

Original Research Article

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Comparative Performance of Turnip (*Brassica rapa* var. *rapifera* L.) Genotypes for Various Quantitative and Quality Traits

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ABSTRACT

Keywords

Comparative Performance, *Brassica rapa* var. *rapifera* L., Genotypes, Variability

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The present investigation entitled Comparative Performance of Turnip (*Brassica rapa* var. *rapifera* L.) genotypes for various quantitative and quality traits was carried out at Vegetable Experimental Field, Division of Vegetable Science, SKUAST-K Shalimar, Kashmir to evaluate the mean performance of twenty-eight turnip genotypes during Rabi 2109. The experiment was carried out in Randomized complete block design (RCBD) with three replications for each genotype and the crop was sown at a spacing of 30 × 15 cm. The analysis of variance revealed mean sum of squares due to genotypes were significant for all the traits that were studied, indicating the presence of sufficient variability among the genotypes. Based on the mean performance of all the genotypes for various traits studied, the genotype viz., SKAU-T-4 was at par with Nageen which showed highest root yield followed by SKAU-T-3 while as minimum root yield was recorded in SKAU-T-23.

Introduction

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 is turnip (*Brassica rapa* var. *rapifera* L.) (2n=2x=20) which is a biennial root vegetable cultivated worldwide as vegetable and fodder (Rakow, 2004; Hammer *et al.*, 2013). 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).

The economic part is the thickened underground portion which is actually hypocotyl. The colour of this underground portion may be white or yellow while as that of the aboveground portion may be red, purple, yellow, pink or green. Normally the roots attain edible maturity in 40-80 days after sowing depending upon the cultivar and cultural conditions. Brassica flowers are born in racemes and are hermaphrodite but due to self-incompatibility these are cross pollinated.

The flowers open during the early hours of daylight and few hours later the anthers dehisce exposing their pollen while as the stigma becomes receptive five days prior to anthesis and remains up to four days after anthesis and during this time cross pollination is obligatory (McCormack, 2005)

There is scanty of literature regarding performance of turnip genotypes. So present study will generate the extent of variation among different genotypes of turnip for various quantitative and quality traits.

Materials and Methods

The present investigation was carried out at Vegetable Experimental field, SKAUST-K, Shalimar during *Rabi* 2019. The site of experimental field is located at an altitude of 1685 meters above mean sea level and situated at 34⁰N latitude and 74.89⁰E longitude. The climate of the site is temperate characterized by mild summers. The mean maximum and minimum temperatures are recorded in June-July and January-February (respectively).

Twenty-eight genotypes of turnip were evaluated for various quantitative and quality traits. The experiment was carried out in Randomized block design with three replications for each genotype. The crop was sown 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.

The observations were recorded for nineteen quantitative traits viz., seedling length, seedling fresh weight, seedling dry weight, leaf length, leaf breadth, petiole length, root length, root breadth, plant length, leaves/plant, total plant weight, total root weight, total shoot weight, root shoot ratio, root compactness, harvest index, root yield/ha, plant spread and leaf area and seven quality traits viz., total dry matter, total soluble solids, vitamin C, anthocyanin content, total sugars, reducing and non-reducing sugars.

Observations were recorded on five randomly selected plants of each genotype from all the three replications and mean was worked out. The data was subjected to statistical analysis using WINDOSTAT software package.

The data of quantitative and quality traits was statistically analysed as per the method lined by Gomez and Gomez (1983) for estimating the analysis of variance.

Results and Discussion

Analysis of variance

Analysis of variance (ANOVA) exposed significant differences among all the genotypes for all the traits that were studied during present investigation (Table 1a and Table 1b) hence, depicting the presence of adequate genetic variability among these turnip genotypes and substantial scope of improvement for these traits.

This was in agreement with Nasarullah (1994) in turnip, Mukhdoomi *et al.*, (2007) in radish, Naseeruddin *et al.*, (2011) in radish, Guleria (2016) in radish.

Table.1a Analysis of variance for various quantitative traits in Turnip (*Brassica rapa* var. *rapifera* L.).

