

Original Research Article

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**Analysis of Genetic Diversity in Kale
(*Brassica oleracea* L. var. *acephala*) Genotypes of Jammu
and Kashmir Region based on Morphological Descriptors**

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ABSTRACT

The present investigation entitled analysis of genetic diversity in kale genotypes of Jammu and Kashmir region based on morphological descriptors was carried out in order to reveal the available genetic diversity present in kale genotypes collected from the different kale growing regions of the J&K state including Jammu, Kashmir and Leh and to select the elite genotypes that possess superior leaf yield attributing traits and quality traits. Remarkable variability was present among genotypes for various leaf attributes. However, there is probability of duplicates being present in above collection. Hence, morphological characterization is resorted to identify the duplicates. Therefore, these collected genotypes were laid out at Vegetable Experimental Farm, Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha, Jammu and data were recorded on traits namely plant height revealed that 20 (66.67%) genotypes had tall plant height, 5(16.67%) genotypes had medium height and 5(16.67%) genotypes are of short height. Plant shape at peak leaf picking stage revealed that 13(43.34%) were found to be dome shaped, 10 were of inverted pyramid shape and (23.34%) and 7 (23.34%) genotypes were of column shape. Leaf blade color at fully developed leaf stage revealed that 25 (83.34%) genotypes among 30 were found to be green in color while 4 (13.34%) genotypes were blue-green in color and only one genotype was found to be of purple color. Leaf type was categorized as entire or lobed with lobed observed in 14 (46.67%) genotypes and entire in 16 (53.34%) genotypes. Leaf shape showed variation from very narrow elliptic, narrow elliptic to elliptic with 11 (36.67%) genotypes very narrow elliptic and 4 (13.34%) being elliptic.

Keywords

Brassica oleracea,
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Introduction

Kale (*Brassica oleracea* L. var. *acephala* DC.) is one of the oldest forms of the cabbage family and is probably the first brassicas to be cultivated which are quite similar to wild cabbage. It is quite similar to cabbage and is a

green leafy vegetable in which central leaves do not form head. Kale has originated from eastern Mediterranean region and is being used as a food crop since 2000 BC (Acikgoz, 2011). Cabbage and other brassicas are 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 India, it is being grown over an area of 400.14 thousand hectares with a productivity of 22.59 tonnes/hectare (Anonymous, 2014a). Among the leafy vegetables, kale is cultivated on a large scale in the temperate regions of our country like J& K, HP and to limited extents in North-East region. In Kashmir, it is grown in almost all kitchen gardens and also as a commercial crop around cities and towns (Khan *et al.*, 2009). Kale grown there is popularly known as “HAK” (Wanchoo, 2000). 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, 2014b).

In Asaba, Delta State of Nigeria, kale is nicknamed “hospital too far”. This is because of the health benefits of kale. It is a very nutritious vegetable, rich in vitamins and minerals particularly vitamin C, pro-vitamin (β -carotene & lutein) and minerals and anti oxidants (Cao *et al.*, 1996). It is one of the richest source of carotenoids especially xanthophylls (Ligor and Buszewski, 2012). Among all 100 of the worlds 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 that analyzes 5,350 foods that contain this carotenoid nutrient. Kale is a potent source of glucosinolates and contains about 15-20 different glucosinolates like compounds (Sikora *et al.*, 2007). These glucosinolates are sulfur containing compounds that are mainly synthesized in crucifers, and reduce the risk of several forms of (Francisco *et al.*, 2011).

Kale is a highly cross pollinated vegetable crop. It is grown under all the agro climatic conditions from subtropical, temperate to cold arid zones of the J&K state. It is one of the hardiest crop and is highly resistant to low

temperatures and can even survive at a low temperature of -15°C (Altinok and Karakya, 2003). The crop is reported rich in diversity due to complex natural intra and interspecific crosses and geographical barriers. Genetic diversity of North West Himalayan region has not been properly documented and characterized for further use in any plant breeding programme.

