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Genetic divergence analysis in ajowan [*Trachyspermum ammi* (L.) Sprague]

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Abstract

Fifty eight genotypes of ajowan (*Trachyspermum ammi*) were subjected to multivariate analysis using D^2 statistics at Pratapgarh (Rajasthan). The characters studied were days to 50% flowering, days to maturity, umbels plant^{-1}, umbellets umbel^{-1}, 1000-seed weight, fatty oil content of seed and seed yield plant^{-1}. The study indicated that the genotypes grouped into seven clusters depending on similarities of their D^2 values and lack of parallelism between genetic and geographic diversity. The inter cluster D^2 values ranged from 16.41 to 45.23, suggesting considerable diversity among the groups of the genotypes. Among the seven characters studied for genetic divergence, fatty oil contributed the maximum accounting for 56.29% of total divergence followed by seed yield plant^{-1}. Based on cluster means, characters such as umbels plant^{-1} and umbellets umbel^{-1} were major factors of differentiation among genotypes, which may be taken into account while selecting parents for hybridization programmes.

Keywords: ajowan, D^2 statistic, genetic divergence, *Trachyspermum ammi.*

The productivity of ajowan [*Trachyspermum ammi* (L.) Sprague] is low in Rajasthan, a major ajowan producing state in India. The genetic divergence based on seven important characters was assessed in 58 collections of ajowan available at Agricultural Research Sub-station, Pratapgarh (Rajasthan), to develop high yielding varieties.

The 58 genotypes (including three checks namely, GA-1, Pratap Ajowan-1 and a Local) collected from various parts of the country, were evaluated in a completely randomised block design with three replications during *kharif* 2004–05. Each plot consisted of two rows of 3 m length spaced at 30 cm and plant within a row at 10 cm. Ten plants were selected at random from each plot for recording observations on seven characters namely, days to 50% flowering, days to maturity, umbels plant^{-1}, umbellets umbel^{-1}, 1000-seed weight, fatty oil content of seed and seed yield plant^{-1}. The data were subjected to multivariate analysis by using Mahalanobis (1936) generalized distance D^2 and the genotypes were clustered on the basis of minimum generalized distance using Tocher's method as given by Rao (1952).

The analysis of variance showed highly significant differences among the genotypes for all the characters studied. The pooled divergence based on all the characters, tested by the Wilk's criterion X^2 (3002 at 399 df) was

significant. Hence, the material was considered appropriate for analysis of genetic divergence. Based on D^2 values, 58 genotypes were grouped into 7 clusters (Table 1). Cluster I had maximum genotypes (29 genotypes) followed by II (11 genotypes), V (6 genotypes), III (5 genotypes), VI (4 genotypes), IV (2 genotypes) and VII (1 genotype). Grouping of collections into seven clusters depicted the presence of considerable amount of genetic diversity in the germplasm collections. The collections which originated from different places were in the same cluster and distribution of genotypes from the same place into different clusters, suggested that the pattern of grouping of genotypes was independent of their geographical distribution. The clustering pattern of the genotypes indicated that geographic diversity had no significant impact on genetic diversity. The genotypes AGP-04-07 and AGP-04-08 from Navania (Rajasthan) were grouped in different clusters (III and IV); similarly, AGP-04-45 and AGP-04-46 from Jamnagar were also placed in clusters III and V.

The considerably smaller estimates of intra cluster than inter cluster distances confirmed the genuineness of clustering pattern (Table 2). Cluster V showed maximum intra cluster distance (13.327) which had six genotypes