Source of variation	D.f	Mean sum of squares																		
		Seedling length (cm)	Seedling fresh weight (g)	Seedling dry weight (g)	Leaf length (cm)	Leaf breadth (cm)	Petiole length (cm)	Root length (cm)	Root breadth (cm)	Plant length (cm)	Leaves per plant	Total plant weight (g)	Total root weight (g)	Total shoot weight (g)	Root shoot ratio	Root compactness	Harvest index (%)	Root yield (q/ha)	Plant spread (cm)	Leaf area (cm ²)
Replication	2	10.56*	0.09	0.003*	11.76*	28.36*	3.04	0.72*	0.08	10.04	16.94*	11.67	38.61	14.59	0.15	277.27	22.78*	144.083	5.59	8.49
Treatments	27	11.28**	1.64**	0.04**	10.41**	6.16**	8.33**	0.86**	3.15**	15.12*	1.54**	7405.12*	4872.54*	342.38**	0.84**	753.44**	25.35*	19439.75**	32.08*	2013.92*
error	54	1.88	0.20	0.0008	2.13	1.24	2.15	0.15	0.15	3.89	0.59	62.35	14.11	13.28	0.08	95.77	6.59	55.09	4.77	10.76

Table.1b Analysis of variance for various quality traits in Turnip (*Brassica rapa* var. *rapifera* L.).

Source of variation	d. f	Mean sum of squares						
		Total dry matter (%)	Total soluble Solids (°Brix)	Vit. C (mg/100g)	Anthocyanin Content (mg/100g)	Total sugars (%)	Reducing Sugars (%)	Non- reducing Sugars (%)
Replication	2	1.01	0.15	8.03	0.004	0.11	0.09	0.13
Treatments	27	8.50**	2.41**	52.38**	3.33**	0.99**	0.37**	0.23**
Error	54	2.46	0.07	5.67	0.03	0.09	0.03	0.06

*, **-. Significant at 5% and 1% level of significance respectively

Table.2a Mean performance of Turnip (*Brassica rapa* var. *rapifera*) genotypes for various quantitative traits