Thus, there is a need for exploration and conservation of existing diversity among the conservation of existing diversity among the available genotypes grown in this region. Therefore, present study was conducted on kale genotypes collected from different areas of Chennani, Assar, Karlah, Kupwara, Pulwama, Bandipura, Drass, Leh, Kashmir and Jammu.

Materials and Methods

The present investigation was carried out in the year 2015-16 in which kale thirty genotypes were firstly collected from the various kale growing regions of the J&K state namely Chennani, Assar, Karlah, Kupwara, Pulwama, Bandipura, Drass, Leh, Kashmir and Jammu and laid out in Vegetable Experimental Farm, Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha, Jammu. The experimental field of Division of Vegetable Science and Floriculture, SKUAST, Jammu is situated at $32^{\circ} 40' \text{N}$ latitude and $74^{\circ} 58' \text{E}$ longitude and has an elevation of 332 m above mean sea level. Agro climatically the location represents Zone V of Jammu and Kashmir and is characterized by subtropical climate. The place experiences hot dry summer, hot and humid rainy season and cold winter months, the maximum temperature goes up to 45°C during summers (May to June) and minimum temperature falls to 1°C during winters. Codes were allotted to each genotypes on the basis of their location (as SJKK stands for SKUAST-Kashmir kale

selection, SJKKP stands for Kupwara kale selection, SJKC for CITH kale selection, SJKB for Bandipura kale selection, SJKL for Leh kale selection, SJKLJ for Jammu local kale selection, SJKD for drass kale selection, SJKP for Pulwama kale selection). Observations were recorded at the time of third leaf picking stage of the plant growth using descriptors given by UPOV (International union for the protection of new varieties of plants) guidelines published in 2014 (UPOV). Plant height was observed as overall height attained by the plant during the peak leaf picking stage as 3 (short), 5 (medium) and 7 (tall). The plant shape was observed as overall shape attained by the plant and was graded as 1 (inverted pyramid), 3 (dome), and 5 (column). Leaf blade was visually observed as the color of fully developed leaf as 2 (green), 4 (blue green), 6 (red or purple). Leaf type observed as 1 (entire) and 9 (lobed). Leaf blade observes as shape for varieties with curled leaves only with 1 (very narrow elliptic), 3 (narrow elliptic) and 5 (elliptic).

Results and Discussion

Plant characteristics of leafy kale are of immense importance as far as the diversity is concerned. Present study revealed wide diversity among the kale genotypes collected after surveying of different locations of J&K state.

On the basis of the results present in the plant height (Table 1 and 2) the genotypes varied between small, medium and tall. Out of 30 Kale genotypes studied 20 (66.67%) genotypes had tall plant height, 5(16.67%) genotypes had medium height and 5(16.67%) genotypes are of short height. Maximum genotypes had tall height. Tall height may attribute towards its genetic constitution. Plant shape at peak leaf picking stage revealed that out of 30 genotypes studied 13(43.34%) were found to be dome shaped,

10 were of inverted pyramid shape and (23.34%) and 7 (23.34%) genotypes were of column shape. This showed that with regard to plant shape the variability observed among genotypes is high. Leaf blade color at fully developed leaf stage revealed that 25 (83.34%) genotypes among 30 were found to be green in color while 4 (13.34%) genotypes were blue-green in color and only one genotype was found to be of purple color. Leaf type was categorized as entire or lobed with lobed observed in 14 (46.67%) genotypes and entire in 16 (53.34%) genotypes. Leaf type was in almost half proportion in both the genotypes (Table 3).

Leaf shape showed variation from very narrow elliptic, narrow elliptic to elliptic with 11 (36.67%) genotypes very narrow elliptic and 4 (13.34%) being elliptic and rest of the genotypes were not curly. Similar studies when done by Stoilova *et al.*, (2014) on morphological descriptors of amaranthus revealed that Amaranth accessions showed possessed an erect growth habit except for accessions Kongei, UG-AM 21 and AC-45, which had a prostrate growth habit. Also, Erum *et al.*, (2012) working on amaranthus accessions diversity concluded that amaranth accessions with a higher number of branches have the potential to produce high leaf yield. The color of amaranth stems was predominantly a mix of green and red color for 48% of accessions, purple to pink for 32%, and green and white color for 20%. Similarly work when done by Shimoya *et al.*, (2002), evaluating the diversity in the elephantgrass germplasm bank based on 17 morphological descriptors, observed that the last five canonic variables presented a variance lower than 0.7 and that the characteristics of greatest weight were, in decreasing order, stem diameter, leaf width in the middle of the adult mean leaf, leaf width in the base of the adult mean leaf, awn length and spikelet length.

