Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(1): 464-467
Received: 13-11-2020
Accepted: 15-12-2020

Chaitanya K
M.Sc. (Horticulture), Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Bagalkote, Karnataka, India

Narayanapur VB
Assistant Professor, Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Bagalkote, Karnataka, India

Vishwanath YC
Assistant Professor, Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Bagalkote, Karnataka, India

Hegde NK
Professor, Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Sirsi, Karnataka, India

Basavarajappa MP
Associate Professor, Department of Plant Pathology, College of Horticulture, Bagalkote, Karnataka, India

Sarvamangala C
Assistant Professor, Department of Biotechnology and Crop Improvement, College of Horticulture, Bagalkote, Karnataka, India

Corresponding Author:
Chaitanya K
M.Sc. (Horticulture), Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Bagalkote, Karnataka, India

Evaluation of Ajwain (*Trachyspermum ammi* L.) genotypes under northern dry zone of Karnataka

Chaitanya K, Narayanapur VB, Vishwanath YC, Hegde NK, Basavarajappa MP and Sarvamangala C

Abstract
Ajwain is an aromatic seed spice which is cultivated mainly for its seed, herb and volatile oil. Analysis of variance among 16 ajwain genotypes indicated that all the genotypes were significantly different with respect to all the characters studied. Wide variability existed among the genotypes for all the morphological and yield traits. Among the sixteen genotypes studied, DAC-5 took minimum days to germination (11.00 days) and GA-1 showed a maximum plant height (111.20 cm). AA-93 took minimum days to 50 per cent flowering (86 days) and it showed maximum number of flowers per umbel (304.10). Genotype AA-1 recorded maximum number of branches (18.20), number of umbels per plant (213), number of umbellets per umbel (15.33), number of seeds per umbel (226.88), seed yield per plant (10.99 g), seed yield per hectare (4.14 q), harvest index (30.29%) and maximum test weight (1.67 g). Among the genotypes AA-93 was found to be early maturing (131 days). The minimum days to maturity was found in AA-93 (131 days). Maximum oleoresin and essential oil content was observed in DAC-5 (7.15%) and AA-1 (2.33%), respectively. Among the genotypes evaluated AA-1 and AA-93 were found suitable to grow under northern dry zone of Karnataka based on growth and yield attributes.

Keywords: Ajwain, *Trachyspermum ammi*, genotypes, umbels, essential oil, oleoresin

1. Introduction
India is known as a land of spices because, no country in the world produces as many varieties of spices as India. India is the largest producer, consumer and exporter of spices. International Organization for Standardization (ISO) has identified more than 112 plant species as spices, out of which 63 spices are being grown in India, among that 20 are seed spices (Tomar and Malik, 2014) [24]. Ajwain (Oma/ Carum seed/ Bishop's weed) is one of the minor seed spices, botanically known as *Trachyspermum ammi* (L.). It is an important *rabi* season seed spice with a diploid chromosome number of 2n=18 and belongs to the family apiaceae. Ajwain is native to Egypt and it is mainly cultivated in eastern India, Egypt, Persia, Afghanistan, Pakistan and Iran. The major ajwain importing countries are Yemen, Dubai, Malaysia, Pakistan, Saudi Arabia, Indonesia, Singapore, UAE and USA (Ravindrababu *et al*., 2012) [12]. In India, ajwain is cultivated in Rajasthan, Gujarat, Madhya Pradesh, Uttar Pradesh, Maharashtra, West Bengal, Bihar, Telangana and Andhra Pradesh (Mohsenzadeh *et al*., 2012) [10]. During 2018-19, 25,000 t of ajwain seeds were produced from 35,000 hectare area. The present productivity of ajwain is 0.71 t/ha.

Rajasthan is the major ajwain producing state with an area of 15430 ha and annual production of 10540 t. Rajasthan contributes 73 per cent of total ajwain production in India. In south India, Telangana is leading in production *i.e.* 5,720 t in an area of 1,380 hectare. In recent years, huge scale cultivation of ajwain is being taken up in Gulburga, Raichur, Vijayapur and Bagalkote, areas of Karnataka (Anon., 2018) [1]. Ajwain seeds contain an essential oil, which consists nearly 50 per cent of thymol along with γ-terpinene (3.83%) and cymene (3.37%). It has a strong anti-spasmodic, fungicidal and germicidal effect (Bhatt *et al*., 2018) [2]. Most important use of ajwain is the home remedy for indigestion. Its seeds and oils are largely used for its stimulant, antioxidants, preservatives, aromatic and carminative properties. The other major use of ajwain in flavoring of foods (Muvel *et al*., 2015) [11].