S. No	Genotype	Seedling length (cm)	Seedling fresh weight (g)	Seedling dry weight (g)	Leaf length (cm)	Leaf breadth (cm)	Petiole length (cm)	Root length (cm)	Root breadth (cm)	Plant length (cm)	Leaves plant ⁻¹
1	SKAU-T-1	22.90 ^{cdefgh}	5.13 ^{abcd}	0.50 ^{efg}	18.70 ^h	11.93 ^{bcdefgh}	12.36 ^{ghijk}	4.91 ^{ghij}	6.33 ^{def}	51.16 ^{efghij}	9.00 ^{ef}
2	SKAU-T-2	20.26 ^{ijk}	4.04 ^{ghijklm}	0.23 ^o	20.36 ^{efghg}	10.78 ^{fghi}	13.66 ^{cdefghi}	5.63 ^{bede}	6.73 ^{cde}	49.33 ^{hij}	10.66 ^{abc}
3	SKAU-T-3	18.73 ^k	3.53 ^{lmnop}	0.30 ⁿ	21.30 ^{cdefg}	12.46 ^{bcdefg}	10.96 ^k	5.83 ^{bed}	7.76 ^{ab}	55.23 ^{abc}	9.33 ^{def}
4	SKAU-T-4	21.66 ^{efghij}	3.87 ^{ijklmn}	0.42 ^{ijk}	23.30 ^{abc}	11.23 ^{efgh}	14.14 ^{bcdefgh}	5.20 ^{defghi}	7.20 ^{bc}	55.60 ^{ab}	11.00 ^{ab}
5	Nageen	21.16 ^{ghij}	3.10 ^{op}	0.30 ⁿ	24.43 ^a	16.30 ^a	14.80 ^{abcdef}	5.60 ^{bcdef}	7.10 ^c	52.96 ^{bcdefg}	9.00 ^{ef}
6	SKAU-T-5	20.83 ^{hijk}	3.84 ^{ijklmno}	0.45 ^{hij}	22.90 ^{abcd}	13.10 ^{bcd}	13.05 ^{defghijk}	5.26 ^{cdefg}	7.76 ^{ab}	51.40 ^{defghij}	9.66 ^{cdef}
7	SKAU-T-6	22.83 ^{cdefgh}	3.17 ^{nop}	0.31 ^{mn}	23.83 ^{ab}	13.66 ^b	11.23 ^{jk}	5.03 ^{efghi}	7.20 ^{bc}	52.26 ^{cdefgh}	10.66 ^{abc}
8	SKAU-T-7	19.66 ^{jk}	3.37 ^{mno}	0.35 ^{lm}	21.70 ^{bcdef}	12.30 ^{bcdefgh}	17.05 ^a	5.60 ^{bcdef}	7.93 ^a	56.06 ^{ab}	10.66 ^{abc}
9	SKAU-T-8	21.83 ^{efghij}	2.95 ^p	0.41 ^{jk}	20.40 ^{efgh}	10.60 ^{hij}	11.40 ^{ijk}	4.96 ^{fghij}	7.10 ^c	54.23 ^{abcde}	10.33 ^{abcd}
10	SKAU-T-9	21.33 ^{fghij}	4.16 ^{fghijkl}	0.52 ^{ef}	22.13 ^{abcde}	11.30 ^{defgh}	14.96 ^{abcdef}	5.00 ^{efghi}	7.20 ^{bc}	54.40 ^{abcd}	9.33 ^{def}
11	SKAU-T-10	23.90 ^{bcde}	4.70 ^{cdefgh}	0.57 ^{cd}	20.83 ^{defgh}	12.00 ^{bcdefgh}	12.93 ^{defghijk}	4.56 ^{ijk}	6.96 ^{cd}	51.13 ^{efghij}	9.00 ^{ef}
12	SKAU-T-11	21.10 ^{ghij}	3.73 ^{klmno}	0.43 ^{ij}	21.16 ^{cdefg}	12.50 ^{bcdefg}	13.50 ^{cdefghij}	5.26 ^{cdefg}	6.76 ^{cde}	50.73 ^{fghij}	9.33 ^{def}
13	PTWG	23.53 ^{cdef}	4.30 ^{efghijk}	0.52 ^{ef}	22.80 ^{abcd}	12.60 ^{bcdef}	10.96 ^k	4.33 ^{jk}	7.36 ^{abc}	53.33 ^{abcdefg}	10.00 ^{bcde}
14	SKAU-T-12	21.73 ^{efghij}	3.96 ^{hijklm}	0.51 ^{efg}	19.76 ^{efgh}	10.60 ^{hij}	12.70 ^{efghijk}	5.23 ^{defgh}	7.13 ^{bc}	49.20 ^{hij}	10.00 ^{bcde}
