Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; SP3: 41-44

Narendra Pratap Singh
Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India.

VP Pandey
Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India.

AK Singh
Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India.

Correspondence
Narendra Pratap Singh
Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India

(Special Issue- 3)
National Conference
"Sustainable Agriculture and Recent Trends in Science & Technology"
(February 22nd & 23rd, 2019)

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

Narendra Pratap Singh, VP Pandey and AK Singh

Abstract
Thirty genotypes of azwain were evaluated for their genetic variability, heritability and potential for screening suitable genotypes for future improvement programmes. Analysis of variance showed the mean sum of square due to treatment was highly significant difference for all the ten characters, indicated presence of sufficient variability in the studied materials. Genotypes, NDAZ-22, NDAZ-20, NDAZ-25, NDAZ-5 and NDAZ-27 were identified as most promising genotypes for seed yield per plant. Highest genotypic and phenotypic coefficient of variation was exhibited by test weight followed by number of umbellets per umbel, weight of grains per umbel and number of primary branches per plant. High estimates of heritability in broad sense was observed for the characters like test weight g (93.19 %), number of umbellets per umbel (91.92 %), weight of grains per umbel (89.64 %), days to maturity (88.34 %) and number of branches per plant (85.99 %). The genetic advance as per cent of mean was highest in case of test weight g (37.45 %) followed by number of umbellets per umbel (29.78 %), weight of grains per umbel g (25.21 %), number of branches per plant (23.93 %), yield/plant (10.83 %), and days to maturity (10.78 %), indicated these characters had additive gene effect and therefore, these are more reliable for effective selection.

Keywords: Azwain, variability, phenotypic coefficient of variation, genotypic coefficient of variation, heritability, genetic advance.

Introduction

India is known as the 'Land of Spices' and is the largest producer, consumer and exporter of seed spices and their products. Azwain, ajowan, also carom (*Trachyspermum ammi* L.), 2n= 2x= 18, is an annual herb in the family Apiaceae. It originated in the eastern Mediterranean, possibly Egypt, and spread up to India from the Near East. Both the leaves and fruit pods of the plant are used for human consumption. Azwain is grown in Iran, Egypt, Afghanistan and extensively in India. In India, it is extensively grown in Rajasthan, Gujarat, Uttar Pradesh, Bihar, Maharastra, Punjab, West Bengal, Tamil Nadu and Andhra Pradesh. In India, it is grown an area and production of azwain are about 0.024 Mha and 0.014 Mt, respectively with 0.58 tonnes per hectare productivity (Anonymous, 2016-17) [1]. The small seed are pale brown and have an oval shape. It has a bitter and pungent taste, with a flavour similar to anise and oregano. They smell almost exactly like thyme because it contains thymol, but is more aromatic and less subtle in taste, as well as slightly bitter and pungent. Even a small amount of seed tends to dominate the flavour of a dish. The seed are rarely eaten raw, they are commonly dry-roasted or fried in ghee, clarified butter. This allows the spice to develop a more subtle and complex aroma. It is considered to be an ant flatulent, a spice which reduces the gaseous effects of beans and other legumes. In Afghanistan the fruit pods are sprinkled over bread and biscuits. It is used in various Indian dishes for flavoring soups, sauces, pastry, bread rolls, liquors meat dishes and in the seasoning of pickles. Azwain owes its characteristic odour and taste due to the presence of an essential oil (2-4%). Other constituents present in the seeds include- sugars, tannins and glucosides. Azwain oil is an almost colorless to brownish liquids, possessing a characteristics odour and a sharp burning taste. On standing, a part of the thymol may separate form of crystals, which is sold in Indian market under the name of "azwain ka phool" or "sat Azwain" and is much valued in medicine as it has nearly all the properties of Azwain seeds. The genetic improvement of any crop depends upon its judicious exploitation through efficient breeding method. Genetic variability is a prerequisite for a successful breeding programme of any crop species and a critical survey of genetic variability is essential before initiating an improvement programme aiming to develop high yielding varieties (Falconer, 1989). The variability analysis and partitioning of the total variation into heritable and nonheritable components with suitable genetic parameters like genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), percent heritability, percent genetic advance etc. is therefore, a necessity (Barma *et al*., 1990) [2]. The magnitude of these components is a measure of the type of gene action involved in the expression of various traits. The information about gene action helps in deciding a breeding procedure for the genetic improvement of traits (Singh and Narayanan, 2007) [13]. However, it is possible to develop high-yielding open pollinated varieties by utilizing existing variability (Islam *et al*., 2009) [7] and this technique could be used in improvement of azwain. Therefore, an attempt was made in the present investigation to estimate the magnitude of genetic variability, heritability, genetic advance in thirty azwain genotypes, which can be utilized as future breeding programme.

