SKAU-T-1, SKAU-T-2, SKAU-T-4, SKAU-T-6, SKAU-T-20 and SKAU-T-23), White (Nageen and SKAU-T-14), Light Greenish (SKAU-T-5 and SKAU-T-10), Pink (SKAU-T-3, SKAU-T-9, SKAU-T-11 and SKAU-T-17) and Purple (SKAU-T-7, SKAU-T-8, PTWG, SKAU-T-12, SKAU-T-13, SKAU-T-15, SKAU-T-16,SKAU-T-18,SKAU-T-19,SKAU-T-21,SKAU-T-22, SKAU-T-24, SKAU-T-25 AND SKAU-T-26). On the basis of colour of lower portion of root skin the genotypes were grouped into 3 categories *viz*., White (SKAU-T-1, SKAU-T-2, SKAU-T-4,Nageen, SKAU-T-5, SKAU-T-6, SKAU-T-8, SKAU-T-10, PTWG, SKAU-T-13, SKAU-T-14, 15, SKAU-T-20, SKAU-T-23 and SKAU-T-26), Pinkish (SKAU-T-3, SKAU-T-9, SKAU-T-11 and SKAU-T-17) and Purple (SKAU-T-7, SKAU-T-12, SKAU-T-16, SKAU-T-18, SKAU-T-19, SKAU-T-21, SKAU-T-22, SKAU-T-24 and SKAU-T-25). All the twenty eight genotype sunder study showed White Flesh Colour. On the basis of root shape twenty eight genotypes were classified into two groups viz, Flattish round root shape (SKAU-T-3, SKAU-T-5, SKAU-T-6, SKAU-T-8, SKAU-T-9, SKAU-T-10, SKAU-T-11, SKAU-T-12, SKAU-T-13,SKAU-T-14, SKAU-T-16, SKAU-T-17, SKAU-T-18, SKAU-T-19, SKAU-T-21, SKAU-T-22, SKAU-T-23, SKAU-T-24 and SKAU-T-25) and Round root shape (SKAU-T-1, SKAU-T-2, SKAU-T-4, Nageen, SKAU-T-7, PTWG, SKAU-T-15, SKAU-T-20 and SKAU-T-26). Core colour was white in all the genotypes. Also pithiness and root branching was absent in all the twenty eight genotype studied. In case of Pungency, among twenty eight genotypes, genotypes viz., SKAU-T-6, SKAU-T-7, SKAU-T-9, PTWG, SKAU-T-12, SKAU-T-17 and SKAU-T-23 showed pungency while in rest of the genotypes it was absent. The studies of Singh *et al.*, (2012) in cabbage, Gupta *et al.*, (2010) in soyabean, Singh *et al.*, (2013) in cauliflower, Choudhary *et al.*, (2015) in muskmelon also described the variation observed in different crops.

The genotypes characterized for various traits were grouped into different categories for each character. These varieties can be used in varietal improvement programme of turnip various desirable traits. It is concluded that DUS descriptor can be effectively used for identification and grouping of varieties and comparing candidate variety for registration under PPV&FR Act to protect farmers and breeders rights.

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