15	SKAU-T-13	23.13 ^{cdefg}	4.83 ^{bcdef}	0.55 ^{de}	23.33 ^{abc}	12.80 ^{bcde}	12.70 ^{efghijk}	4.23 ^k	7.26 ^{bc}	48.60 ^j	9.00 ^{ef}
16	SKAU-T-14	22.03 ^{defghi}	4.53 ^{defghij}	0.50 ^{efg}	22.90 ^{abcd}	12.76 ^{bcde}	15.46 ^{abc}	5.73 ^{bcd}	7.20 ^{bc}	56.43 ^a	9.00 ^{ef}
17	SKAU-T-15	21.23 ^{ghij}	5.01 ^{abcde}	0.58 ^{cd}	20.66 ^{defgh}	13.40 ^{bc}	14.56 ^{bcdefg}	5.90 ^{bc}	7.00 ^c	54.03 ^{abcde}	9.66 ^{cdef}
18	SKAU-T-16	24.10 ^{bcd}	5.50 ^{ab}	0.58 ^{cd}	22.80 ^{abcd}	12.53 ^{bcdef}	14.13 ^{bcdefgh}	5.33 ^{bcdefg}	6.06 ^{fg}	51.73 ^{defghij}	10.00 ^{bcde}
19	SKAU-T-17	25.83 ^{ab}	4.73 ^{cdefg}	0.60 ^c	20.70 ^{defgh}	11.26 ^{efgh}	13.43 ^{cdefghij}	5.26 ^{cdefg}	5.13 ^{hi}	48.76 ^{ij}	9.33 ^{def}
20	SKAU-T-18	23.16 ^{cdefg}	4.60 ^{cdefghi}	0.60 ^c	21.06 ^{cdefgh}	12.36 ^{bcdefgh}	11.76 ^{hijk}	6.66 ^a	4.73 ⁱ	54.33 ^{abcde}	10.33 ^{abcd}
21	SKAU-T-19	22.73 ^{cdefgh}	4.11 ^{fghijklm}	0.49 ^{fgh}	19.22 ^{gh}	11.63 ^{cdefgh}	15.00 ^{abcde}	4.71 ^{ghijk}	6.06 ^{fg}	53.80 ^{abcdef}	10.66 ^{abc}
22	SKAU-T-20	24.46 ^{bc}	5.05 ^{abcd}	0.66 ^{ab}	19.33 ^{fgh}	11.23 ^{efgh}	15.30 ^{abcd}	5.96 ^b	6.23 ^{efg}	51.20 ^{defghij}	11.33 ^a
23	SKAU-T-21	22.76 ^{cdefgh}	5.28 ^{abc}	0.66 ^b	21.73 ^{bcde}	10.93 ^{fghi}	15.33 ^{abcd}	4.73 ^{ghijk}	5.16 ^{hi}	51.30 ^{defghij}	10.00 ^{bcde}
24	SKAU-T-22	26.06 ^{ab}	5.12 ^{abcd}	0.59 ^{cd}	20.36 ^{efgh}	8.86 ^j	12.06 ^{hijk}	4.80 ^{ghijk}	4.83 ⁱ	50.23 ^{ghij}	10.33 ^{abcd}
25	SKAU-T-23	24.66 ^{bc}	4.82 ^{bcdef}	0.50 ^{fgh}	16.00 ⁱ	9.13 ^{ij}	16.40 ^{ab}	5.00 ^{efghi}	4.83 ⁱ	49.43 ^{hij}	9.33 ^{def}
26	SKAU-T-24	27.23 ^a	5.71 ^a	0.71 ^a	18.70 ^h	10.70 ^{ghi}	15.13 ^{abcd}	5.20 ^{defghi}	5.23 ^{hi}	53.00 ^{bcdefg}	8.66 ^f
27	SKAU-T-25	23.90 ^{bcde}	4.29 ^{efghijk}	0.38 ^{kl}	21.63 ^{bcdef}	12.36 ^{bcdefgh}	12.26 ^{ghijk}	4.60 ^{hijk}	4.76 ⁱ	51.83 ^{defghi}	9.33 ^{def}
28	SKAU-T-26	23.33 ^{cdefg}	4.05 ^{fghijkl}	0.46 ^{ghi}	23.00 ^{abcd}	12.00 ^{bcdefgh}	12.56 ^{fghijk}	5.33 ^{bcdefg}	5.63 ^{gh}	52.03 ^{cdefgh}	10.33 ^{abcd}
C.D.5%		2.24	0.74	0.04	2.38	1.82	2.40	0.64	0.63	3.23	1.26
S.E.Diff		1.12	0.37	0.02	1.19	0.91	1.19	0.32	0.31	1.61	0.62

