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Estimates of Variability Studies for Various Leaf Yield Attributing Traits in Kale (*Brassica oleracea* L. var. *acephala*) Genotypes

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A B S T R A C T

The present investigation entitled "Estimates of variability studies for various leaf yield attributing traits in kale (*Brassica oleracea* L. var. *acephala*)" comprising of thirty genotypes was carried out at Vegetable Research Farm, Division of Vegetable Science & Floriculture, FOA, Chatha, SKUAST-J, Main campus, Chatha to estimate variability for 12 traits during the year 2015-16 and 2016-17. The field experiment was laid out in Randomized Block Design with three replications, spaced at 60 cm × 45 cm. The observations were recorded on five randomly selected tagged plants. The analysis of variance of pooled data revealed significant differences among the genotypes for all the characters studied. Based on the mean performance genotypes namely SJK-02, SJK-03 SJK-04 and SJK-05 were high yielding with regard to number of leaves per plant, number of pickings per plant, duration of pickings and leaf yield per plant & SJK-19 was also found to be best performers for mean leaf weight per plant. Genotypes namely SJK-10 was found to be the earliest for days to first leaf picking. Thus, revealing that substantial amount of variability in present for various traits among the kale genotypes studied and therefore can be further exploited in further kale improvement programme.

Introduction

Kale (*Brassica oleracea* L. var. *acephala* DC.) is leafy green vegetable belonging to cabbage family and is probably the first brassicas to be cultivated and probable progenitor of cabbage, cauliflower, broccoli. It belongs to family Cruciferaae (Khan *et al.*, 2011) and includes leafy kale (var. *acephala*), thousand head kale (var. *ramosa*), scotch kale (var. *sabellica*), marrow stem kale (var. *medullosa*), palm kale (var. *palmifolia*), collards (var. *viridis*) and Chinese kale (var. *alboglabra*) (Diederichsen, 2001). At present grown extensively throughout all the parts of the world over an area of 2470.27 thousand hectares with a productivity of 29.05 tonnes/hectare. In Jammu and Kashmir, it is being grown over an area of 2460 hectares out of which in Jammu region it occupies an area of 160 hectares with a productivity of 18.78 tonnes/hectare (Anonymous, 2014).

Kale is a very nutritious vegetable, rich in vitamins and minerals particularly vitamin C, pro-vitamin (β-carotene & lutein) and

minerals and anti oxidants. Consumption of kale juice is determined to raise the HDL levels and lower the LDL levels, and also improve their artherogenic profiles which measured their likelihood of developing coronary artery disease (Kim *et al.,* 2008). Among all 100 of the world's healthiest foods, kale grabs the first position in terms of lutein content and is the primary lutein-containing food in the USDA's National Nutrient Database. Kale is a potent source of glucosinolates and contains about 15-20 different glucosinolates like compounds (Sikora *et al.,* 2007). Kale is a highly cross pollinated vegetable crop and is grown under all the agro climatic conditions from subtropical, temperate to cold arid zones of the J&K state. The crop is reported rich in diversity due to complex natural intra and inters specific crosses and geographical barriers. Estimates of variability parameters is present in North West Himalayan region and has not been properly documented and characterized for further use in any plant breeding programme. It is a well documented fact that variation shown by available genetic resources for quantitative and quality traits is important for vegetable breeding programme (Esribano *et al.,* 1998). These studies can provide potential genetic resources by elucidating genetic information and relationships between different populations for crop improvement and facilitating the identification of diverse parents to cross in hybrid combinations in order to maximize the expression of heterosis (Purugganan *et al.,* 2000).

Materials and Methods

The present investigation entitled "Estimates of variability studies for various leaf yield attributing traits in kale (*Brassica oleracea* L. var. *acephala*)" was carried out under subtropical conditions of Jammu at Vegetable Experimental Farm, Division of Vegetable Science and Floriculture, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology, Main Campus, Chatha, Jammu (J&K). The experimental field of Division of Vegetable Science and Floriculture, SKUAST, Jammu is situated at 32^{o} 40'N latitude and 74^{o} 58' E longitude and has an elevation of 332 m above mean sea level.

