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Genetic divergence between half-sib families of *Bunium persicum* (Boiss.) Fedtsch.

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Abstract

The present investigation on *Bunium persicum* (Boiss.) Fedtsch was carried out with an objective to assess the genetic variability of this species in Himachal Pradesh and Jammu & Kashmir. A wide range of variation was observed among the five sites for various morphological and yield contributing attributes. Clustering pattern of five populations revealed that they could be classified into two clusters. Cluster I consisted of Gurez, Sangla and Khrew sites whereas, Cluster II included Kalpa and Harwan sites. Highest heritability was recorded for number of days from bulb sprouting to complete flowering followed by number of umblets per umbel which indicates that these characters can be improved upon selection.

Key words: Genetic divergence, euclidean cluster, inter and intra cluster, *Bunium persicum*

Introduction

Bunium persicum (Boiss.) Fedtsch. commonly known as 'kalazeera' is a spice yielding member of the family Apiaceae. It grows wild in some parts of Himachal Pradesh (Lahaul-Spiti, Chamba and Kinnaur), Jammu & Kashmir (Srinagar and its adjoining areas and Kishtwar) at an altitude ranging from 2000-3500 m amsl in the Western Himalayan region, extending up to Baluchistan and Afghanistan [1]. It is a perennial herb, distributed in dry temperate zone and restricted to the mountains. Its fruits, commonly called as seeds are used as prized spice in cooking for flavouring. The seed of this plant which represents kalazeera is sold in the market at the rate of Rs. 500-1000 per kg. High altitude regions of Kinnaur, Lahaul-Spiti, Pangi and Bharmour in Himachal Pradesh and Paddar valley of Jammu & Kashmir are the potential areas of its production in India [2].

Bunium persicum is a perennial, glabrous, branched herb. Fruit oblong, 3-4 mm long, dark brown, ridges prominent, stylopodium flattened, styles reflexed. It has also found place in indigenous system of medicine, as the fruits are regarded as stimulant, carminative and are useful in curing diarrhoea, dyspepsia, fever, flatulence, stomach-ache, haemorrhoids and obstinate hiccup [3].The seeds (fruits) have, however, been replaced by their essential oil which is now widely used for seasoning pickles, meat sauce, soups, candies etc. In the world of multi-billion trade and transactions in agricultural commodities, the share of spices is very small (around 2339 million US$), but not insignificant [4].

Bunium persicum, the ripe fruits of which form the "kalazeera" of commerce, is also one of the over-exploited, economically important plants. Gradual decline in size and number of populations has reduced its yield and consequently there is an increase in its market prize. As of today, genetic conservation in medicinal and aromatic plants has become of paramount importance because of ruthless extraction. Therefore, it is prudent to study *Bunium persicum* at genetic levels for efficient conservation and management of genetic diversity. In addition identification of useful genotypes that can be developed as cultivar for field trial and sustainable utilization can be achieved. Materials and methods

Kalazeera bulbs were collected during July-August, from Gurez, Harwan and Khrew sites located in Kashmir valley, Sangla and Kalpa sites of district Kinnaur (Himachal Pradesh). The details of the sites from where the bulbs were collected are presented in Table 1.

The experimental farm falls under dry temperate zone having cold conditions from November to February. While, the months of May-June are hot. Rain is scanty

Table 1. Passport data on each collection of kalazeera

Place of collection	District (State)	Altitude (m)	Latitude*	Longitude*
Gurez	Baramulla (J&K)	1980	34°38'N	74° 49'E
Khrew	Pulwama (J&K)	1360	33°54'N	75°01'E
Harwan	Srinagar (J&K)	1620	34° 10'N	74° 54'E
Sangla	Kinnaur (H.P.)	2590	31°25'N	78° 14'E
Kalpa	Kinnaur (H.P.)	2774	31°32'N	78° 15'E

*Encarta U.S. geological survey

in this area, although some rainfall occurs during June-August. The experiment was conducted at Shilly nursery of Dr. Y.S. Parmar University of Horticulture and Forestry Solan. The plot size was kept as 1.5 x 2.0 m with spacing of 20 x 20 cm as row to row and plant and plant. Before planting, the kalazeera bulbs were treated with 0.2 per cent carbendazim (50 per cent WP) for 10 minutes.

