

Correlation and Path Analysis for Seed Yield its Contributing Traits and Oil content in Ajwain (*Trachyspermum ammi* L.)

Monika Meena, N. S. Dodiya, Baudh Bharti,
 Rajani Verma, Bharat Lal Meena

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Abstract Twenty five elite genotypes of ajwain along with three checks namely, Gujarat Ajwain-1, Pratap Ajwain-1 and Local check were evaluated under four different environments to understand the contribution of various characters to the yield. The genotypic correlation coefficients were higher than corresponding phenotypic ones for most of the character combinations. Biological yield and test weight had positive and significant association with seed yield. The biological yield showed maximum positive direct effect followed by number of primary

branches, plant height, number of umbelets per umbel and oil content. Biological yield and test weight were the most important characters contributing to seed yield and can be strategically used in the selection process for seed yield improvement in ajwain under late shown condition.

Keywords Correlation, Path, Seed yield, Oil content, Ajwain.

Introduction

Ajwain (*Trachyspermum ammi* L. Sprague, $2n=18$), belong to the family Apiaceae, a highly valued medicinally important seed spices. It is native of Egypt and is cultivated in Iraq, Iran, Afghanistan and India. It is also known as Bishop's weed and Carum in English and cultivated mainly for its seed, herb and volatile oil. It has medicinal value specially for curing indigestion, stomach pain and elements concerning digestive system. It is also used in cholera, diarrhea, gastric and urinary trouble. Seed contains volatile oil (2–4%) that is yellow brownish in color used in many *Ayurvedic* medicines and industries. In India, it is grown in Gujarat, Rajasthan, Madhya Pradesh, Bihar, Punjab, Tamil Nadu, West Bengal, Andhra Pradesh and Uttar Pradesh. In India, 19000 m t of Ajwain was produced from 27000 ha area with the productivity of 703.70 kg/ha [1]. In Rajasthan, it

Monika Meena, N. S. Dodiya, Baudh Bharti*
 Department of Plant Breeding and Genetics, Maharana Pratap
 University of Agriculture and Technology,
 Udaipur 313001 (Rajasthan), India

Rajani Verma
 Department of Plant Breeding and Genetics,
 S. K. N. College of Agriculture (Sri Karan Narendra Agriculture
 University), Jobner 30329 (Rajasthan), India

Bharat Lal Meena
 ARS, Pratapgarh, Maharana Pratap University of Agriculture
 and Technology, Udaipur 313001 (Rajasthan), India
 e-mail : baudhbhartigpb@gmail.com

* Correspondence

is cultivated in Chittorgarh, Udaipur, Jhalawar, Pratapgarh, Baran, Rajsamand, Bhilwara and Kota districts covering an area of 12620 ha with the production and productivity of 9220 m t and 730.58 kg/ha, respectively [2]. Ajwain is an annual herbaceous plant. The plant is profusely branched having height of 60-90 cm, erect with soft hair. It has feather like leaves, 2-3 pinnately divided, and linear segments. Flower is terminal compound umbel. The minute grayish white fruits are oval in nature. The flowers are protandrous and cross pollination occurs through insects [3].

Various components of seed yield very often exhibit varying degree of associations with seed yield as well as among themselves. Analysis of correlation coefficients between characters contributing directly or indirectly towards seed yield is a matter of considerable importance in exercising the selection program. A study of correlation alone is not enough to provide an exact picture of relative importance of direct and indirect influences of each of the component traits on seed yield. In this context, path coefficient analysis is an important tool for plant breeders in partitioning the total correlation coefficients into direct and indirect effects of independent variables on dependent variable i. e. seed yield per plant. Therefore, an attempt was made to study correlation and path coefficient analysis in correlation and path analysis for seed yield its contributing traits and oil content in ajwain.

Materials and Methods

Experimental material consist of 25 elite genotypes of ajwain viz., UA-7, UA-28, UA-29, UA-30, UA-32, UA-41, UA-48, UA-53, UA-63, UA-66, UA-70, UA-71, UA-83, UA-87, UA-90, UA-113, UA-125, UA-127, UA-131, UA-141, UA-149, UA-168, UA-169, UA-175 and Ua-191 and along with three checks namely, Gujarat, Ajwain-1, Pratap Ajwain-1 and local check. These genotypes were evaluated under four different environments viz E₁ (late *kharif*, during 2013-14 at Udaipur), E₂ (late *kharif*, during, 2013-14 at Pratapgarh), E₃ (late *kharif*, during 2014-15 at Udaipur) and E₄ (late *kharif*, during 2014-15 at Pratapgarh) in randomized block design with three replications. Each genotype was sown in