The experimental material comprised of 30 diverse genotypes of kale locally collected from all the three region of J&K including Central Institute of Temperate Horticulture & SKUAST-K. The details of the genotypes along with their source are given below in Table 1.

The experimental material comprised of thirty genotypes of Kale which after raising healthy seedlings were transplanted in Randomized Block Design with three replications during 2015-2016 and 2016-17 at the experimental farm of Division of Vegetable Science and Floriculture, SKUAST-Jammu.

All the thirty genotypes were grown in a plot size of 3.0 m × 1.80 m with a spacing of 60 cm row to row and 45 cm plant to plant. Observations were recorded on various morphological/yield contributing traits on five randomly selecting tagged plants from each treatment in each replication and there means were worked out for statistical analysis as per method given by Panse and Sukhatme (1967).

Results and Discussion

The analysis of variance for various characters in kale (*Brassica oleracea* L. var. *acephala*) during 2015-16, 2016-17 and in pooled analysis showed significant differences among genotypes used in the present investigation for 12 traits under study (Table 2, 3 and 4).

Table.1 List of genotypes along with the source of procurement

S. No.	Code no.	Source
1.	SJK-01	SKUAST-K
2.	SJK-02	Kupwara
3.	SJK-03	CITH
4.	SJK-04	Bandipura
5.	SJK-05	Farmers Friendly Participatory Research Station, Karlah
6.	SJK-06	SKUAST-K
7.	SJK-07	Kupwara
8.	SJK-08	CITH
9.	SJK-09	Bandipura
10.	SJK-10	Farmers Friendly Participatory Research Station, Karlah
11.	SJK-11	Leh
12.	SJK-12	Leh
13.	SJK-13	Kanachak
14.	SJK-14	Sarora
15.	SJK-15	Marh
16.	SJK-16	Karloop
17.	SJK-17	Chenani
18.	SJK-18	Assar
19.	SJK-19	SKUAST-K
20.	SJK-20	SKUAST-K
21.	SJK-21	SKUAST-K
22.	SJK-22	SKUAST-K
23.	SJK-23	CITH
24.	SJK-24	CITH
25.	SJK-25	Drass
26.	SJK-26	SKUAST-K
27.	SJK-27	SKUAST-K
28.	SJK-28	SKUAST-K
29.	SJK-29	CITH
30.	SJK-30	Pulwama

Table.2 Analysis of variance for various quantitative and quality traits in kale (*Brassica oleracea* L. var. *acephala*): 2015-16

Traits	Mean sum of squares		F-value
	Genotypes	Error	
Days to first leaf picking	46.54	3.26	14.24*
Leaf area index	1.93	0.22	8.95*
Mean leaf weight per plant (g)	8.85	4.19	2.05*
Stem thickness (cm)	2.75	0.16	16.73*
Plant height (cm)	417.15	31.97	13.05*
Number of leaves per plant	927.42	89.57	10.35*
Number of nodes per plant	43.78	4.24	10.32*
Intermodal length (cm)	1.26	0.08	15.16*
Number of pickings per plant	16.04	1.44	11.12*
Duration of picking	479.81	85.79	5.59*
Leaf yield per plant (g)	191878.30	36061.02	5.32*
Leaf yield per hectare (q/ha)	1289.21	2423.85	5.32*

Table.3 Analysis of variance for various quantitative and quality traits in kale (*Brassica oleracea* L. var. *acephala*): 2016-17

Traits	Mean sum of squares		F-value
	Genotypes	Error	
Days to first leaf picking	46.59	3.48	13.40*
Leaf area index	1.80	0.24	7.39*
Mean leaf weight per plant (g)	5.94	3.10	1.92*
Stem thickness (cm)	2.66	0.17	15.98*
Plant height (cm)	416.44	37.19	11.20*
Number of leaves per plant	852.49	87.25	9.77*
Number of nodes per plant	41.02	3.73	10.99*
Intermodal length (cm)	1.15	0.06	19.02*
Number of pickings per plant	14.54	1.34	10.85*
Duration of picking	416.11	88.89	4.68*
Leaf yield per plant (g)	193132.09	44085.53	4.38*
Leaf yield per hectare (q/ha)	12981.43	2963.19	4.38*