Twenty plants from each site were removed along with roots to record observations for different morphological traits viz., Plant height (cm), Number of primary branches per plant, Number of secondary branches per plant, Number of tertiary branches per plant ,Days from bulb sprouting to complete flowering, Number of umbels per plant, Number of umblets per umbel, Days to maturity of seeds, Number of seeds per umblet, Mature seeds per umblet, Immature seeds per umblet, Seeds per plant ,Mature seeds per plant, Immature seeds per plant. Analysis of variance was done as per Panse and Sukhatme [5] and genetic divergence by using non-hierarchical Euclidean cluster analysis [6].

Results and discussion

Seedling characteristics can be used as a quantitative character defining genotype in measuring genetic distance between populations and differentiating population at early stages in variability studies. As tree characters measured in natural population are amenable to geographical and environmental interactions, seedling characters measured in different environment are more useful in differentiating population at preliminary stage [7]. The analysis of variance revealed the existence of significant difference for all the traits, indicating the existence of huge genetic variability.

Clustering pattern of five populations of *Bunium persicum* on the basis of morphological and other yield contributing attributes revealed that they could be classified into two clusters (Table 2). The sites Gurez, Sangla and Khrew formed cluster I, while Kalpa and Harwan formed cluster II.

Table 2. Distribution of five different sites on the basis of different morphological and yield contributing attributes

Cluster No.	No. of sites	Notation of sites
I	3	i) Gurez ii) Sangla iii) Khrew
II	2	i) Kalpa ii) Harwan

The mean performance of each cluster for traits studied is presented in Table 3, which indicates appreciable differences from all the traits. Cluster I depicted the highest entries for days to maturity of seeds (59.49) and immature seeds per umblet (3.23) while lowest entries for plant height (33.39), number of primary branches per plant (1.66), number of secondary branches per plant (2.21), number of tertiary branches per plant (3.54), days from bulb sprouting to complete flowering (41.81), number of umbels per plant (7.0), number of umblets per umbel (11.14), number of seeds per umblet (12.52), mature seeds per umblet (8.94), seeds per plant (1022.34), mature seeds per plant (732.03) and immature seeds per plant (266.22).

Table 3. Cluster mean of 2 clusters in different morphological and yield contributing attributes

Characters	Mean clusters I	Mean clusters II	Percent contribution
Plant height (cm)	33.39	35.13	62.34
Number of primary branches per plant	1.66	1.89	21.36
Number of secondary branches per plant	2.21	3.33	8.52
Number of tertiary branches per plant	3.54	5.22	5.51
Days from bulb sprouting to complete flowering	41.81	44.10	1.32
Number of umbels/plant	7.00	9.11	0.72
Number of umblets/umbel	11.14	12.52	0.23
Days to maturity of seeds	59.49	56.78	0.00
Number of seeds/umblet	12.52	13.73	0.00
Mature seeds/umblet	8.94	10.18	0.00
Immature seeds/umblet	3.23	3.22	0.00
Seeds per plant	1022.34	1648.55	0.00
Mature seeds/plant	732.03	1232.44	0.00
Immature seeds/plant	266.22	384.22	0.00

Cluster II recorded the highest entries for plant height (35.13), number of primary branches per plant (1.89), number of secondary branches per plant (3.33), number of tertiary branches per plant (5.22), days from bulb sprouting to complete flowering (44.10), number of umbels per plant (9.11), number of umblets per umbel (12.52), number of seeds per umblet (13.73), mature seeds per umblet (10.18), seeds per plant (1648.55), mature seeds per plant (1232.44) and immature seeds per plant (384.22) whereas, the same depicted the lowest entries for days to maturity of seeds (56.78) and immature seeds per umblet (3.22).

