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Genetic variability studies in ajwain (*Trachyspermum ammi* L.)

S S Meena*, R K Solanki, R K Kakani & S Kumari

ICAR-National Research Centre on Seed Spices
Tabiji, Ajmer-305 206, Rajasthan.
**E-mail: ssmnrcss5@yahoo.com*

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Abstract

In Ajwain (*Trachyspermum ammi* L.) extent of variability was assessed in eighty four genotypes using augmented design. The analysis of variance indicated presence of considerable amount of variability. Genetic coefficient of variation (GCV) was high for plant height, seed yield plant^{-1}, length of internodes, and number of secondary branches, test weight, number of umbels plant^{-1} and number of seeds umbel^{-1}. High heritability and genetic advance was found for number of seed umbel^{-1}, number of secondary branches and seed yield plant^{-1}. Hence, in ajwain ample amount of variability exists for the important component traits like number of secondary branches, harvest index, number of seed umbel^{-1} and number of umbellate umbel^{-1} thus the scope of improving the crop by selection in the available variability is high.

Keywords: Ajwain, germplasm, genetic variability, heritability and genetic advance

Ajwain (*Trachyspermum ammi* L.) well known as carom seed or Bishop's weed belongs to family *Apiaceae* and is a native of Egypt (Sayre 2001). It is a popular minor seed spice crop having good medicinal value in India. It is also produced by countries like Persia, Iran, Egypt, Afghanistan and Pakistan. During 2007–08, 1120 tonnes of ajwain seed was produced from 19590 hectare in India (Meena *et al*. 2009). Despite the economic importance of ajwain, it is still cultivated on marginal lands with poor fertility because of which, productivity is still low. Most of the area is under local varieties due to unavailability of improved varieties. Very few studies have been done in ajwain for assessing the extent of genetic variability.

About 84 genotypes were evaluated in an Augmented Randomised Block design with three check varieties (Ajmer Ajwain-1, Ajmer Ajwain-2, Gujarat Ajwain-1). Recommended package of practice was followed for raising a good healthy crop. Observation were recorded on 14 component traits *viz*., Plant height (cm) at 60 and 90 days after sowing DAS and at harvest, length of first internodes in cm (at 50% flowering), days to 50% flowering, number of primary branches, number of secondary branches plant^{-1}, diameter of main umbel (cm), days to 50% maturity in main umbel, number of umbels plant^{-1}, numbers of umbellates umbel^{-1}, number of seeds umbellate^{-1}, number of seeds umbel^{-1}, test weight (g), seed yield

plant^{-1} (g) and harvest index (%). The data pertaining to various characters were subjected to analysis of variance as per Petersen (1985). The estimates of variability, heritability and genetic advance were calculated as per Johnson *et al*. (1955), Burton (1955) and Allard (1960).

Highly significant genotypic differences were observed for all the characters indicating presence of considerable amount of variability. Wide range of phenotypic variability was observed for all the traits except for diameter of main umbel (Table 1, 2). Phenotypic variation based on mean values is not the precise criterion to estimate extent of variability therefore phenotypic and genotypic variances are important to better understand the variability level. 4 better index for measuring the genetic variability is genotypic coefficient of variation (GCV) as described by Burton (1952) for comparing the genetic variability present in various characters. Plant height at 60 DAS (58.68%) had the highest GCV followed by seed yield plant^{-1} (28.65%), length of internodes (28.44%), test weight (20.70), number of secondary branches (18.82), number of effective branches or number of umbels plant^{-1} (18.52%) and number of seed umbel^{-1} (15.59%), indicating that these characters have high to moderate amount of genetic variability (Table 1, 2). Heritability indicates the effectiveness with which selection of genotypes could be done based on phenotypic performances. This could be achieved through estimating heritability and genetic advance for the component trait before performing selection. The heritability in broad sense estimates were quite high for the characters *viz*., days to 75% maturity in main umbel (94.55), test weight (94.55), plant height at 60 DAS (79.09), days to 50% flowering (77.59), number of secondary branches plant^{-1} (68.89). Similar finding in ajwain was also reported by Dalkani *et al.* (2012). Traits having high to moderate heritability values coupled with high to moderate GCV should be chosen for effective selection programme *viz*., test weight, seed yield plant^{-1}, harvest index and number of secondary branches.

Shift in gene frequencies under selection pressure towards superior is termed as genetic advance, generally expressed as percentage of mean (genetic gain), Johnson *et al.* (1955) found heritability values together with genetic advance to be more useful in predicting the response to selection. However, high expected genetic gain along with high heritability shows most effective conditions for genetic improvement in a trait. High heritability estimates coupled with moderate to high genetic advance as percent of mean (GAM) were recorded for days to 75% maturity (H^2=95.97%, GAM=10.03%), test weight (H^2=94.55%, GAM=41.47%), plant height at 60 DAS (H^2=79.09%, GAM=61.87%) and seed yield per plant (H^2=58.32%, GAM=45.07%) indicating that direct selection of these traits would be responsive.