Table.4 Pooled analysis of variance for various quantitative and quality traits in kale (*Brassica oleracea* L. var. *acephala*)

Traits	Mean sum of squares		F-value
	Genotypes	Error	
Days to first leaf picking	46.47	3.30	14.09*
Leaf area index	1.86	0.22	8.29*
Mean leaf weight per plant (g)	6.34	2.81	2.25*
Stem thickness (cm)	2.70	0.16	17.07*
Plant height (cm)	413.70	32.09	12.89*
Number of leaves per plant	884.78	88.07	10.04*
Number of nodes per plant	42.31	3.90	10.84*
Intermodal length (cm)	1.19	0.06	19.27*
Number of pickings per plant	15.16	1.27	11.96*
Duration of picking	4*39.60	80.61	5.45
Leaf yield per plant (g)	184182.80	33915.89	5.43*
Leaf yield per hectare (q/ha)	12379.86	2279.68	5.43*

Table.5 Mean performance of various quantitative and quality traits in kale (*Brassica oleracea* L var. *acephala*) -2015-16

Genotype (Ideotype of genotype)	Days to first leaf picking	Leaf area index	Mean leaf weight/plant (g)	Stem thickness (cm)	Plant height (cm)	Number of leaves/plant	Number of nodes/plant	Intermodal length (cm)	Number of pickings /plant	Duration of picking (days)	Leaf yield/plant (g)	Leaf yield/ha (q/ha)
SJK-01 (Khanyari -1)	23.35	3.43	13.65	2.31	47.54	89.05	17.67	2.42	11.25	100.02	1302.43	337.67
SJK-02 (Khanyari -1)	24.82	2.72	14.48	2.54	39.50	102.53	10.67	3.23	10.37	94.41	1579.59	409.52
SJK-03 (Khanyari -1)	23.28	2.79	12.33	2.41	50.80	97.86	12.00	3.87	13.32	95.48	1309.13	339.40
SJK-04 (Khanyari -1)	24.81	2.68	12.31	2.23	43.36	114.72	12.33	3.14	12.81	97.19	1509.50	391.35
SJK-05 (Khanyari -1)	25.24	3.14	12.16	3.18	68.87	123.52	17.67	3.63	11.92	99.49	1610.09	417.43
SJK-06 (G.M.Dari-1)	24.92	3.53	13.03	2.29	38.23	80.48	16.33	2.03	7.79	80.25	1135.64	294.43
SJK-07 (G.M.Dari-1)	22.89	4.18	12.51	3.75	54.73	74.83	19.33	2.57	7.46	70.61	1008.78	261.53
SJK-08 (G.M.Dari-1)	23.48	4.54	14.59	2.45	38.73	86.94	18.00	1.87	7.03	73.09	1349.28	349.81
SJK-09 (G.M.Dari-1)	22.64	4.34	14.56	4.14	28.37	88.13	8.00	2.97	6.58	73.72	1368.87	354.89
SJK-10 (G.M.Dari-1)	21.35	4.42	13.51	2.47	54.40	75.58	14.67	3.37	6.53	75.79	1089.78	282.53