Ajwain is mainly a dryland crop which can be grown with less amount of water and least inputs. In spite of this, crop is grown in less area, so there's a scope for further expansion of area under ajwain in dryland regions with high yielding varieties or genotypes. These genotypes play very critical role in optimizing the yield, As they have differential adaptability to diverse agroclimatic conditions. The selection of genotypes basically depends on the soil and climatic conditions, which are prevailing in the area because of changing length of growth season, flowering and maturity.

The length of growing season of ajwain in Karnataka is short compared to that prevailing in Rajasthan (Solemani *et al*, 2011) [20]. Hence, there's need to test the available genotypes under northern dry zone of Karnataka. Therefore, the present study was carried out to evaluate the 16 ajwain genotypes for growth, yield and quality traits.

2. Materials and Methods

The present investigation on was undertaken during *rabi* in 2019-20 at Department of Plantation, Spices, Medicinal and Aromatic Crops (PMA), College of Horticulture, Bagalkote to study the performance of elite ajwain (*Trachyspermum ammi* L.) genotypes. Sixteen genotypes (Table 1) were grown in Randomized Complete Block Design (RCBD) with four replications at a spacing of 45 cm × 30 cm. All the recommended agronomical practices and plant protection measures were adopted to raise a healthy crop to attain maturity. Recommended dose of fertilizer (100: 50: 50 NPK kg ha^{-1}) was applied in the form of SSP at the rate of 312.50 kg ha^{-1}, urea at 217.00 kg ha^{-1} and MOP at 83.00 kg ha^{-1}. Full dose of potash, phosphorous and half dose of nitrogen were applied as basal dose and remaining nitrogen was given after 30 days after sowing (DAS). The seeds were line sown as per the recommended seed rate (2.5 kg ha^{-1}). Seeds were sown in individual plots separately. Totally, 15 irrigations were given during the experimental period. Observation were taken on each genotype for growth, yield and quality traits *viz*., days to germination, plant height, number of branches, days to 50 per cent flowering, number of flowers per umbel, number of umbels per plant, number of seeds per umbel, number of umbelletes per umbel, seed yield, test weight, harvest index, essential oil content and oleoresin content. Mean data from each of the replications were used for analysis. The essential oil percentage was determined by steam distillation method by clevenger apparatus (Sadgrove and Jones, 2015) [13] and oleoresin was extracted by using soxhlet apparatus (Sontakke *et al.,* 2018) [21].

Table 1: Genotypes and source of collection

Sl. No.	Genotypes	Source
1	Ajmer Ajwain -1 (AA-1)	NRCSS, Ajmer, Rajasthan.
2	Ajmer Ajwain -2 (AA-2)	NRCSS, Ajmer, Rajasthan.
3	Ajmer Ajwain -93 (AA-93)	NRCSS, Ajmer, Rajasthan.
4	Ajwain Local -3 (AL-3)	NRCSS, Ajmer, Rajasthan.
5	Ajwain Local -4 (AL-4)	NRCSS, Ajmer, Rajasthan.
6	Ajwain Local -5 (AL-5)	NRCSS, Ajmer, Rajasthan.
7	Gujarat Ajwain -1 (GA-1)	Sardarkrushinagar Dantiwada Agricultural University, Gujarat.
8	Lam Selection-1 (LS-1)	RARS, Guntur, Andhra Pradesh.
9	LTa-26	RARS, Guntur, Andhra Pradesh.
10	DAC-1	HREC, Devihosur, Haveri.
11	DAC-2	HREC, Devihosur, Haveri.
12	DAC-3	HREC, Devihosur, Haveri.
13	DAC-4	HREC, Devihosur, Haveri.
14	DAC-5	HREC, Devihosur, Haveri.
15	DAC-6	HREC, Devihosur, Haveri.
16	DAC-7	HREC, Devihosur, Haveri.