Contribution of different characters to total divergence showed that plant height contributed maximum (62.34%) followed by number of primary branches per plant (21.36%) and number of secondary branches per plant (8.52%).

Intra and inter cluster distances are given in Table 4. The magnitude of intra cluster distance measures the extent of genetic diversity between different populations of *Bunium persicum* within the same cluster. The maximum intra cluster distance was observed for cluster I (2.574). This indicates that cluster I has more diversity for the traits studied.

Table 4. Average inter and intra cluster distance in different sites based on different morphological and yield contributing attributes

Cluster No.	I	II
I	**2.574**	
II	4.975	**1.792**

Underlined figures represent intra cluster distance

Inter cluster distance is the measure of genetic distance between two clusters. The inter cluster distance (4.975) was observed between cluster I and II.

Therefore, selection of genotypes for hybridization may be made on the basis of genetic diversity rather than geographic diversity. However, due attention needs to be paid to geographic diversity, to accommodate sufficient genetic diversity in the germplasm. Many workers such as Singh [8] while working with *Bambusa tulda* and Chauhan *et al.* [9] in chirpine found no ecogeographical link with cluster pattern of the genotypes and the progenies, respectively.

Thus, on the basis of variability studies based on Yield and morphological traits, it can be concluded that a wide range of variation was exhibited in different morphological traits. The coefficient of variation, heritability and genetic gain recorded for some of the

Table 5. Estimates of various genetic parameters of *Bunium persicum*

Characters	Mean	Heritability (%)	Coefficient of variation (phenotypic) (%)	Coefficient of variation (genotypic) (%)	Genetic advance	Genetic gain (%)
Plant height (cm)	34.09	24.30	9.97	4.91	1.70	4.99
No. of primary branches per plant	1.75	69.50	8.44	7.03	0.21	12.00
No. of secondary branches per plant	2.66	92.50	25.15	24.19	1.27	47.74
No. of tertiary branches per plant	4.21	91.90	26.17	25.09	2.09	49.64
Days from bulb sprouting to complete flowering	42.73	99.40	22.71	22.65	19.88	46.52
No. of umbels per plant	7.84	86.50	18.52	17.22	2.59	33.03
No. of umblets per umbel	11.69	95.00	9.68	9.44	2.22	18.99
Days to maturity of seeds	58.41	85.40	6.51	6.02	6.69	11.45
No. of seeds per umblet	13.00	81.70	6.79	6.14	1.49	11.46
Mature seeds per umblet	9.43	78.70	8.89	7.88	1.36	14.42
Immature seeds per umblet	3.22	84.40	12.82	11.78	0.72	22.36
No. of seeds per plant	1272.83	92.20	32.59	31.29	787.88	61.90
Mature seeds per plant	932.19	91.40	34.62	33.09	607.57	65.18
Immature seeds per plant	313.42	89.30	33.12	31.29	190.90	60.91

characters indicated that they can be improved upon selection.

The data for different characters were analyzed for the estimation of variability and genetic parameters under study. Table 5 revealed that maximum heritability (99.40) was recorded for day from bulb sprouting to complete flowering followed by number of umblets per umbel (95.00), number of seed per plant (92.20), number of tertiary branches per plant (91.90) and mature seeds/plant (91.40). The phenotypic coefficient of variation was higher than the genotypic coefficient of variation. Phenotypic and genotypic coefficient of variation was recorded maximum (34.62 and 33.09) for mature seed/plant followed by immature seed/plant (33.12 and 31.29) and number of seed/plant (32.59 and 31.29). Highest genetic advance (787.88) was recorded for number of seeds/plant, followed by mature seed/plant (607.57) and immature seeds/plant (190.90). Maximum genetic gain (65.18) was recorded for mature seed/plant, followed by number of seeds/plant (61.90) and immature seeds/plant (60.91) respectively. The present result substantiates, the findings of Murthy *et al.* in Linseed [10] and Parsad and Singh in Maize [11].

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