SJK-11 (Leh local-1)	21.19	4.75	15.74	2.27	23.67	91.17	9.00	2.13	9.22	103.83	1526.18	395.68
SJK-12 (Leh local-2)	28.55	2.31	9.62	2.22	39.93	95.61	16.33	2.17	9.74	87.84	1016.98	263.66
SJK-13 (Jammu local-1)	27.74	2.46	12.43	2.32	56.63	68.86	19.33	2.67	7.55	67.43	918.42	238.11
SJK-14 (Jammu local-2)	31.53	2.48	11.03	2.60	32.90	62.68	18.67	1.50	6.97	62.62	755.24	195.80
SJK-15 (Jammu local-3)	30.88	2.90	11.47	4.55	59.67	68.27	19.00	2.87	7.43	62.89	841.41	218.14
SJK-16 (Jammu local-4)	31.97	2.28	11.30	2.41	40.97	55.77	11.67	3.09	6.53	61.82	688.24	178.43
SJK-17 (Jammu local-5)	33.67	2.47	11.69	2.10	34.83	63.72	13.00	2.30	10.17	82.78	783.37	203.09
SJK-18 (Jammu local-6)	27.62	2.14	12.24	2.09	49.33	62.60	13.00	3.40	10.80	83.18	818.35	212.16
SJK-19 (Anchari green)	34.71	2.42	15.32	2.35	21.56	83.19	9.33	1.83	13.00	84.41	1346.56	349.11
SJK-20 (Kawdari)	29.26	2.36	11.56	2.10	33.73	85.82	8.33	3.47	8.83	65.89	1082.41	280.62
SJK-21 (Wantipuri)	29.80	2.26	12.12	2.65	27.91	85.80	9.67	2.44	11.13	84.33	1129.97	292.96
SJK-22 (Sag Purple Sel.)	29.24	2.37	13.20	2.06	36.63	88.79	12.67	2.50	9.72	67.22	1254.05	325.12
SJK-23 (Japanese Green)	29.32	2.36	12.83	5.27	32.17	71.13	12.67	2.13	7.26	67.87	975.18	252.82
SJK-24 (Siberian Kale)	22.95	4.06	13.74	3.81	40.30	67.04	10.67	3.30	7.42	70.62	984.41	255.22
SJK-25 (Drass Kale)	22.35	4.02	15.96	2.40	45.60	65.39	18.67	2.17	6.75	75.28	1098.11	284.69
SJK-26 (Sag-81)	22.59	3.65	15.88	2.28	46.93	59.40	14.00	2.99	6.24	88.74	999.06	259.02
SJK-27 (Sag-88)	22.20	3.21	14.97	2.49	18.09	59.61	7.33	1.76	6.20	88.31	944.53	244.88
SJK-28 (Sag-100)	23.23	3.40	15.86	2.72	30.63	54.40	9.67	2.73	5.33	61.71	901.93	233.83
SJK-29 (Hanz Hak)	22.69	3.59	14.78	4.75	37.90	60.16	10.33	3.17	6.45	84.49	955.32	247.68
SJK-30 (Kashmir local)	23.16	3.36	15.18	4.99	51.20	62.50	12.00	3.83	7.03	73.64	1024.54	265.62
General Mean	26.05	3.15	13.34	2.87	40.84	78.19	13.40	2.72	8.63	79.50	1110.24	287.84
SE m±	1.04	0.27	1.18	0.23	3.27	5.46	1.19	0.17	0.69	5.35	109.64	28.42
CV (%)	6.94	14.71	15.35	14.12	13.85	12.10	15.37	10.63	13.92	11.65	17.10	17.10
CD (at 0.05)	2.96	0.76	3.35	0.66	9.27	15.51	3.37	0.47	1.97	15.18	311.17	80.67