3. Results and Discussion

Analysis of variance revealed significant differences among the genotypes for different characters studied. Days to germination was ranged between 11.00 and 18.50. The minimum days to germination was noticed in DAC-5 (11.00), which was on par with DAC-3 (11.25), AA-1 (11.50), DAC-6 (11.50), AA-93 (11.75), DAC-1 (11.75), DAC-4 (11.75), DAC-7 (11.75), LTa-26 (12.00) and DAC-2 (12.25). The maximum days taken for germination were noticed in AL-3 (18.50). The reason for early germination was rapid imbibition of water by a seeds of different genotypes until the seed tissues are fully hydrated and late germination was observed in some ajwain genotypes due to limited uptake of water. The present observations on days to germination are in co-ordinated with the description of Meena *et al*., 2012 [6, 9] and Giridhar *et al*. (2017).

The plant height was identified maximum in GA-1 (104.60 cm), which was on par with DAC-2 (102.50 cm), LTa-26 (102.45 cm), AL-5 (100.95 cm) and AA-93 (99.35 cm). Whereas, the least plant height was found in DAC-4 (89.55 cm). The variation in plant height as a result of genetic makeup of genotype and its interactivity with the favorable agroclimatic and soil condition. There are several earlier reports showed variation in this trait between the genotypes of ajwain (Datta *et al*., 2001; Singh *et al*., 2003; Saxena *et al*., 2005; Sarada *et al.,* 2009; Meena, 2012; Subramaniyan *et al*., 2019 and Meena *et al*., 2020) [3, 19, 15, 14, 6, 9, 22, 8]. The total number of branches per plant was maximum in AA-1 (18.20), which was found on par with AA-93 (17.25) and DAC-1 (17.25). The minimum number of branches per plant was recorded in AL-4 (13.98). More number of branches leads to increases the photosynthetic activity by increasing the production of more number of leaves. The present observations on ajwain are in consonance with the reports of Datta *et al*., 2001 [3]; Meena, 2012 [6, 9]; Subramaniyan *et al*., 2019 [22] and Meena *et al*., 2020 [8].

The highest number of flowers per umbel was noticed in AA-93 (304.10), which was found on a line with AA-1 (304.05), while, the lowest number of flowers per umbel was registered in AL-4 (150.70). Similar variation was reported by Subramaniyan *et al.* (2019) [22]. AA-93 took minimum days taken for commencement of 50 per cent flowering *i.e.,* 86.00 days, followed by AL-5 (92.00), DAC-6 (93.00) and AL-3 (94.25). Whereas, the maximum days taken for commencement of 50 per cent commencement of flowering was noticed in DAC-7 (110.25). This is because of genotypic character, its interactivity with the surrounding environment and conversion of vegetative stage to reproductive stage might be different among the genotypes. Contrary reports were observed by Meena (2012) [6, 9], Meena *et al*. (2014) [7] and Meena *et al*. (2020) [8].

