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Exploring Genetic Potential of Carom Seed (*Trachyspermum ammi* L.) Germplasm for Seed Yield in Akola Conditions

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ABSTRACT

Carom seeds (*Trachyspermum ammi* L.) has long been used in traditional Indian cuisine and Ayurvedic medicine. Cultivation of carom seed or ajwain reported for brining profit to farmers as a basically a dryland crop which can be grown with very less amount of water and minimum inputs. Ajwain has wide scope for boosting socio-economic status of farmers of Vidharbha region having marginal land holdings and mostly depends on dryland farm practices.The selection or recommendation of any crop for a particular region depends primarily on its adaptation to the soil and climatic conditions and preferably on their having resistance for other biotic factors viz., pest and diseases. These aspects of adaptation moreover depend on genetic potential and its expression in context of particular environment.Therefore, an experiment was carried out for exploring the genetic potential of twenty-sixcultivars of ajwain in Randomized Block Design with three replications during Rabi 2020 at Chilli and Vegetable Research Unit(CVRU), Dr. PDKV, Akola. Investigation revealed the presence of wide range of variability for all the characters viz., number of seeds per umbel, number of umbels per plant, plant height at maturity, days to first flowering, days to 50 per cent flowering, days to maturity, number of seeds per umbellate, number of umbellate per umbel, seed yield per plant, number of primary branches per plant, diameter of main umbel, length of first internode and test weightamong the genotypes, which are amenable to improvement. Further, it significant seed yield potential was exhibited by genotypes viz., PDKV AJ 11, PDKV AJ 10 and PDKV AJ 16 indicating their fitness at the location and subsequently they may be used in future breeding program or may be tested on large area for suitability for cultivation in the Vidarbha region.

Carom Seed or Ajwain (*Trachyspermum ammi* L.) belongs to family Apiaceae is a native of Egypt and is a popular seed spice crop in India. It is an annual herbaceous plant bearing small egg shaped grayish brown fruits. Themajor Ajwainproducing countries are India, Persia, Iran, Egypt, Afghanistan, Pakistan and North Africa. In India its productionis concentrated mainly in Rajasthan, Gujarat, Andhra Pradesh, Madhya Pradesh, Bihar, Uttar Pradesh, TamilNadu and West Bengal. Ajwain is an annual herbaceous plant, which profusely branches, with feather like leaves, 2-3pinnately divided, segments linear. Flowers in terminal compound umbel, which on fertilization converts in the minute grayish white fruits which are ovoid in nature. The diploid chromosome number of ajwain is 2n=18. Theflowers are portentous and cross-pollination occurs through insects. Ajwain seed analysis has revealed it to contain fiber (11.9%), carbohydrates (38.6%), tannins, glycosides, moisture (8.9%), protein (15.4%), fat (18.1%), saponins, flavone and mineral matter (7.1%) containing calcium, phosphorous, iron and nicotinic acid. Ajwain fruits yield 2 to 4 per cent brownish essential oil, with thymol as the major constituent (35 to 60%) (Ishikawah, 2001).

The genetic variability and correlation study helps to determine the yield contributing characters on which the selection can bebased for genetic improvement in yield and thus helps in the selection ofelite genotypes. Heritability and genetic advance are important selection parameter. Heritability estimates along with genetic advance are more helpful in predicting the gain under selection. Therefore, the present investigation was planned to evaluatethe genetic potential in terms of magnitudes of variability for the yield and its contributing traits of available ajwain genotypes in Akola conditions.

MATERIAL AND METHODS

Experimental material comprised of twenty six lines of ajwain.Out of which twenty-two genotypes were collected from Chilli and vegetable research unit, Dr.PDKV, Akola where the pedigree had been maintained. Four

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varieties *viz.*, AA-19-01, AA-2, PKV07andAA-93 were collectedfrom National Research Centre on Seed Spices (NRCSS), Tabji, Ajmer, Rajasthan. Keeping in-view the necessity for exploration of existing genetic variability present in the available genepool of ajwain, an experiment for morphological characterization was conducted in Ajwain (*Trachyspermum ammi* L.) emphasizing on exploration the nature and magnitude of variability for different characters using twenty-six genotypes during Rabi 2020-2021 at Chilli and Vegetable Research Unit Dr. PDKV, Akola.