Table.6 Mean performance of various quantitative and quality traits in kale (Brassica oleracea L var. acephala) -2016-17

Genotype (Ideotype of genotype)	Days to first leaf picking	Leaf area index	Mean leaf weight/plant (g)	Stem thickness (cm)	Plant height (cm)	Number of leaves/plant	Number of nodes/plant	Intermodal length (cm)	Number of pickings /plant	Duration of picking (days)	Leaf yield/plant (g)	Leaf yield/ha (q/ha)
SJK-01 (Khanyari -1)	24.26	3.68	10.37	2.35	43.31	89.15	19.31	2.24	11.83	102.86	1007.85	261.29
SJK-02 (Khanyari -1)	25.74	2.97	13.82	2.82	42.57	109.63	12.17	3.49	10.97	97.98	1621.50	420.39
SJK-03 (Khanyari -1)	23.87	3.04	13.23	2.62	47.46	104.96	13.35	3.55	13.02	102.38	1497.45	388.23
SJK-04 (Khanyari -1)	25.39	2.93	12.44	2.11	45.11	117.49	13.67	3.23	13.51	104.09	1565.44	405.85
SJK-05 (Khanyari -1)	25.82	3.39	11.69	3.32	68.84	126.95	18.99	3.62	12.62	104.06	1577.91	409.09
SJK-06 (G.M.Dari-1)	26.17	3.78	13.89	2.56	33.34	87.58	17.58	1.89	8.49	87.15	1301.39	337.40
SJK-07 (G.M.Dari-1)	24.80	4.43	13.70	4.06	53.33	81.93	20.32	2.62	8.16	76.51	1201.34	311.46
SJK-08 (G.M.Dari-1)	24.73	4.71	14.44	2.63	40.49	94.04	19.65	2.06	7.77	79.99	1453.44	376.82
SJK-09 (G.M.Dari-1)	23.23	4.43	14.59	4.39	29.30	95.23	9.36	3.02	7.04	80.62	1479.31	383.52
SJK-10 (G.M.Dari-1)	22.27	4.67	13.88	2.68	54.46	83.34	15.23	3.56	7.03	82.69	1235.41	320.29
SJK-11 (Leh local-1)	22.44	4.91	14.76	2.48	24.40	97.94	10.20	2.32	10.05	99.40	1536.77	398.42
SJK-12 (Leh local-2)	29.80	2.56	11.46	2.43	41.05	102.04	17.61	2.26	10.34	94.74	1274.67	330.47
SJK-13 (Jammu local-1)	28.32	2.71	11.64	2.53	57.90	76.96	20.26	2.86	8.28	74.33	968.18	251.01
SJK-14 (Jammu local-2)	32.78	2.73	12.15	2.81	33.26	64.78	19.54	1.69	7.41	69.52	854.27	221.48
SJK-15 (Jammu local-3)	32.03	3.15	11.24	4.76	58.98	75.37	19.27	3.06	8.13	68.12	921.04	238.79
SJK-16 (Jammu local-4)	33.22	2.59	11.93	2.62	43.77	62.87	13.23	3.28	7.17	65.39	815.46	211.41
SJK-17 (Jammu local-5)	34.59	3.05	10.65	2.31	35.21	71.22	14.17	2.47	10.87	91.68	819.52	212.47
SJK-18 (Jammu local-6)	28.87	2.39	11.99	2.30	52.69	69.70	14.64	3.59	11.50	88.41	896.11	232.32
SJK-19 (Anchari green)	34.96	2.67	15.65	2.56	22.13	90.29	10.91	2.02	12.00	78.97	1504.32	390.01
SJK-20 (Kawdari)	30.18	2.71	12.45	2.31	35.86	92.92	9.84	3.56	9.53	72.79	1253.57	325.00
SJK-21 (Wantipuri)	30.72	2.51	13.00	2.86	26.70	92.90	10.40	2.49	11.83	91.23	1304.50	338.20
SJK-22 (Sag Purple Sel.)	30.16	2.55	13.56	2.27	36.17	94.89	13.84	2.59	10.42	74.12	1373.33	356.05
SJK-23 (Japanese Green)	29.90	2.54	13.12	5.15	32.80	77.23	14.04	2.32	8.02	74.77	1077.58	279.37
SJK-24 (Siberian Kale)	24.20	4.31	13.06	4.02	43.36	74.14	12.38	3.49	7.46	78.52	1039.97	269.62
SJK-25 (Drass Kale)	23.26	4.27	13.36	2.61	45.44	71.49	19.25	2.36	7.35	80.51	1026.26	266.07
SJK-26 (Sag-81)	23.17	4.04	14.28	2.49	48.58	66.50	15.25	3.18	6.27	88.98	1023.72	265.41
SJK-27 (Sag-88)	23.11	3.46	14.52	2.67	16.72	66.04	8.48	1.95	7.57	95.21	1020.55	264.59
SJK-28 (Sag-100)	24.15	3.55	14.87	2.93	30.07	60.50	10.88	2.72	5.81	68.61	947.85	245.74
SJK-29 (Hanz Hak)	23.61	3.77	13.84	4.96	39.20	67.26	11.74	3.32	7.15	91.39	1008.55	261.48
SJK-30 (Kashmir local)	23.19	3.50	15.69	5.13	48.77	79.27	13.22	3.67	7.73	77.20	1291.05	334.72
General Mean	26.96	3.40	13.18	3.06	41.04	84.82	14.63	2.82	9.18	84.74	1196.61	310.23
SE m±	1.08	0.29	1.02	0.24	3.52	5.39	1.11	0.14	0.67	5.44	121.22	31.43
CV (%)	6.92	14.51	13.36	13.35	14.86	11.01	13.21	8.74	12.61	11.13	17.55	17.55
CD (at 0.05)	3.06	0.89	2.88	0.67	9.99	15.31	3.17	0.40	1.90	15.45	344.05	89.20