Table.2b Mean performance of Turnip (*Brassica rapa* var. *rapifera*) genotypes for various quantitative traits

S.no	Genotype	Total plant weight(g)	Total root weight(g)	Total shoot weight(g)	Root shoot ratio	Root compactness	Harvest index(%)	Root yield (q/ha))	Plant spread (cm)	Leaf area (cm ²)
1	SKAU-T-1	173.33 ^{hij}	134.66 ^h	40.00 ^{hijk}	3.36 ^{defgh}	76.78 ^{bcdefg}	77.70 ^{bcdef}	269.33 ^h	52.00 ^{cdefgh}	227.70 ^{fg}
2	SKAU-T-2	194.66 ^{fg}	145.33 ^g	46.66 ^{efg}	3.13 ^{ghi}	62.90 ^{fghij}	74.60 ^{efgh}	290.66 ^g	51.60 ^{cdefghi}	259.40 ^c
3	SKAU-T-3	260.66 ^b	201.16 ^b	61.83 ^{ab}	3.22 ^{fghi}	63.66 ^{efghij}	76.50 ^{cdef}	402.33 ^b	50.46 ^{defghij}	204.53 ^m
4	SKAU-T-4	285.00 ^a	231.00 ^a	54.00 ^{cd}	4.29 ^a	91.00 ^{ab}	81.03 ^{ab}	462.00 ^a	47.40 ^{jk}	221.93 ^{hi}
5	Nageen	295.00 ^a	235.33 ^a	56.00 ^{bc}	4.17 ^{ab}	91.46 ^{ab}	79.01 ^{abcd}	470.66 ^a	50.46 ^{defghij}	262.33 ^{bc}
6	SKAU-T-5	144.66 ^{mn}	107.00 ^{kl}	37.66 ^{ijkl}	2.84 ^{ij}	39.24 ^l	73.96 ^{fghi}	214.00 ^{kl}	54.76 ^{bc}	266.46 ^b
7	SKAU-T-6	214.33 ^d	165.66 ^e	50.00 ^{def}	3.35 ^{defgh}	72.51 ^{defgh}	77.46 ^{bcdef}	331.33 ^e	53.16 ^{cdefg}	287.63 ^a
8	SKAU-T-7	209.66 ^{de}	166.00 ^e	46.33 ^{efg}	3.59 ^{cdefg}	53.74 ^{ijkl}	79.28 ^{abc}	332.00 ^e	58.30 ^{ab}	206.36 ^{lm}
9	SKAU-T-8	209.33 ^{de}	170.66 ^{de}	45.33 ^{efgh}	3.73 ^{bcde}	77.54 ^{bcdef}	77.06 ^{bcdef}	341.33 ^{de}	51.56 ^{cdefghi}	217.43 ^{ij}
10	SKAU-T-9	271.00 ^b	200.00 ^b	64.66 ^a	3.00 ^{hij}	87.50 ^{abcd}	73.90 ^{fghi}	400.00 ^b	51.60 ^{cdefghi}	252.30 ^d
11	SKAU-T-10	164.00 ^{jk}	126.00 ⁱ	53.33 ^{cd}	2.20 ^l	61.16 ^{ghijk}	71.40 ^{hi}	252.00 ⁱ	50.26 ^{efghij}	183.26 ^p
12	SKAU-T-11	149.33 ^{lm}	108.00 ^{kl}	41.33 ^{ghij}	2.63 ^{jkl}	49.66 ^{jkl}	72.26 ^{ghi}	216.00 ^{kl}	50.93 ^{defghij}	214.76 ^{jk}
13	PTWG	228.33 ^c	176.33 ^{cd}	62.66 ^a	2.81 ^{ijk}	89.65 ^{abc}	77.26 ^{bcdef}	352.66 ^{cd}	54.00 ^{cd}	195.96 ^{no}