The observations were recorded for the important thirteen characters studied viz., days to first flowering, days to 50 per cent flowering, days to maturity, plant height at maturity, number of primary branches per plant, length of first internode, number of umbels per plant, number of umbellate per umbel, number of seeds per umbel, number of seeds per umbellate, diameter of main umbel, test weight and seed yield per plant.

The mean value worked out from the observations recordedon five randomly selected plants for thirteen morphological characters used for statistical analysis. The following statistical parameters used for presentation of data on quantitative attributions. Statistical analysis was carriedout as per the standard methods / techniques. The mean values of all the characters of each genotype in each replication were used for analysis of variance. The significant differences for all the characters among thegenotypes was tested by 'F' test**.** The genetic parameters such as genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance for different characters was worked out for all the genotypes under study using standard procedures.

RESULTS AND DISCUSSION

The results of analysis of variance for all thirteen characterstudied are presented in Table 1. The significance was tested by applying'F' test. The mean sum of squares, due to genotypes found to be highly significant for all the characters, indicating the presence of substantial genetic variability in the experimental material. The range of all thirteen morphological traits are given in Table 2, revealed the presence of wide ranges of variation were observed for all the thirteen characters amongtwenty six ajwain genotypes in present investigation. The variation was thehighest for number of seeds per umbel (147.50-424.98), number of umbelsper plant (30.24-119.24), plant height at maturity (75.57-118.33), days tofirst flowering (61.67-92.33), days to 50 per cent flowering (82.00-110.67), days to maturity (129.67-144.67), number of seeds per umbellate (11.33-22.28), seed yield per plant (3.02-8.29), number of umbellate per umbel(9.31-16.46), number of primary branches per plant (8.42-13.19), while itwas found in lower magnitude for length of first internode (1.77-3.38) and diameter of main umbel (3.03-4.23) and test weight (0.52-1.42).

The present study genetic parameter analysis revealed that the magnitude of phenotypic coefficient of variation were higher than the corresponding genotypic coefficient of variation for the characters *viz*., days to first flowering, days to50 per cent flowering, days to maturity, plant height at maturity, number ofprimary branches per plant, length of first internode, number of umbels perplant, number of umbellate per umbel, number of seeds per umbel, numberof seeds per umbellate, diameter of main umbel, test weight and seed yieldper plant. However, the differences were narrow which implied their relative resistance to environmental variation. It indicated that in present material,the genetic factors were predominantly responsible for expression of the character studied. Therefore, selection could be made effectively on thebasis of phenotypic performance. The higher magnitude of PCV than GCVwere also observed by Jyothi *et al*.(2017), Kumar *et al*. (2017) in fennel, Meena and Dhakar (2017), Yadav *et al.* (2017),Nagar *et al*. (2018), Yadav *et al*. (2018) and Singh *et al.* (2019)

The phenotypic coefficient of variation for the character studied ranged from 4.01 per cent to 33.05 per cent. The phenotypic coefficient of variation was the highest for characters *viz*. number of seeds umbel^{-1} (33.05%), test weight (31.08 %), seed yield plant^{-1} (29.86 %), number of umbels plant^{-1} (27.58 %), length of first internode (22.08 %) and number of seeds umbellate^{-1} (20.94 %). This finding is in close harmony with the results of for number of umbels per plant and seed yield per plant

Table1.Analysis of variance forthe thirteen morphological characters

Source ofvariation	Df	Meansumofsquares						
		Days to first flowering	Days to 50% flowering	Days to maturity	Plant height at maturity (cm)	Number of primary branches perplant	Length of first internode (cm)	Number of umbels plant^{-1}
Replications	2	0.66666	8.769	4.884	32.030	0.443	0.046	9.966
Genotypes	25	270.498**	173.251**	73.042**	493.785**	4.886**	0.458**	1617.919**
Error	50	7.120	12.662	7.831	55.646	1.018	0.17	26.050

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Source of variation	Df	Meansumofsquares					
		Number of umbellate umbel^{-1}	Number of seeds umbel^{-1}	Number of seeds umbellate^{-1}	Diameter of mainumbel (cm)	Test weight (g)	Seed yield plant^{-1} (g)
Replications	2	0.457	245.383	5.609	0.017	0.008	0.364
Genotypes	25	14.584**	24008.738**	32.532**	0.505**	0.175**	7.125**
Error	50	1.001	1114.286	3.492	0.081	0.001	0.151

*,**significant at 5% and 1% levelofsignificance respectively

Table2.Mean performance of twentysix ajwain genotypes for thirteen morphological characters