Table.7 Pooled mean performance of various quantitative and quality traits in kale (*Brassica oleracea* L var. *acephala*)

Genotype (Ideotype of genotype)	Days to first leaf picking	Leaf area index	Mean leaf weight/plant (g)	Stem thickness (cm)	Plant height (cm)	Number of leaves/plant	Number of nodes/plant	Intermodal length (cm)	Number of pickings /plant	Duration of picking (days)	Leaf yield/plant (g)	Leaf yield/ha (q/ha)
SJK-01 (Khanyari -1)	23.81	3.56	12.01	2.33	45.42	89.10	18.49	2.34	11.54	101.44	1155.14	299.48
SJK-02 (Khanyari -1)	25.29	2.85	14.15	2.68	41.04	106.08	11.42	3.37	10.67	96.19	1600.54	414.96
SJK-03 (Khanyari -1)	23.58	2.92	12.78	2.52	49.13	101.41	12.68	3.71	13.17	98.93	1403.29	363.82
SJK-04 (Khanyari -1)	25.11	2.81	12.37	2.18	44.24	116.10	13.01	3.19	13.16	100.64	1537.47	398.60
SJK-05 (Khanyari -1)	25.54	3.27	11.92	3.25	68.85	125.23	18.33	3.63	12.27	101.78	1594.00	413.26
SJK-06 (G.M.Dari-1)	25.55	3.66	13.46	2.43	35.79	84.03	16.96	1.97	8.14	83.70	1218.51	315.91
SJK-07 (G.M.Dari-1)	23.85	4.31	13.11	3.91	54.04	78.38	19.83	2.60	7.81	73.73	1105.06	286.50
SJK-08 (G.M.Dari-1)	24.11	4.63	14.52	2.54	39.61	90.49	18.83	1.97	7.40	76.54	1401.36	363.31
SJK-09 (G.M.Dari-1)	22.94	4.39	14.57	4.27	28.84	91.68	8.69	3.00	6.81	77.17	1424.09	369.21
SJK-10 (G.M.Dari-1)	21.81	4.55	13.70	2.58	54.44	79.46	14.95	3.47	6.78	79.24	1162.59	301.41
SJK-11 (Leh local-1)	21.82	4.84	15.25	2.38	24.03	94.55	9.60	2.23	9.63	101.62	1531.47	397.05
SJK-12 (Leh local-2)	29.18	2.44	10.54	2.33	40.49	98.83	16.98	2.22	10.04	91.29	1145.83	297.07
SJK-13 (Jammu local-1)	28.04	2.59	12.03	2.43	57.27	72.91	19.80	2.77	7.91	70.88	943.30	244.56
SJK-14 (Jammu local-2)	32.16	2.61	11.59	2.71	33.08	63.73	19.11	1.60	7.19	66.07	804.75	208.64
SJK-15 (Jammu local-3)	31.46	3.03	11.35	4.66	59.32	71.82	19.14	2.97	7.78	65.50	881.22	228.47
SJK-16 (Jammu local-4)	32.60	2.44	11.62	2.52	42.37	59.32	12.45	3.19	6.85	63.61	751.84	194.92
SJK-17 (Jammu local-5)	34.14	2.76	11.17	2.21	35.02	67.47	13.59	2.39	10.52	87.23	801.44	207.78
SJK-18 (Jammu local-6)	28.25	2.27	12.11	2.20	51.01	66.15	13.83	3.50	11.15	85.80	857.23	222.24
SJK-19 (Anchari green)	34.84	2.55	15.49	2.46	21.84	86.74	10.13	1.93	12.50	81.69	1425.44	369.56
SJK-20 (Kawdari)	29.73	2.54	12.00	2.21	34.79	89.37	9.09	3.52	9.18	69.34	1167.99	302.81
SJK-21 (Wantipuri)	30.26	2.39	12.57	2.76	27.30	89.35	10.04	2.47	11.48	87.78	1217.23	315.58
SJK-22 (Sag Purple Sel.)	29.70	2.47	13.38	2.17	36.40	91.84	13.26	2.55	10.07	70.67	1313.69	340.59
SJK-23 (Japanese Green)	29.61	2.46	12.97	5.22	32.48	74.18	13.36	2.23	7.64	71.32	1026.38	266.10
SJK-24 (Siberian Kale)	23.58	4.19	13.40	3.92	41.83	70.59	11.53	3.40	7.44	74.57	1012.18	262.42
SJK-25 (Drass Kale)	22.81	4.15	14.66	2.51	45.52	68.44	18.96	2.27	7.05	77.90	1062.18	275.38
SJK-26 (Sag-81)	22.88	3.85	15.08	2.39	47.75	62.95	14.63	3.09	6.26	88.86	1011.39	262.21
SJK-27 (Sag-88)	22.66	3.34	14.75	2.58	17.40	62.82	7.91	1.86	6.89	91.76	982.54	254.73
SJK-28 (Sag-100)	23.70	3.48	15.37	2.83	30.35	57.45	10.28	2.73	5.57	65.16	924.89	239.79
SJK-29 (Hanz Hak)	23.16	3.68	14.31	4.86	38.55	63.71	11.04	3.25	6.80	87.94	981.94	254.58
SJK-30 (Kashmir local)	23.18	3.43	15.43	5.06	49.98	70.88	12.62	3.76	7.38	75.42	1157.80	300.17
General Mean	26.51	3.28	13.26	2.97	40.94	81.50	14.02	2.77	8.90	82.13	1153.43	299.04
SE m±	1.05	0.27	0.97	0.23	3.27	5.42	1.14	0.14	0.65	5.18	106.33	27.56
CV (%)	6.85	14.72	12.65	13.39	13.84	11.52	14.10	8.98	12.65	10.93	15.96	15.97
CD (at 0.05)	2.98	0.78	2.75	0.65	9.28	15.38	3.24	0.41	1.85	14.71	301.77	78.24