Materials and Methods

The present investigation was carried out at Main Experimental Station of Vegetable Science, N. D. U. A. & T., Faizabad (Uttar Pradesh) during rabi season, 2015. Geographically, Narendra Nagar, falls under humid sub-tropical climate and is located in between 24.47^0 and 26.56^0 N latitude and 82.12^0 and 83.98^0 E longitude at an altitude of 113 m above the mean sea level in the Gangetic Alluvial Plains of Eastern Uttar Pradesh. The experiment was conducted in Randomized Complete Block Design with three replications to assess the performance of 30 genotypes of azwain including check variety. The plot size was of 0.6 m × 1.80 m with row to row spacing of 45 cm and plant to plant spacing of 20 cm. All the recommended package of practices was followed to raise a healthy crop. The observations were recorded on five randomly selected plants from each genotype in each replication for the characters *viz*., plant height (cm), number of branches per plant, number of umbels per plant, number of umbellates per umbel, weight of grains per umbel (g), test weight (g) and seed yield per plant (g), while for germination (%), days to 50% flowering and days to maturity, the data were recorded as whole plot basis. The analysis of variance for the design of experiment (RBD) was carried out according to the procedure outlined by Panse and Sukhatme (1967) [12]. The data were analyzed for phenotypic and genotypic variances (Johnson *et al*., 1955) [8]. The Genotypic and phenotypic coefficients of variations were estimated according to the formula suggested by Burton (1952) [3]. Heritability in broad sense (h^2bs), genetic advance (GA), and genetic advance in percent of mean (GA%) were estimated for different characters by the formula suggested by Johnson *et al*. (1955) [8].

Results and Discussion

Mean performance of genotypes

The mean performance, general mean and range of thirty entries for 10 characters has been presented in (Table 1). The germination percentage ranged from 75.97% (NDAZ-27) to 94.70% (NDAZ-8) while general mean for germination percentage was 89.62 per cent. However, days to 50% flowering ranged from 86.33 days (NDAZ-20) to 103.33 days (NDAZ-2). General mean of this trait for all genotypes were 95.74 days. Number of branches per plant ranged from 6.00 (NDAZ-11) to 11.07 (NDAZ-20). General mean of this trait for all genotypes were 9.28. Character like number of umbels per plant ranged from 31.00 (NDAZ-16) to 37.20 (NDAZ-21). General mean of this trait for all genotypes were 33.85. On the other hand, number of umbellets per umbel ranged between 14.40 (NDAZ-29) to 27.20 (GA-1). General mean of this trait for all genotypes were 19.46. Weight of grains per umbel (g) ranged between 0.87 (NDAZ-23) to 1.47 (NDAZ-3). General mean of this trait for all genotypes were 1.17. The range value for plant height (cm) was observed in case of NDAZ-21 (101.47 cm) and NDAZ-5 (111.40 cm) and general mean for plant height was 107.12 cm. While, days to maturity ranged from 160.60 (NDAZ-12) to 193.73 (NDAZ-17). General mean of this trait for all genotypes were found 177.17. Test weight ranged from1.19 g (NDAZ-14) to 3.09 g (NDAZ-8). General mean of this trait for all genotypes were found 2.35 g. Therefore, seed yield per plant ranged from 26.80 g (NDAZ-3) to 39.90 g (NDAZ-22). General mean of this trait for all genotypes were 33.59.

Table 1: Mean performance of 30 genotypes for ten characters in azwain genotypes.