Table 2: Growth, yield and quality parameters in ajwain genotypes

Genotypes	Days to germination	Plant height at 150 DAS	Number of branches at harvest	Number of flowers per umbel	Days to 50 per cent flowering	Number of umbels per plant	Number of umbellates per umbel	Number of seeds per umbel	Seed yield per plant (g)	Seed yield (q/ha)	Days to maturity	Harvest index (%)	1000 seed weight (g)	Essential oil (%)	Oleoresin (%)
AA-1	11.50	101.61	18.20	304.05	99.25	213.00	15.33	226.88	10.99	4.14	144.25	30.29	1.67	2.33	3.57
AA-2	13.75	101.75	15.20	239.85	95.75	190.10	13.30	185.33	8.53	3.12	140.75	25.20	1.36	1.76	3.23
AA-93	11.75	105.45	17.25	304.10	86.00	204.65	13.10	223.95	9.93	3.64	131.00	24.02	1.38	1.86	4.23
GA-1	13.75	111.20	15.10	221.13	95.00	203.53	11.80	181.18	9.17	3.32	140.00	20.30	1.28	1.20	4.25
AL-3	18.50	99.25	14.25	241.13	94.25	109.40	14.55	204.78	5.86	2.12	139.25	17.12	1.44	1.60	1.91
AL-4	17.00	99.60	13.98	150.70	95.50	98.25	11.70	129.45	5.20	1.88	140.50	15.15	0.89	1.40	4.29
AL-5	14.00	106.60	16.90	181.78	92.00	148.95	12.65	151.03	7.70	2.77	137.00	18.36	1.32	2.00	3.96
Lam selection-1	14.00	96.50	14.45	182.15	94.50	110.10	11.95	152.15	6.18	2.24	139.50	18.83	1.21	1.50	4.01
LTa-26	12.00	108.30	14.05	231.73	96.50	111.85	14.10	194.23	6.27	2.27	141.50	15.23	1.53	1.80	3.08
DAC-1	11.75	104.40	17.25	212.55	95.00	168.25	12.50	177.55	7.96	2.88	140.00	21.48	1.58	1.50	2.46
DAC-2	12.25	108.90	16.90	282.88	97.50	99.40	14.30	210.53	5.70	2.07	142.50	13.66	1.22	2.10	2.62
DAC-3	11.25	101.65	15.10	187.40	108.50	121.40	13.15	157.48	6.70	2.43	153.50	17.51	1.02	2.16	2.73
DAC-4	11.75	95.20	16.65	285.03	108.50	128.70	14.65	212.53	7.61	2.75	153.50	23.13	1.43	2.13	6.36
DAC-5	11.00	104.25	14.35	179.65	94.75	143.05	10.40	148.65	7.65	2.76	139.75	19.41	1.22	1.50	7.15
DAC-6	11.50	99.35	16.65	178.95	93.00	156.95	10.40	148.95	7.74	2.80	138.00	22.43	1.57	2.03	4.70
DAC-7	11.75	99.65	16.65	217.98	110.25	120.45	11.45	178.05	6.49	2.35	155.25	19.55	1.45	2.00	3.32
S. Em ±	0.53	1.71	0.38	5.74	0.93	3.68	0.34	3.83	0.18	0.06	1.10	0.51	0.05	0.05	0.22
C. D. (P = 0.05)	1.52	4.87	1.08	16.35	2.66	10.48	0.97	10.90	0.52	0.18	3.12	1.44	0.15	0.15	0.64

AA-1 showed the highest number of umbels per plant *i.e.*, 213.00, which was at the same level with AA-93 (204.65) and GA-1 (203.53). The lowest number of umbels per plant was recorded in AL-4 (98.25). This variation is based on the genotypic character and also its reaction to local environmental condition. Similar findings were reported by Meena, 2012 [6, 9]; Subramaniyan *et al*., 2019 [22] and Meena *et al*., 2020 [8]. Number of umbellates in an umbel ranged between 10.40 and 15.33. AA-1 showed the highest number of umbellates per umbel *i.e.,* 15.33 which was on a level with DAC-4 (14.65) and AL-3 (14.55) followed by DAC-2 (14.30). The lowest number of umbellates per umbel was recorded in DAC-5 (10.40) and DAC-6 (10.40). Similar records were reported in ajwain by Sunilkumar (2010), Meena (2012) [6, 9] and Meena *et al*. (2020) [8]. AA-1 showed the highest number of seeds per umbel (226.88), which was on par with AA-93 (223.95), followed by DAC-4 (212.53) and DAC-2 (210.53). The minimum number of seeds per umbel was recorded in AL-4 (129.45). The more number of seeds in an umbel was mainly because of good pollination and more number of fertilized ovules with the retension of zygote. Similar results were reported by Singh *et al*. (2003) [19], Meena (2012) [6, 9], Subramaniyan *et al*. (2019) [22] and Meena *et al*. (2020) [8].

AA-1 noticed for its highest seed yield (10.99 g) per plant, succeeded by AA-93 (9.93 g), GA-1 (9.17 g), AA-2 (8.53 g) and DAC-1 (7.96 g). While, AL-4 noted less for its seed yield of a single plant (5.20 g). The variation in seed yield may be because of variation in growth and yield traits *viz*., number of umbels in a plant, number of flowers in an umbel, number of umbellates per umbel, number of seeds in an umbel and thousand seed weight. In this experiment seed yield was less due to the stem fly incidence (20.91-45.40%) (Datta *et al*., 2001; Sarada *et al.*, 2009; Meena, 2012; Giridhar *et al.*, 2014 and Giridhar *et al*., 2017) [3, 14, 6, 9, 5]. Days to maturity of seeds varied from 131.00 to 155.25. The minimum days taken for harvest recorded in AA-93 (131.00), succeeded by AL-5 (137.00), DAC-6 (138.00), AL-3 (139.25) and Lam selection-1 (139.50). Late maturity was identified in DAC-7 (155.25). Differences in crop duration in ajwain was described by Meena (2012) [6, 9] and Meena *et al*. (2014) [7]. AA-1 recorded maximum harvest index of (30.29%), followed by AA-2 (25.20%), AA-93 (24.02%), DAC-4 (23.13%) and DAC-6 (22.43%). Whereas, the harvest index was recorded minimum in DAC-2 (13.66%). Similar findings was reported by Singh and Choudhary (2008) [18] and Meena *et al*. (2020) [8]. Thousand seed weight differed significantly among the ajwain genotypes. The test weight of seeds ranged between 0.89 and 1.67 g. The maximum test weight was observed in AA-1 (1.67 g), which was on a level with the DAC-1 (1.58 g), DAC-6 (1.57 g) and LTa-26 (1.53 g). The genotype AL-4 showed least test weight of 0.89 g. The boldness of the seeds contributed maximum test weigh in ajwain. Similar results were observed by Meena (2012) [6, 9] and Meena *et al*. (2020) [8].