S.N.	Genotypes	Days to first flowering	Days to 50% flowering	Days to maturity	Plant height at maturity (cm)	No. of primary branches plant^{-1}	Length of first internode (cm)	No. of umbels plant^{-1}	No. of umbellate umbel^{-1}	No. of seeds umbel^{-1}	No. of seeds umbellate^{-1}	Diameter of main umbel (cm)	Test weight (g)	Seed yield plant^{-1} (g)
1	PDKVAJ 01	75.67	83.33	132.33	80.37	9.15	1.97	70.09	15.14	244.61	19.47	3.03	0.91	4.13
2	PDKVAJ 02	80.00	90.00	131.67	90.73	10.85	2.57	53.19	11.73	338.67	20.61	3.27	1.02	4.17
3	PDKVAJ 03	74.33	88.33	130.33	89.40	8.78	2.50	60.78	13.42	225.50	19.14	4.10	1.05	3.02
4	PDKVAJ 04	91.67	91.33	131.67	88.40	9.99	1.97	62.66	15.93	424.96	19.77	3.17	0.56	6.78
5	PDKVAJ 05	64.67	82.00	132.67	80.10	10.71	2.57	59.13	14.75	185.45	15.89	4.03	0.73	3.13
6	PDKVAJ 06	77.33	92.00	144.67	80.80	10.94	2.07	101.67	14.59	227.62	18.48	4.00	0.56	6.87
7	PDKVAJ 07	90.00	96.33	144.33	75.57	8.60	2.13	81.27	10.55	147.51	16.05	3.37	0.74	4.23
8	PDKVAJ08	64.67	83.00	141.33	81.43	8.42	2.12	89.54	9.35	215.78	18.62	3.20	0.96	3.03
9	PDKVAJ09	61.67	90.00	133.33	81.03	10.36	2.03	59.21	9.65	190.43	15.01	3.33	1.42	6.51
10	PDKVAJ 10	71.67	92.33	135.67	86.77	8.89	2.27	114.47	11.50	405.07	21.85	3.50	1.06	8.16
11	PDKVAJ11	91.67	107.33	132.67	103.67	9.54	2.53	79.23	13.69	194.05	12.79	3.10	1.26	8.29
12	PDKVAJ 12	84.67	102.33	132.33	77.40	9.02	3.03	30.24	9.31	149.59	21.54	4.10	0.89	6.32
13	PDKVAJ 13	78.67	93.67	132.33	83.93	9.13	2.37	71.67	14.17	394.98	14.75	4.00	1.03	4.63
14	PDKVAJ 14	76.67	89.67	129.67	86.57	8.70	2.50	91.91	9.71	282.91	13.56	3.03	0.53	4.73
15	PDKVAJ 15	85.00	98.67	135.33	94.27	11.60	2.60	101.51	13.43	388.49	11.54	3.07	0.54	5.63
16	PDKVAJ 16	74.67	89.33	133.33	85.63	13.19	2.03	115.07	13.15	359.55	11.66	4.20	0.64	7.84