Genotypes	Germination (%)	Days to 50 % flowering	Number of branches per plant	Number of umbels per plant	Number of umbellets per umbel	Weight of grains per umbel (g)	Plant height (cm)	Days to maturity	Test weight (g)	Seed yield per plant (g)
NDAZ-1	91.47	96.67	10.53	34.60	15.60	1.24	109.27	167.07	2.05	34.00
NDAZ-2	93.73	103.33	10.67	35.57	17.53	1.31	107.27	170.27	2.18	32.07
NDAZ-3	82.83	93.00	9.47	31.80	18.47	1.47	103.97	177.20	2.33	26.80
NDAZ-4	92.27	101.33	10.13	35.77	21.67	0.94	107.30	167.53	2.43	30.90
NDAZ-5	93.50	90.67	10.83	34.37	22.00	1.12	111.40	180.00	2.21	32.97
NDAZ-6	93.07	101.33	7.47	35.27	21.93	1.03	111.10	182.53	2.16	38.43
NDAZ-7	90.70	87.33	8.47	35.20	22.40	1.22	109.63	189.60	2.25	34.40
NDAZ-8	94.70	95.00	9.20	35.23	19.47	0.88	105.73	182.73	3.09	37.87
NDAZ-9	89.27	97.00	9.47	32.00	20.53	1.38	109.27	162.27	2.35	32.23
NDAZ-10	84.77	99.67	8.80	32.37	26.87	1.21	107.50	174.67	2.43	31.63
NDAZ-11	91.63	94.67	6.00	33.77	19.67	1.11	106.60	169.73	2.23	31.77
NDAZ-12	83.73	99.33	9.13	32.83	20.73	1.12	104.03	160.60	2.01	33.90
NDAZ-13	92.50	98.67	8.60	35.80	17.80	1.28	109.33	167.07	1.60	33.27
NDAZ-14	89.93	97.67	10.87	32.77	21.00	1.06	105.43	168.93	1.19	30.70
NDAZ-15	93.20	99.00	9.53	33.77	17.93	1.12	108.07	181.40	1.47	32.93

NDAZ-16	92.03	96.00	8.73	31.00	17.73	1.11	110.70	190.07	2.93	33.73
NDAZ-17	88.30	99.67	8.67	33.17	19.07	0.97	107.20	193.73	2.40	34.30
NDAZ-18	91.37	97.67	9.13	31.77	19.60	0.99	106.07	174.07	2.76	33.50
NDAZ-19	91.33	100.33	8.40	33.57	18.60	1.27	109.47	163.67	1.98	32.40
NDAZ-20	92.00	86.33	11.07	32.77	20.73	1.31	108.53	190.53	2.17	39.40
NDAZ-21	93.83	95.67	10.80	37.20	18.67	1.32	101.47	174.60	2.67	31.73
NDAZ-22	90.37	92.33	9.40	35.73	19.87	1.10	106.67	186.80	2.27	39.90
NDAZ-23	89.00	93.33	10.73	35.30	18.80	0.87	106.70	164.80	3.01	34.13
NDAZ-24	84.50	94.00	9.53	31.60	16.87	1.42	105.67	180.07	2.88	32.80
NDAZ-25	85.10	97.33	9.07	34.03	15.67	1.17	107.87	180.80	2.61	38.70
NDAZ-26	87.53	94.67	10.53	35.13	21.47	1.20	103.67	185.73	2.18	33.50
NDAZ-27	75.97	93.33	7.73	33.57	15.00	1.15	103.67	185.27	2.73	34.57
NDAZ-28	86.73	89.00	9.40	32.47	16.47	1.23	104.00	192.33	3.05	32.07
NDAZ-29	91.80	97.33	7.73	33.67	14.40	1.40	108.60	163.80	2.46	32.83
Gujarat Azwain -1	91.47	90.67	8.27	33.37	27.20	1.18	107.53	187.33	2.32	30.20
Mean	89.62	95.74	9.28	33.85	19.46	1.17	107.12	177.17	2.35	33.59
C.V. (%)	2.43	4.71	5.06	4.15	4.47	4.40	2.14	2.02	5.09	7.33
S.E. (±)	1.26	2.60	0.27	0.81	0.50	0.03	1.32	2.07	0.07	1.42
C.D. at 5 %	3.57	7.37	0.77	2.29	1.42	0.08	3.74	5.86	0.20	4.02

Analysis of variance

Mean sum of square due to treatment was found highly significant for all the characters (Table 2), indicated the presence of high magnitude of variability are present among the genotypes.