Table.1 Plant and leaf characteristics of kale (*Brassica oleracea* L. var. *acephala*) genotypes

S.no.	Genotypes	Plant Height	Plant Shape	Leaf Blade color	Leaf type	Leaf blade
1.	SJJK-1	7	3	4	9	1
2.	SJKKP-1	7	3	2	9	1
3.	SJKC-1	7	3	4	9	1
4.	SJKB-1	7	3	2	9	1
5.	SJKJ-1	7	3	4	9	1
6.	SJJK-2	7	5	2	9	1
7.	SJKKP-2	7	5	4	9	1
8.	SJKC-2	7	5	2	9	1
9.	SJKB-2	7	5	2	9	1
10.	SJKJ-2	7	5	2	9	1
11.	SJKL-1	3	1	2	1	-
12.	SJKL-2	7	3	2	1	-
13.	SJKL-1	7	1	2	1	-
14.	SJKL-2	7	1	2	1	-
15.	SJKL-3	7	1	2	1	-

Legends

Plant height	Note	Plant shape	Note	Leaf blade color	Note	Leaf type	Note	Leaf blade shape	Note
Short	3	Inverted pyramid	1	green	2	entire	1	Very narrow elliptic	1
Medium	5	Dome	3	Blue green	4	Lobed	9	Narrow elliptic	3
Tall	7	Column	5	Red or purple	6			elliptic	5

Table.3 Summary of frequency of leaf and plant characteristics of kale genotypes

Plant characteristics	Category	No. of genotypes	Percentage
Plant height	Short	5	16.67
	Medium	5	16.67
	Tall	20	66.67
Plant shape	Inverted pyramid	10	33.34
	Dome	13	43.34
	Column	7	23.34
Leaf blade	green	25	83.34
	Blue green	4	13.34
	Red or purple	1	3.34
Leaf type	entire	16	53.34
	Lobed	14	46.67
Leaf blade shape	Very narrow elliptic	8	26.67
	Narrow elliptic	11	36.67
	elliptic	11	36.67

Table.2 Plant and leaf characteristics of kale (*Brassica oleracea* L. var. *acephala*) genotypes

S.no.	Genotypes	Plant Height	Plant Shape	Leaf Blade color	Leaf type	Leaf blade
16.	SJKL-4	7	1	2	1	-
17.	SJKL-5	7	1	2	1	-
18.	SJKL-6	7	1	2	1	-
19.	SJJK-3	5	3	2	1	3
20.	SJJK-4	5	5	2	1	3
21.	SJJK-5	3	5	2	1	3
22.	SJJK-6	3	3	6	9	3
23.	SJKC-3	3	1	2	1	1
24.	SJKC-4	5	1	2	1	-
25.	SJKD-1	7	3	2	1	-
26.	SJJK-7	7	3	2	9	-
27.	SJJK-8	7	3	2	9	-
28.	SJJK-9	5	3	2	9	-
29.	SJKC-5	5	3	2	1	-
30.	SJKP-1	3	1	2	1	-

Legends

Plant height	Note	Plant shape	Note	Leaf blade color	Note	Leaf type	Note	Leaf blade shape	Note
Short	3	Inverted pyramid	1	green	2	entire	1	Very narrow elliptic	1
Medium	5	Dome	3	Blue green	4	Lobed	9	Narrow elliptic	3
Tall	7	Column	5	Red or purple	6			elliptic	5

From the results it is evident that based on morphological characters, wide variability was observed in both the crops. this variability can be accounted by the fact that kale genotypes present in this region can be further used in various kale improvement programs and thus, the variability needs to be conserved for all future breeding programs and should be documented.

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