Table 2 Continued…

S.N.	Genotypes	Days to first flowering	Days to 50% flowering	Days to maturity	Plant height at maturity (cm)	Number of primary branches plant^{-1}	Length of first internode (cm)	No. of umbels plant^{-1}	No. of umbellate umbel^{-1}	No. of seeds umbel^{-1}	No. of seeds umbellate^{-1}	Diameter of main umbel (cm)	Test weight (g)	Seed yield plant^{-1} (g)
17	PDKVAJ17	75.33	87.33	132.33	94.47	10.83	2.23	95.44	13.28	335.35	22.28	3.80	0.58	3.45
18	PDKVAJ18	71.33	91.00	131.67	104.43	10.57	2.10	70.71	15.30	188.97	17.56	4.03	0.64	5.33
19	PDKVAJ19	68.33	84.00	130.33	112.33	9.19	3.17	111.46	16.46	302.10	20.90	3.43	0.53	4.27
20	PDKVAJ20	87.33	96.33	131.67	99.20	11.74	2.27	106.04	13.33	235.37	11.33	3.67	0.52	6.49
21	PDKVAJ21	63.00	86.00	132.67	118.33	12.43	1.77	118.27	14.89	252.04	19.20	3.70	0.62	4.12
22	PDKVAJ22	92.33	110.67	144.67	107.07	10.74	1.87	95.61	13.13	282.87	19.43	3.17	0.78	5.08
23	AA-19-01	78.00	90.00	144.33	100.37	10.03	2.20	87.44	15.80	414.88	19.55	4.23	0.86	6.18
24	AA-2	88.00	106.00	141.33	102.77	11.15	2.40	76.07	12.52	217.97	17.31	3.93	0.67	5.08
25	AA-93	65.33	85.33	133.33	113.33	11.61	2.50	101.93	16.27	419.70	15.94	3.67	0.68	4.44
26	PKV-07	71.33	88.67	135.67	115.50	11.06	3.38	119.24	15.12	331.88	16.25	3.93	0.68	5.10
	Max	92.33	110.67	144.67	118.33	13.19	3.38	119.24	16.45	424.96	22.28	4.23	1.42	8.29
	Min	61.67	82.00	129.67	75.57	8.42	1.77	30.24	9.31	147.50	11.33	3.03	0.52	3.02
	Mean	77.05	92.11	135.46	93.61	10.27	2.35	85.53	13.31	282.93	17.32	3.61	0.79	5.26
	S.E.(m)±	1.54	2.05	1.61	4.30	0.58	0.24	2.94	0.57	19.27	1.07	0.16	0.02	0.22
	C.D.5%	4.37	5.83	4.58	12.23	1.65	0.68	8.37	1.64	54.74	3.06	0.46	0.07	0.63

andGhanshyam *et al*.(2014) for length of first internode. However, it was exhibited low for character days to maturity(4.01 %). Similar finding regarding PCV for days to maturity was also reported by Dhakad *et al*. (2017), Subramaniyan *et al*. (2018) and Rawat *et al.* (2020).

The genotypic coefficient of variation varied from 3.44 per cent to 30.87 per cent (Table 3). High genotypic coefficient of variation was noted for number of seeds per umbel (30.87 %), test weight (30.59 %), seed yield plant^{-1} (28.93 %), number of umbels plant^{-1} (26.93 %), number of seeds umbellate^{-1} (17.95 %) and number of umbellate umbel^{-1} (15.95 %) and length of first internode (13.08 %). The findings are in close harmony with Rawat *et al.* (2020) for number of umbels plant^{-1} and seed yield plant^{-1} and Rawat *et al.* (2020) for length of first internode. Days to maturity (3.44 %) and days to 50 per cent (7.94 %) showed the lower values of genotypic coefficient of variation, which resembles to the findings of Dhakad *et al*. (2017), and Subramaniyan *et al*. (2018) and Rawat *et al.* (2020) While it was recorded moderate for plant height at maturity, days to first flowering, number of primary branches plant^{-1}.

Over all coefficient of variation studies revealed the narrowrange between phenotypic coefficient of variation and genotypic coefficient of variation, indicating less influence of environmental factor on the expression of characters seed yield plant^{-1}, number of umbels plant^{-1}, test weight, number of seeds umbel^{-1}, length of first internodeand number of seeds umbellate^{-1}. Thus, these characters are confined to genetic factors. Therefore, selection based on phenotypic expression would be prove useful for obtaining the promising results.

The results indicated that the heritability estimates were very high for test weight, number of umbels plant^{-1}, seed yield plant^{-1}, days to first flowering, number of seeds umbel^{-1}, number of umbellate umbel^{-1} and days to 50 per cent flowering. (Table 3). These results are in close proximate to that of Ghanshyam *et al*. (2014) for test weight, Meena *et al.* (2014) for number of umbels per plant, number of seeds per umbel, testweight and seed yield perplant, Dhakad *et al*. (2017) for days to first flowering and number of seeds umbel^{-1} and Subramaniyan *et al*. (2018) and Rawat *et al.*(2020) seed yield plant^{-1}. Heritability estimates were recorded high for the traits viz., number of umbellate umbel^{-1}, days to 50 per cent flowering and days to maturity. The results were in close proximate to that of Ghanshyam *et al*.(2014) for days to 50 per cent flowering, Dhakad *et al*. (2017) number of umbellate umbel^{-1} and Subramaniyan *et al*. (2018) for days to 50 per cent flowering and number of umbellate umbel^{-1} and Rawat *et al.* (2020) for number of umbellate umbel^{-1},daysto 50 percent flowering. The estimate of heritability were low for length of first internode which indicates that the character is rather more influenced by environment and may not respond much to selection. Whereas, character number of primary branches and diameter of main umbel exhibit moderate value of heritability, which is similar to the result reported by Ghanshyam *et al*. (2014), Meena *et al.* (2014) for number of primary branches plant^{-1}, Rawat *et al.* (2020) for diameter of main umbel.