Table 2: Analysis of variance (mean sum of squares) for 10 characters in azwain genotypes.

Characters	Source of variation		
	Replication	**Treatments**	**Error**
d. f.	**2**	**29**	**58**
Germination (%)	1.741	52.004**	4.762
Days to 50% flowering	7.811	52.958**	20.339
Number of branches per plant	0.000	4.274**	0.220
Number of umbels per plant	0.238	7.148**	1.969
Number of umbellets per umbel	0.976	26.592**	0.757
Weight of grains per umbel (g)	0.002	0.071**	0.002
Plant height (cm)	0.170	17.854**	5.245
Days to maturity	0.652	304.851**	12.851
Test weight (g)	0.022	0.600**	0.014
Seed yield per plant (g)	2.534	24.615**	6.062

*, ** Significant at 5% and 1% probability levels, respectively.

Estimation of genetic variability

Estimates of high variability of 30 genotypes in respects of ten characters have been presented in Table 3. The coefficient of genotypic and phenotypic variability is helpful to measure the extent of variability present in particular trait. They also provide a helpful measure to compare the variability present among various quantitative traits. The estimates of coefficient of variances revealed that magnitude of phenotypic coefficient of variation for all the traits were higher than the magnitude of genotypic coefficient of variation that indicated the role of environment in expression of traits. The estimate of phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all traits. Low genotypic coefficient of variation was estimated in plant height (1.91 %) followed by days to 50% flowering (3.44 %), germination (4.43 %), days to maturity (5.57 %) and yield per plant (7.40 %). Moderate genotypic coefficient of variation was estimated in only four genotypes test weight (18.84 %), umbellets per umbel (15.08 %), weight of grains per umbel (12.93 %) and branches per plant (12.53 %). However, high genotypic coefficient of variation (GCV) was not found in any characters. The phenotypic coefficient of variation was estimated in plant height (2.87 %), germination (5.05 %), umbels per plant (5.68 %), umbels per plant (5.68 %), days to maturity (5.92 %) and days to 50% flowering (5.84 %) while only four genotypes showed moderate rate of PCV for test weight (19.51 %), umbellets per umbel (15.73 %), weight of grains per umbel (13.66 %), branches per plant (13.51 %) and yield per plant (10.42 %). However, none of the traits showed high phenotypic coefficient of variation (PCV). These observations corroborates the findings of the previous workers of Palanikumar *et al.* (2012) [10]; Dyulgerov and Dyulgerova (2013) [4]; Meena *et al.* (2015) [9]; Subramaniyan *et al.* (2018) [14].

Table 3: Range, grand mean, phenotypic (PCV), genotypic (GCV), heritability in broad sense, genetic advance in per cent of mean (Ga) for ten characters in azwain genotypes.

Characters	Range		Grand mean	PCV (%)	GCV (%)	Heritability broad sense (%) (h^2_{bs})	Genetic advance in per cent of mean (Ga)
	Lowest	Highest					
Germination (%)	75.97	94.70	89.62	5.05	4.43	76.78	7.99
Days to 50% flowering	86.33	103.33	95.74	5.84	3.44	34.83	4.18
Number of branches per plant	6.00	11.07	9.27	13.51	12.53	85.99	23.93
Number of umbels per plant	31.00	37.20	33.84	5.68	3.83	46.71	5.46
Number of umbellets per umbel	14.40	27.00	19.45	15.73	15.08	91.92	29.78
Weight of grains per umbel (g)	0.87	1.47	1.17	13.66	12.93	89.64	25.21
Plant height (cm)	101.47	111.40	107.12	2.87	1.91	44.48	2.62
Days to maturity	160.60	193.73	177.17	5.92	5.57	88.34	10.78
Test weight (g)	1.19	3.09	2.34	19.51	18.84	93.19	37.45
Seed yield per plant (g)	26.80	39.90	33.58	10.42	7.40	50.49	10.83