14	SKAU-T-12	140.66 ^{mn}	108.00 ^{jk}	32.66 ^{lm}	3.33 ^{defgh}	46.23	76.70 ^{cdef}	219.33 ^{jk}	58.86 ^a	203.83 ^m
15	SKAU-T-13	165.33 ^{ijk}	124.00 ⁱ	41.33 ^{ghij}	2.99 ^{hij}	65.93 ^{efghi}	74.93 ^{defgh}	248.00 ⁱ	51.33 ^{cdefghi}	217.06 ^{ij}
16	SKAU-T-14	218.66 ^{cd}	181.33 ^c	44.33 ^{fgh}	4.12 ^{ab}	67.09 ^{efghi}	82.96 ^a	362.66 ^c	46.50 ^k	220.20 ^{hi}
17	SKAU-T-15	163.33 ^{jk}	127.33 ⁱ	41.33 ^{ghij}	3.02 ^{hij}	46.46 ^{kl}	76.33 ^{cdefg}	254.66 ⁱ	51.13 ^{defghi}	240.20 ^e
18	SKAU-T-16	136.66 ^{mn}	108.00 ^{kl}	34.33 ^{klm}	3.15 ^{ghi}	58.76 ^{hijk}	79.05 ^{abcd}	216.00 ^{kl}	46.50 ^k	218.33 ^{hi}
19	SKAU-T-17	159.33 ^{kl}	126.00 ⁱ	34.00 ^{lm}	3.69 ^{bcdef}	86.63 ^{abcd}	78.60 ^{bcde}	252.00 ⁱ	53.73 ^{cdef}	223.60 ^{gh}
20	SKAU-T-18	145.33 ^{mn}	102.00 ^l	43.33 ^{ghi}	2.35 ^{kl}	55.66 ^{ijk}	70.16 ⁱ	204.00 ^l	49.86 ^{ghijk}	219.83 ^{hij}
21	SKAU-T-19	199.66 ^{ef}	151.66 ^f	50.33 ^{cde}	2.97 ^{hij}	95.30 ^a	74.73 ^{efgh}	303.33 ^f	53.50 ^{cdef}	252.76 ^d
22	SKAU-T-20	178.00 ^{hi}	144.33 ^g	36.66 ^{jklm}	3.85 ^{abc}	62.70 ^{fghij}	79.38 ^{abc}	288.66 ^g	53.06 ^{cdefg}	211.36 ^{kl}
23	SKAU-T-21	145.33 ^{mn}	114.33 ^j	34.00 ^{lm}	3.27 ^{efghi}	88.40 ^{abcd}	76.56 ^{cdef}	228.66 ^j	50.16 ^{fghij}	237.73 ^e
24	SKAU-T-22	121.33 ^o	95.33 ^m	25.33 ⁿ	3.78 ^{bed}	75.80 ^{bcdefg}	78.64 ^{bcde}	190.66 ^m	50.66 ^{defghij}	201.13 ^{mn}
25	SKAU-T-23	117.33 ^o	91.33 ^m	24.00 ⁿ	3.90 ^{abc}	79.66 ^{abcde}	79.46 ^{abc}	182.66 ^m	53.80 ^{cde}	193.60 ^o
26	SKAU-T-24	135.00 ⁿ	103.66 ^{kl}	31.33 ^m	3.64 ^{cdef}	74.76 ^{cdefgh}	76.76 ^{cdef}	207.33 ^{kl}	59.46 ^a	188.20 ^p
27	SKAU-T-25	135.33 ⁿ	107.66 ^{kl}	34.33 ^{klm}	3.03 ^{hij}	87.96 ^{abcd}	76.83 ^{bcdef}	215.33 ^{kl}	49.43 ^{hijk}	230.13 ^f
28	SKAU-T-26	183.33 ^{gh}	147.00 ^{fg}	38.00 ^{ijkl}	3.88 ^{abc}	77.18 ^{bcdefg}	80.15 ^{abc}	294.00 ^{gf}	48.06 ^{ijk}	252.23 ^d
C.D at 5%		12.92	6.14	5.96	0.48	16.02	4.20	12.15	3.57	5.37
S.E.Diff		6.44	3.06	2.97	0.24	7.99	2.09	6.06	1.78	2.67