These differences indicated the presence of substantial amount of variability found for these traits and considerable scope for improvement of various characters namely days to first leaf picking, leaf area index, mean leaf weight per plant, stem thickness, plant height, number of leaves per plant, number of nodes per plant, internodal length, number of pickings per plant and leaf yield per plant in the material under study. These results are in accordance with the findings of earlier researcher's *viz.* Ali *et al.*, (2017), Tripathi *et al.*, (2015), Synrem *et al.*, (2014) and Akbar *et al.*, (2003), who also observed wide range of variability for various traits in *Brassica* species.

Based on the mean performance of genotypes with respect to various leaf and seed yield attributing traits, during 2015-16 (Table 5), genotypes namely SJK-02, SJK-03, SJK-04, SJK-08, SJK09, SJK-11, SJK-19 gave leaf yield statistically at par with SJK-05 which was the best performer. SJK-05 also found to be one of the best performers for plant height and number of leaves per plant; during 2016-17 (Table 6), genotype namely SJK-03, SJK-04, SJK-05, SJK-08, SJK-09, SJK-11 and SJK-19 gave leaf yield statistically at par with SJK-02 which was the best performer; in pooled analysis (Table 7) genotypes namely SJK-03, SJK-04, SJK-05, SJK08, SJK-09, SJK-11, SJK-19 and SJK-22 gave leaf yield statistically at par with SJK-02 which was the best performer. SJK-05 was found to be one of the best performers for various leaf yield attributing traits including plant height, number of leaves per plant and duration of picking indicating that these genotypes can be further exploited for further use in breeding programme.

Considerable amount of variability was observed with respect to range and pronounced mean values for plant height, number of leaves per plant, duration of picking and leaf yield per plant indicated the scope of selection of these traits. Similar findings were obtained by other workers namely Saleem *et al.*, (2017), Khan *et al.*, (2010) and Malode *et al.*, (2010) for number of leaves per plant, plant height, number of nodes per plant and duration of picking. The results obtained in the present investigation indicated that considerable variability and diversity was available for converging the elite allelic resources present in the genotypes through planned breeding and selection approaches to recover high yielding segregants that would possess good quality characteristics as well. Improvement over existing varieties is a continuous process in plant breeding.

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