four row plot of 3.0 m row length. Row to row and plat to plant distance was maintained as 30 cm and 10 cm at each location, respectively. All the recommended agronomical practices and plant protection measures were adopted to raise a healthy crop to attain maturity. Fertilizers were applied @ 20 kg N : 20 kg P₂O₅ at the time of sowing as basal dose while 20 kg N/ha was top-dressed in two split doses in thirty and sixty days respectively. Crop was irrigated 6 times during the crop season. First irrigation was given immediately after sowing and there after irrigation was given at an interval of 20-25 days. The observations were recorded on ten randomly selected plants of each genotype in each replication for each environment for 11 quantitative characters viz., plant height, number of primary branches per plant, number of umbels per plant, number of umbelets per umbel, number of seeds per umbelets, biological yield per plant, seed yield per plant, test weight and oil content. However, days to 50% flowering and days to 75% maturity were recorded on plot basis, while oil content was estimated by using [4] and average pooled mean values were used for statistical analysis. The Genotypic and phenotypic correlation coefficients were calculated from the phenotypic and genotypic components of variances and co-variances as per the procedure suggested earlier [5, 6]. The direct and indirect effects of the yield components on the yield were estimated by path coefficient analysis as suggested by wright [7] and elaborated by Dewey and Lu [8]. The path coefficients were obtained by solving the 'p' normal equations following the matrix method given by Singh and Choudhary [9].

Results and Discussion

Correlation coefficient of seed yield its contributing traits and oil content in ajwain showed most of the important traits taken under this experiment were positively and significantly correlated with seed yield (Table 1). Seed yield is a complex polygenic character resulting from interaction of various yield components. Improvement in this character by selection based on component characters appears to be more useful as compared to selection of yield per se. Since all yield contributing characters are correlated, the change in one of the character would bring about a

Table 1. Genotypic and phenotypic correlation coefficient among different characters studied in Ajwain for over pooled environment. *, ** significant at 5% and 1% level, respectively.

Characters	G/P	Day to 50% flowering	Days to 75% maturity	Plant height (cm)	No of primary branches	No of umbels		Seeds per umbelet	Biological yield (g)	Test weight (g)	Oil content (%)	Seed yield (g)
						per plant	per umbel					
Days to 50% flowering	G	1.00	0.07	0.07	-0.34	0.02	0.14	-0.22	0.25	0.20	0.22	0.27
	P	1.00	0.48*	0.36	0.13	0.10	0.12	0.23	0.22	0.26	0.14	0.15
Days to 75% maturity	G		1.00	0.12	0.11	-0.15	0.32	-0.07	-0.27	-0.24	-0.26	-0.15
	P		1.00	0.43*	0.19	0.13	0.18	0.29	0.12	0.16	0.04	0.10
Plant height (cm)	G			1.00	-0.09	0.25	0.31	0.24	-0.37	-0.28	-0.08	-0.33
	P			1.00	0.09	0.23	0.27	0.24	0.06	0.08	0.04	0.02
No of primary branches	G				1.00	0.32	-0.28	0.36	0.10	0.08	-0.01	0.16
	P				1.00	0.17	0.14	0.25	0.19	0.23	0.13	0.14
No of umbels per plant	G					1.00	0.35	0.47*	0.01	-0.22	0.22	-0.17
	P					1.00	0.16	0.32	0.06	-0.03	0.15	-0.00
No of umbelets per umbel	G						1.00	0.07	-0.17	-0.30	-0.10	-0.13
	P						1.00	0.06	-0.02	-0.04	-0.04	-0.02
Seeds per umbelet	G							1.00	-0.42*	-0.56**	-0.11	-0.44*
	P							1.00	-0.11	-0.21	-0.00	-0.16
Biological yield per plant (g)	G								1.00	0.91**	0.02	0.92**
	P								1.00	0.82**	0.20	0.83**
Test weight (g)	G									1.00	-0.02	0.85**
	P									1.00	0.21	0.72**
Oil content (%)	G										1.00	0.01
	P										1.00	0.15

series of changes in other characters. Thus, to bring a change in yield or in any other characters (s) to a desired level, proper understanding of association among the yield and yield contributing characters is must. If association is in desirable direction, it would accelerate the rate of genetic gain and if it is in undesirable direction then it would restrict the genetic progress.

Correlation of characters arises due to linkage and pleiotropy. In general, genotypic correlations were higher than phenotypic correlations. Grain yield per plant showed positive significant correlation with biological yield (0.92 and 0.83) and test weight (0.85 and 0.72) at both genotypic and phenotypic level. Similar finding for yield and yield contributing traits were reported earlier [10—12]. However, it had negative significant association with seeds per umbelet (-0.44) at genotypic level. Grain yield per plant exhibited negative and non-significant correlation with days to 75% maturity (-0.15) and plant height (-0.33) at genotypic level. Similarly seed yield per plant were exhibited positive and non-significant

correlation with oil content (0.01 and 0.15), days to 50% flowering (0.27 and 0.15) and number of primary branches (0.16 and 0.14) at both genotypic and phenotypic level.