Table.2c Mean performance of Turnip (*Brassica rapa* var. *rapifera*) genotypes for various quality traits

S. no	Genotypes	Total dry matter (%)	Total soluble solids (⁰ Brix)	Vit. C (mg/100g)	Anthocyanin Content (mg/100g)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)
1	SKAU-T-1	10.31 ^{fghi}	6.80 ^a	33.00 ^a	1.73 ^{no}	3.74 ^a	2.70 ^a	1.04 ^{bc}
2	SKAU-T-2	7.79 ⁱ	5.73 ^{defgh}	20.66 ^{kl}	1.96 ^{mno}	2.28 ^{efghi}	1.57 ^{hijk}	0.69 ^{bcdefghi}
3	SKAU-T-3	11.28 ^{defg}	3.80 ^o	24.00 ^{ghijk}	3.26 ^{def}	3.05 ^b	2.19 ^{bc}	0.86 ^{bcdef}
4	SKAU-T-4	9.07 ^{ghi}	5.13 ^{jklm}	22.00 ^{ijk}	2.22 ^{lm}	2.43 ^{defgh}	1.90 ^{cdefg}	0.53 ^{efghi}
5	Nageen	8.64 ^{hi}	5.46 ^{ghijk}	25.33 ^{fghi}	1.73 ^{no}	2.36 ^{defgh}	1.53 ^{jk}	0.82 ^{bcdefgh}
6	SKAU-T-5	11.32 ^{defg}	5.46 ^{ghijk}	22.66 ^{hijk}	3.51 ^d	2.84 ^{bcd}	2.03 ^{cde}	0.80 ^{bcdefgh}
7	SKAU-T-6	11.88 ^{bcdef}	5.86 ^{cdefg}	24.00 ^{ghijk}	1.67 ^o	1.79 ⁱ	1.46 ^k	0.33 ⁱ
8	SKAU-T-7	13.22 ^{bcd}	4.73 ^{mn}	32.00 ^{ab}	3.14 ^{efg}	1.96 ^{hi}	1.53 ^{jk}	0.42 ^{hi}
9	SKAU-T-8	11.34 ^{defg}	3.66 ^o	21.33 ^{jkl}	2.87 ^{ghi}	2.46 ^{cdefgh}	2.00 ^{cdef}	0.45 ^{fghi}
10	SKAU-T-9	10.83 ^{defgh}	5.13 ^{jklm}	26.33 ^{efgh}	1.26 ^p	2.05 ^{ghi}	1.68 ^{ghijk}	0.36 ^l
11	SKAU-T-10	12.06 ^{bcdef}	6.13 ^{bcd}	26.66 ^{defg}	1.97 ^{mno}	2.63 ^{bcdef}	1.92 ^{cdefg}	0.84 ^{bcdefg}
12	SKAU-T-11	12.90 ^{bcde}	4.86 ^{klm}	26.33 ^{efgh}	2.90 ^{ghi}	3.72 ^a	2.63 ^a	1.09 ^{ab}
13	PTWG	16.14 ^a	6.73 ^a	28.00 ^{cdef}	2.99 ^{fgh}	2.42 ^{cdefgh}	1.79 ^{defghij}	0.63 ^{cdefghi}
14	SKAU-T-12	10.87 ^{defgh}	6.03 ^{bcde}	30.33 ^{abcd}	3.35 ^{de}	2.36 ^{defgh}	1.91 ^{cdefg}	0.44 ^{ghi}
15	SKAU-T-13	11.82 ^{cdef}	5.96 ^{cdef}	28.00 ^{cdef}	2.68 ^{ijk}	2.25 ^{efghi}	1.71 ^{fghijk}	0.53 ^{defghi}
16	SKAU-T-14	14.39 ^{ab}	5.66 ^{efgh}	28.33 ^{bcdef}	1.97 ^{mn}	3.80 ^a	2.70 ^a	1.10 ^{ab}
17	SKAU-T-15	13.10 ^{bcd}	5.03 ^{klm}	29.33 ^{abcde}	1.81 ^{no}	2.63 ^{bcdef}	2.19 ^{bc}	0.44 ^{ghi}
18	SKAU-T-16	11.95 ^{bcdef}	6.26 ^{bc}	28.33 ^{bcdef}	2.42 ^{kl}	2.90 ^{bc}	1.95 ^{cdefg}	0.95 ^{bcd}
19	SKAU-T-17	10.41 ^{efgh}	4.56 ⁿ	23.00 ^{abc}	2.87 ^{ghi}	2.29 ^{efghi}	1.84 ^{defghi}	0.44 ^{fghi}
20	SKAU-T-18	11.56 ^{cdefg}	6.46 ^{ab}	30.66 ^{ghijk}	3.16 ^{efg}	2.90 ^{bc}	2.02 ^{cde}	0.88 ^{bcde}
21	SKAU-T-19	11.73 ^{cdef}	5.30 ^{hijkl}	32.00 ^{ab}	2.77 ^{hij}	2.36 ^{defgh}	1.68 ^{ghijk}	0.67 ^{cdefghi}
22	SKAU-T-20	13.97 ^{abc}	2.76 ^p	26.00 ^{efgh}	4.16 ^c	2.11 ^{ghi}	1.66 ^{ghijk}	0.45 ^{fghi}
23	SKAU-T-21	11.46 ^{cdefg}	5.60 ^{efghi}	18.00 ^l	5.04 ^b	2.21 ^{fghi}	1.56 ^{hijk}	0.65 ^{cdefghi}
24	SKAU-T-22	11.36 ^{defg}	5.13 ^{jklm}	17.66 ^l	2.51 ^{jkl}	1.98 ^{hi}	1.54 ^{ijk}	0.42 ^{hi}
25	SKAU-T-23	11.59 ^{cdefg}	5.56 ^{fghj}	21.00 ^{kl}	3.05 ^{fgh}	2.74 ^{bcde}	1.74 ^{efghijk}	1.00 ^{bc}
26	SKAU-T-24	12.73 ^{bcdef}	5.20 ^{ijkl}	22.00 ^{ijk}	5.96 ^a	3.91 ^a	2.42 ^{ab}	1.48 ^a
27	SKAU-T-25	12.13 ^{bcdef}	5.06 ^{klm}	25.00 ^{fghij}	4.28 ^c	2.89 ^{bc}	2.06 ^{cd}	0.83 ^{bcdefgh}
28	SKAU-T-26	11.65 ^{cdef}	5.56 ^{fghij}	22.00 ^{ijk}	3.12 ^{efg}	2.50 ^{cdefg}	1.86 ^{defgh}	0.64 ^{cdefghi}
C.D 5%		2.57	0.46	3.90	0.29	0.51	0.30	0.41