Estimation of heritability and genetic advance

Heritability is of interest to the plant breeders primarily as a measure of the value of selection for the particular character in various types of progeny and as an index of transmissibility of characters from parent to offspring (Hayes *et al*., 1955) [6]. So, concept of heritability is important to evaluate the relative magnitude of the effect of genes and environments on total phenotypic variability. For this reason, Burton (1952) [3] suggested that genetic variability along with heritability should be considered for assessing the maximum and accurate effect of selection. The heritability estimates in broad sense were high for most of the characters (Table 3), it indicating that though the character is least influenced by the environment effects, the selection for improvement of such character may be useful, because broad sense heritability is based on total genetic variance which includes both fixable (additive) and non-fixable (dominance and epistatic variance). The value of heritability in broad sense (h^2_{bs}) ranged from 34.83 % (days to 50% flowering) to 93.19 % (test weight). High estimate of heritability in broad sense (more than 75 %) was observed in test weight (93.19%), number of umbellets per umbel (91.92%), weight of grains per umbel (89.64%), days to maturity (88.34%), number of branches per plant (85.99 %), while, moderate heritability (50-75%) was recorded in germination percentage and seed yield per plant (50.49%). High heritability accompanied with high genetic advance as per cent of mean indicates that most likely the heritability is due to additive gene effects and selection may be effective. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson *et al*., 1955) [8]. Results revealed that high heritability coupled with high genetic advance as per cent of mean was observed for the characters number of branches per plant, number of umbellets per umbel, weight of grains per umbel and test weight, indicating that these characters were also controlled by the additive action of polygene (Panse, 1957) [11] and would be considered for selection criteria. Similar findings support from the previous studies of Dyulgerov and Dyulgerova (2013) [4]; Meena *et al.* (2015) [9]; Subramaniyan *et al*. (2018) [14].

References

1. Anonymous. Horticulture Data Base, 2nd Edn. National Horticulture Board, Gurugram, Ministry of Agriculture and Farmer's Welfare, India, 2016-17.
2. Barma NCD, Khan SH, Mian MAK, Islam A. Variability and interrelationships of eight quantitative characters in bread wheat (*Triticum aestivum* L.). Bangladesh J Plant Breed. Genet. 1990; 3(1&2):71-75.
3. Burton GW. Quantitative inheritance in grasses. Proceedings of the 6th International Grassland Congress. 1952; 1:277-283.
4. Dyulgerov N, Dyulgerova B. Genetic divergence among accession of coriander. Journal of Agricultural Science and Technology. 2013; 5(1):13-15.
5. Falconar DS. Introduction to Quantitative Genetics. 2nd Ed. English Language Book Society/ Longman, 1989, 288.
6. Hayes HK, Immer FR, Smith DE. *Methods of Plant Breeding*. McGraw Hill Book Co., New York, 1955, 551.
7. Islam MR, Hossain MS, Bhuiyan MSR, Husna A, Syed MA. Genetic variability and path-coefficient analysis of bitter gourd (*Momordica charantia* L.). International Journal of Agricultural Sustainability. 2009; 1(3):53-57.
8. Johnson HW, Robinson JF, Comstock RE. Estimation of genetic and environmental variability in soya bean. Agronomy Journal. 1955; 7:314-318.
9. Meena SS, Solanki RK, Kakani RK, Kumari S. Genetic variability studies in ajwain (*Trachyspermum ammi* L.). Journal of Spices and Aromatic Crops. 2015; 24(2):119-123.
10. Palanikumar M, Rajamani K, Muthiah AR. Path coefficient analysis in coriander (*Coriandrum sativum* L.) genotypes for fresh biomass yield under different seasons. Crop Research. (Hisar). 2012; 44 (1/2):222-226.
11. Panse VG. Genetics of quantitative characters in relation to plant breeding. Indian Journal of Genetics and Plant Breeding. 1957; 17:318-328.
12. Panse VG, Shukhatme PV. Statistical methods for agriculture workers (2nd Edn.). Indian Council of Agriculture Research, New Delhi, 1967.
13. Singh P, Narayanan SS. Biometrical techniques in plant breeding. 1st Edn., Kalyani Publishers, New Delhi, 2007, 37-50.
14. Subramaniyan P, Jothi Jeeva L, Sundharaiya K, Shoba N, Murugesan S. Genetic variability, heritability, genetic advance, correlation coefficient and path analysis in ajowan (*Trachyspermum ammi* L.). Indian Journal of Science Research. 2018; 19(1):37-46.