Another traits viz., days to 75% maturity (0.10) and plant height (0.02) were exhibited positive and non-significant correlation with seed yield per plant at only phenotypic level. Days to 75% maturity (-0.15), plant height (-0.33), and number of umbels per plant (0.17) were exhibited negative and non-significant correlation with seed yield per plant at genotypic level while, it was also exhibited negative and non-significant correlation with number of umbelets per umbel (-0.13 and 0.02) at both genotypic and phenotypic level. Seeds per umbelet had negative and non-significant correlation with seed yield (-0.16) at phenotypic level. These findings corroborate the earlier observations of [13, 14].

Test weight showed positive and significant correlation with Biological yield per plant (0.91 and 0.82) at both genotypic and phenotypic level whereas,

Table 2. Genotypic path analysis showing direct (diagonal) and indirect effect (off diagonal) of eight characters on seed yield per plant in Ajwain for pooled over the environments. Residual effect = 0.17.

Characters	Plant height (cm)	No of primary branches	No of umbels per plant	No of umbelets per umbel	Seeds per umbelet	Biological yield (g)	Test weight (g)	Oil content (%)	'r' with seed yield per plant
Plant height (cm)	0.20	-0.03	-0.14	0.05	-0.02	-0.59	0.20	-0.01	-0.33
No of primary branches	-0.02	0.32	-0.18	-0.05	-0.02	0.16	-0.06	-0.00	0.16
No of umbels per plant	0.05	0.10	-0.56	0.06	-0.03	0.02	0.16	0.03	-0.17
No of umbelets per umbel	0.06	-0.09	-0.20	0.16	-0.00	-0.27	0.21	-0.01	-0.13
Seeds per umbelet	0.05	0.12	-0.26	0.01	-0.07	-0.67	0.40	-0.01	-0.44*
Biological yield per plant (g)	-0.07	0.03	-0.01	-0.03	0.03	1.61	-0.65	0.00	0.92**
Test weight (g)	-0.06	0.03	0.13	-0.05	0.04	1.47	-0.71	-0.00	0.85**
Oil content (%)	-0.02	-0.00	-0.12	0.02	0.01	0.02	0.01	0.13	0.01

it had negative and significant association with seeds per umbelet (-0.56) at only genotypic level. Biological yield per plant exhibited negative and significant correlation with seeds per umbelet (0.42) at genotypic level. Our results are in close agreement with the results obtained earlier [15, 16].

Seeds per umbelet showed positive and significant correlation with number of umbels per plant (0.47) at genotypic level. Plant height exhibited positive and significant correlation with days to 75% maturity (0.43) at phenotypic level. Similarly day to 50% flowering had positive and significant correlation with days to 75% maturity (0.48) at only phenotypic level.

Path analysis allows the correlation coefficient into direct and indirect effect of the traits contributing towards the dependent variable. The path coefficients studies (Table 2) revealed that biological yield (1.61) showed maximum positive direct followed by number of primary branches (0.32), plant height (0.20), number of umbelets per umbel (0.16) and oil content (0.13) on grain yield per plant. The present findings are in close conformity with earlier reports [11, 12].

Test weight (1.47) showed maximum positive indirect effects followed by number of primary branches (0.16) on grain yield per plant via biological yield per plant. Seeds per umbelet (0.40) exhibited maximum positive indirect effects followed by

number of umbelets per umbel (0.21), plant height (0.20) and number of umbels per plant (0.16) via test weight on grain yield per plant. On seed yield plant maximum indirect positive effects were exhibited seeds per umbelet (0.12) and number of umbels per plant (0.10) via number of primary branches. Similar results have been earlier reported [10–12, 17].

Test weight (0.13) exhibited maximum positive indirect effect on grain yield per plant via number of umbels per plant while other characters showed negative and negligible indirect effects on grain yield per plant so no need of explanation of these yield contributing traits. These results are consonance with the earlier findings [12, 18, 19]. Residual effects of genotypic path was low (0.17) it means 83% variability contributed by yield component traits toward the grain yield per plant while remaining variability contributed by other factor either or environmental factor or other traits toward the grain yield per plant which was not included under the study.

On the basis of character association and path analysis it can be concluded that biological yield and test weight were the most important characters contributing to seed yield and can be strategically used in the selection process for seed yield improvement in ajwain under late shown condition.

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