Table 1. Distribution of ajowan genotypes in clusters based on D^2 values

Cluster	Genotype	No. of genotypes
I	AGP-04-04 (Bhatewar); AGP-04-05, AGP-04-06 (Vana); AGP-04-10, AGP-04-11, AGP-04-12, AGP-04-13 (Dalot); AGP-04-15 (Arnod); AGP-04-22, AGP-04-23 (Kanwalpura, Kota); AGP-04-27, AGP-04-28 (Jhalawar); AGP-04-31, AGP-04-32, AGP-04-34, AGP-04-40 (Mehsana); AGP-04-41, AGP-04-42, AGP-04-43 (Unjha); AGP-04-56 (Rajkot); GA-1 (C) (Gujarat); AGP-04-71, AGP-04-73, AGP-04-90, AGP-04-92, AGP-04-93, AGP-04-94, Local (C), Pratap Ajowan-1 (C) (Pratapgarh)	29
II	AGP-04-03 (Bhatewar); AGP-04-26 (Jhalawar); AGP-04-35 (Mehsana); AGP-04-72, AGP-04-84, AGP-04-85, AGP-04-87, AGP-04-67, AGP-04-68 (Pratapgarh); AGP-04-51, AGP-04-54 (Jamnagar)	11
III	AGP-04-44(Unjha); AGP-04-45(Jamnagar); AGP-04-19(Arnod); AGP-04-21(Darakota); AGP-04-08 (Navania)	5
IV	AGP-04-07 (Navania); AGP-04-37(Mehsana)	2
V	AGP-04-30 (Jhalawar); AGP-04-33 (Mehsana); AGP-04-46, AGP-04-47, AGP-04-48, AGP-04-49 (Jamnagar)	6
VI	AGP-04-70 (Pratapgarh), AGP-04-29 (Jhalawar); AGP-04-36, AGP-04-38 (Mehsana)	4
VII	AGP-04-09 (Pratapgarh)	1

Table 2. Average intra- (diagonal) and inter-cluster D^2 values in seven clusters of ajowan

Cluster	I	II	III	IV	V	VI	VII
I	**12.15**	19.904	20.674	17.469	24.402	32.496	22.631
II		**11.936**	16.744	31.932	28.990	19.511	19.372
III			**11.275**	31.359	27.424	18.577	16.929
IV				**0.000**	23.801	45.235	29.956
V					**13.327**	35.692	16.411
VI						**7.869**	21.452
VII							**0.000**

Values in bold are intra-cluster distances

Table 3. Overall mean values for various characters and their contribution to divergence in ajowan

Character	Mean ± SE	Times ranked 1st	Contribution (%)
Days to 50% flowering	99.06 ± 1.45	327	19.78
Days to maturity	134.29 ± 2.69	2	0.12
Umbels plant^{-1}	142.48 ± 11.62	1	0.06
Umbellets umbel^{-1}	9.85 ± 0.33	43	2.60
1000-seed weight	2.44 ± 0.05	3	0.18
Fatty oil content of seed	18.90 ± 0.13	930	56.26
Seed yield plant^{-1}	9.12 ± 0.19	347	20.99

Table 4. Cluster mean values for seven characters in ajowan

Cluster	Days to 50% flowering	Days to maturity	Umbels plant^{-1}	Umbellets umbel^{-1}	1000-seed weight (g)	Fatty oil content of seed (%)	Seed yield plant^{-1} (g)
I	98.31	132.92	134.21	9.38	2.45	17.47	8.41
II	111.30	144.73	127.50	9.18	2.43	21.02	7.68
III	83.33	125.83	118.00	8.47	2.37	21.06	8.71
IV	93.33	122.00	167.00	10.60	2.51	14.23	10.56
V	97.80	131.00	211.20	13.94	2.48	17.75	14.88
VI	99.89	137.00	139.00	9.03	2.39	24.59	8.62
VII	95.00	133.67	172.00	13.20	2.57	20.68	12.52

followed by cluster I (12.15), cluster II (11.93) and cluster III (11.275). Intra-cluster distance is the main criterion for selection of genotypes using D^2 analysis. Inter-cluster distance varied from 16.411 to 45.235. Minimum inter cluster D^2 value was observed between cluster V and VII and maximum between VI and IV. The inter-cluster D^2 values were also higher between cluster VI and V (35.692), VI and I (32.496); IV and II (31.932), and IV and III (31.359).

The contribution of individual characters to the divergence assessed on the basis of numbers of times it appeared first, indicated that fatty oil content in seed contributed maximum towards genetic divergence followed by seed yield plant^{-1} and days to 50% flowering (Table 3). Besides genetic divergence, mean values for traits studied for different clusters can be utilized to identify diverse and agronomically superior genotypes (Table 4). Genotypes included in cluster V showed maximum seed yield plant^{-1}, umbels plant^{-1} and umbellets umbel^{-1}. Genotypes included in cluster VI showed maximum fatty oil content in seed whereas, genotypes included in cluster VII showed maximum 1000-seed weight. Genotypes included in cluster III and IV showed early flowering and maturity, respectively. It can therefore, be concluded that hybridization among genotypes of these cluster combinations is expected to enhance variability in ajowan for the targetted traits. This will provide an opportunity to select better recombinants for various traits in ajowan.

References

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