Thus, the overall result on variability parameters revealed that the characters *viz*., seed yield plant^{-1}, days to 75% maturity, number of seed umbel^{-1} and number of secondary branches contributed substantially to high genetic variability. The above stated characters also exhibited high to moderate heritability values coupled with high to moderate genetic gain. Selection practised for these characters would lead to an improvement in the desirable direction in ajwain. Genotypes *viz*., AA-93 for earliness, AA-73, AA-21 for high seed yield plant^{-1}, AA-27, AA-84 for high test weight and AA-73, AA-21, AA-27 for high harvest index mentioned in the Table 2 can be utilized as potential genetic resources for developing high yielding varieties in ajwain and further yield improvement in desirable genotypes for traits like early flowering coupled with early maturity can also be done by following population improvement methods.

Table 1. Genetic variability parameters (GCV, PCV, H^2, GAM) for 15 traits in ajwain

Characters		Minimum	Maximum	Mean	Phenotypic variance ($ó^2_p$)	Genotypic variance ($ó^2_g$)	PCV (%)	GCV (%)	H^2 (%)	GA as % of Mean
1	Plant height at 60 DAS (cm)	5.16	47.36	10.98	52.50	41.52	65.98	58.68	79.09	107.45
2	Plant height at 90 DAS (cm)	45.71	103.24	81.32	172.48	99.80	16.15	12.28	57.86	19.25
3	Plant height at Harvest (cm)	85.06	140.72	116.25	152.24	78.66	10.61	7.63	51.67	11.30
4	Days to 50% flowering	56.39	149.39	93.37	140.90	109.32	12.71	11.20	77.59	20.32
5	Length of first internodes (cm)	0.78	3.04	1.73	0.37	0.24	35.35	28.44	64.71	46.98
6	No. of primary branches plant^{-1}	13.06	21.26	16.95	4.50	2.76	12.52	9.81	61.37	15.81
7	No. of umbel plant^{-1}	97.98	339.12	223.60	2564.64	1715.14	22.65	18.52	66.88	31.20
8	No. of umbellate umbel^{-1}	10.82	22.96	16.94	8.24	2.01	16.95	8.37	24.41	8.52
9	No. of seeds umbel^{-1}	195.34	614.08	357.03	8535.12	3098.34	25.88	15.59	36.30	19.35
10	No. of seeds umbellate^{-1}	14.1	27.48	21.11	10.70	5.40	15.49	11.00	50.45	16.10
11	Diameter of main umbel (cm)	4.11	6.86	5.33	0.56	0.28	14.06	9.97	50.31	14.46
12	Days to 75% maturity in main umbel	113.7	174.17	161.58	67.20	64.49	5.07	4.97	95.97	10.03
13	Seed yield plant^{-1} (g)	2.27	17.32	9.93	13.86	8.09	37.51	28.65	58.32	45.08
14	Test Weight (g)	0.48	1.40	0.73	0.024	0.023	21.29	20.70	94.55	41.15
15	Harvest index	26.15	56.55	40.34	52.87	38.41	18.02	15.36	72.65	26.97

Table 2. Range of variability observed for 15 traits in ajwain

	Characters	Minimum	Maximum	Mean	Desirable trait	Promising Genotypes
3	Plant height at harvest (cm)	85.06	140.72	116.25	Dwarf erect non-lodging type type	AA-93, AA-96
4	Days to 50% flowering	56.39	149.39	93.37	Early type	AA-93, AA-21
5	Length of first internodes (cm)	0.78	3.04	1.73	Short to medium	AA-21, AA-84, AA-94
6	No. of primary branches plant^{-1}	13.06	21.26	16.95	High	AA-73, AA-01-272,
7	No. of umbel plant^{-1}	97.98	339.12	223.60	High	AA-73, AA-01-272
8	No. of umbellate umbel^{-1}	10.82	22.96	16.94	High	AA-73, AA-27
9	No. of seeds umbel^{-1}	195.34	614.08	357.03	High	AA-73, AA-21
10	No. of seeds umbellate^{-1}	14.10	27.48	21.11	High	AA-73, AA-21
11	Diameter of main umbel (cm)	4.11	6.86	5.33	High	AA-84, AA-96
12	Days to 75% maturity in main umbel	113.70	174.17	161.58	Early to medium	AA-93, AA-21
13	Seed yield plant^{-1} (g)	2.27	17.32	9.93	High	AA-73, AA-27
14	Test Weight (g)	0.48	1.40	0.73	Medium to high	AA-84, AA-
15	Harvest index	26.15	56.55	40.34	Medium to high	AA-73, AA-21, AA-27

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