Mean Performance of different Genotypes

The estimates of mean values (Table 2a, 2b and 2c) revealed that no single genotype was superior for all the characters under study. However SKAU-T-24 (27.23cm) followed by SKAU-T-22 (26.06cm) and SKAU-T-17 (25.83cm) were superior for seedling length. SKAU-T-24 (5.71g) followed by SKAU-T-16 (5.50g) and SKAU-T-21 (5.28g) were superior for seedling fresh weight, SKAU-T-24 (0.71g) followed by SKAU-T-20 and SKAU-T-21 (0.66g each) and SKAU-T-2 (0.23g) were found superior for seedling dry weight. Nageen (24.43cm) followed by SKAU-T-6 (23.83cm) and SKAU-T-13 (23.33cm) were found superior for leaf length, Nageen (16.30cm) followed by SKAU-T-6 (13.66cm) and SKAU-T-15 (13.40cm) were found superior for leaf breadth, SKAU-T-7 (17.05cm) followed by SKAU-T-23 (16.40cm) and SKAU-T-14 (15.46cm) for petiole length, SKAU-T-18 (6.66cm) followed by SKAU-T-20 (5.96cm) and SKAU-T-15 (5.90cm) for root length, SKAU-T-7 (7.93cm) followed by SKAU-T-3 and SKAU-T-5 (7.76cm each) for root breadth, SKAU-T-14 (56.43cm) followed by SKAU-T-7 (56.06cm) and SKAU-T-4 (55.60cm) for plant length, SKAU-T-20 (11.33) followed by SKAU-T-4 (11) and SKAU-T-2 (10.66) for leaves/plant, Nageen (295g) followed by SKAU-T-4 (285g) and SKAU-T-9 (271.00g) for total plant weight, Nageen (235.33g) followed by SKAU-T-4 (231.00g) and SKAU-T-3 (201.16g) for total root weight, SKAU-T-9 (64.66g) followed by PTWG (62.66g) and SKAU-T-3 (61.83) for total shoot weight, SKAU-T-4 (4.29) followed by Nageen (4.17) and SKAU-T-14 (4.12) for root shoot ratio, SKAU-T-19 (95.30) followed by Nageen (91.46) and SKAU-T-4 (91.00) for root compactness, SKAU-T-14 (82.96%) followed by SKAU-T-4 (81.03%) and SKAU-T-23 (79.46%) for harvest index, Nageen (470.66q/ha) followed

by SKAU-T-4 (462.00q/ha) and SKAU-T-3 (402.33q/ha) for root yield/ha, SKAU-T-24 (59.46cm) followed by SKAU-T-12 (58.86cm) and SKAU-T-5 (54.76cm) for plant spread, SKAU-T-6 (287.63cm²) followed by SKAU-T-5 (266.46 cm²) and Nageen (262.33 cm²) for leaf area, PTWG (16.14%) followed by SKAU-T-14 (14.39%) and SKAU-T-20 (13.97%) for total dry matter content, SKAU-T-1 (6.80 °Brix) followed by PTWG (6.73 °Brix) and SKAU-T-18 (6.46 °Brix) for total soluble solids, SKAU-T-1 (33.00mg/100g) followed by SKAU-T-7 and SKAU-T-19 (32.00 mg/100g each) for Vit. C, SKAU-T-24 (5.96 mg/100g) followed by SKAU-T-21 (5.04mg/100g) and SKAU-T-25 (4.28 mg/100g) for anthocyanin content, SKAU-T-24 (3.91%) followed by SKAU-T-14 (3.80%) and SKAU-T-1 (3.74%) for total sugars, SKAU-T-14 (2.70%) and SKAU-T-1 (2.70%) followed by SKAU-T-11 (2.63 %) for reducing sugars, and SKAU-T-24 (1.48 %) and SKAU-T-11 (1.09%) for non-reducing sugars. Similarly a wide range of variation for different traits in turnip was observed by Nasarullah (1994), Khan *et al.*, (2010) in Kale, Santhosha *et al.*, (2015) in cabbage.

The maximum range was recorded for root yield/ha followed by total root weight and total plant weight, while as minimum range was recorded in seedling dry weight followed by non-reducing sugars and reducing sugars. In this study the genotypes showed a wide range of variation for almost all the traits studied. Hence, based on the mean performance of all the genotypes, the genotypes *viz.*, Nageen, SKAU-T-4, SKAU-T-3, SKAU-T-9, SKAU-T-14 and PTWG were found superior in terms of root yield/ha and should be used in further breeding programmes.

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