The magnitude of genetic advance was ranged from 0.37 to 168.10 (Table 3). The value of genetic advance was recorded significantly highest for character number of seeds umbel^{-1} (168.10) followed by number of umbels plant^{-1} (46.32), days to first flowering (29.42) and plant height at maturity (21.18). Moderate values of genetic advance were recorded for days to 50 per cent flowering (19.16) and days to maturity (8.23). Whereas lower values of genetic advance were recorded for characters number of seeds umbellate^{-1} (5.49), number of umbellate umbel^{-1} (3.96), seed yield plant^{-1} (3.04), number of primary branches plant (1.74), diameter of main umbel (0.61), test weight (0.49) and length of first internode (0.37). Results are in close proximate to that of Sharma *et al.* (2015), Dhakad *et al*. (2017) and Rawat *et al.* (2020). Heritability however, indicates only the effectiveness with which selection of genotype can be done, based on phenotypic performance, but fails to indicate the genetic progress. Heritability estimates along with genetic gain are more effective and reliable in predicting the improvement through selection. Estimates of genetic advance helps to predict the extent of improvement that can be achieved for improving the different characters. Genetic advance as percentage of mean ranged between 6.07 per cent to 62.02 per cent. The highest estimate of genetic advance as percentage of mean was recorded for test weight, number of seeds umbel^{-1}, seed yield plant^{-1}, number of umbel plant^{-1}, number of seed

Table3: Estimates of genetic parameters studied for thirteen morphological characters in Ajwain

S.N.	Characters	Range	Mean	GCV (%)	PCV(%)	Heritability h^2 (%)	GA	GAM(%)
1.	Daysto first Flowering	61.67-92.33	77.05	12.16	12.64	92.50	29.42	24.09
2.	Daysto50% flowering	82.00-110.66	92.12	7.94	8.83	80.87	19.16	14.71
3.	Days to maturity	129.67-144.67	135.46	3.44	4.01	73.51	8.23	6.07
4.	Plantheightat maturity (cm)	75.57-118.33	93.61	12.90	15.17	72.41	21.18	22.63
5.	No.ofprimary branchesper plant	8.41-13.19	10.27	11.04	14.77	55.86	1.74	17.00
6.	Lengthoffirst internode(cm)	1.77-3.38	2.35	13.08	22.08	35.08	0.37	15.96
7.	No.ofumbelsper plant	30.23-119.24	85.53	26.93	27.58	95.32	46.32	54.16
8.	No.ofumbellate perumbel	9.30-16.45	13.31	15.98	17.66	81.88	3.96	29.79
9.	No.ofseedsper umbel	147.50-424.96	282.93	30.87	33.05	87.26	168.10	59.41
10.	No.ofseedsper umbellate	11.33-22.28	17.32	17.95	20.94	73.49	5.49	31.71
11.	Diameterofmain umbel(cm)	3.03-4.23	3.61	10.39	13.05	63.48	0.61	17.06
12.	Testweight(g)	0.52-1.42	0.78	30.59	31.08	96.86	0.49	62.02
13.	Seed yieldperplant (g)	3.02-8.29	5.26	28.93	29.86	93.88	3.04	57.75

umbellate^{-1}, number of umbels plant^{-1}, number of seeds umbellate^{-1}, number of umbellate umbel^{-1}, days to first flowering, plant height atmaturity, diameter of main umbel, number of primary branches plant^{-1}. These are similar to the findings of Dhakad *et al*. (2017), Jyothi *et al.* (2017) and Rawat *et al.*(2020).

CONCLUSION

Further it is concluded that the genotypes viz., PDKV AJ 11, PDKV AJ 10, PDKV AJ 16, PDKV AJ 06, PDKV AJ 04, PDKV AJ 09, PDKV AJ 20, PDKV AJ 12, AA-19-01, PDKV AJ 18, PKV-07AA-2 and PDKV AJ 22 found high potential for seed yield, whereas PDKV AJ 14, PDKV AJ 19, PDKV AJ 02, PDKV AJ 04, PDKV AJ 18, PDKV AJ 20 were the early maturing genotypes, which can be exploited for further breeding programme and need to be tested on large area.

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