The highest essential oil content was recorded in AA-1 (2.33%), followed by DAC-3 (2.16%) and DAC-4 (2.13%). The highest oleoresin content was noticed in DAC-5 (7.15%), followed by DAC-4 (6.36%) and AL-4 (4.29%). The lowest oleoresin content was found in AL-3 (1.91%). Present experimental results were is in correspondence with the earlier studies by Agrawal *et al*. (2003), Saxena *et al*. (2012) [16], Saxena *et al*. (2016) [17] and Subramaniyan *et al*. (2019) [22].

4. Conclusion

In the present investigation, AA-1 and AA-93 genotype recorded highest yield, maximum essential oil content and were found suitable to grow under northern dry zone of Karnataka based on growth, yield and quality characteristics.

5. References

1. Anonymous. Department of Agriculture and Co-operation, Hand book on Horticulture Statistics, New Delhi 2018, 135-143.
2. Bhatt V, Kumar MM, Selvam PS. Antimicrobial effect of ajwain seed ethanolic extract against food borne pathogenic bacteria. Int. Food Res. J 2018;25(3):908-912.
3. Datta S, Chatterjee R, Medda PS, Chattopadhyay PK. Evaluation of ajowan (*Trachyspermum ammi* L.) for growth, yield and quality. J Spices and Aromatic Crops 2001;10(1):37-39.
4. Giridhar K, Sarada C. Identification of coriander (*Coriandrum sativum* L.) genotypes for vertisols of

Andhra Pradesh. In National Symosium on Current Trends in Onion, Garlic, Chillies and Seed Spices Production, Marketing and Utilization, SYMSAC-II, 25-27 November, NRCOG, Rajgurunagar 2005,92.
5. Giridhar K, Kumari SS, Rajani A, Sarada V, Naidu LN. Identification of potential genotypes of coriander (*Coriandrum sativum* L.) suitable for rainfed vertisols. Appl. Biol. Res 2014;16(2):155-160.
6. Meena KK. Performance of ajwain (*Trachyspermum ammi* L.) germplasm under Udaipur agro-climatic conditions. M. Sc. (Agri.) Thesis, Maharana Pratap University of Agriculture and Technology, Udaipur 2012
7. Meena SS, Kakani RK, Singh B, Meena RS, Mehta RS, Kant K *et al*. AA 93: An early maturing variety of ajwain developed at NRCSS for all ajwain growing areas. Int. J. Seed Spices 2014;4(2):91-93.
8. Meena SS, Lal G, Sharma YK, Meena MD, Lal S. Effect of spacing and fertilizer levels on growth, yield and yield attributes of different ajwain (*Trachyspermum ammi* L.) genotypes. Int. J. Seed Spices 2020;10(1):47-51.
9. Meena SS, Mehta RS, Lal G, Anwer MM. Effect of agronomic practices on productivity and profitability of anise (*Pimpinella anisum* L.). J Spices Aromatic Crop 2012;21(2):102-105.
10. Mohsenzadeh S, Zaboli J, Jaime A, Silva TD. Allelopathic potential of ajwain (*Trachyspermum copticum*). Med. Aromat. Plant Sci. Biotechnol 2012;6(1):72-74.
11. Muvel R, Naruka IS, Chundawat RS, Shaktawat RPS, Rathore SS, Verma KS. Production, productivity and quality of ajwain (*Trachyspermum ammi* L.) as affected by plant geometry and fertilizer levels. Inter. J Seed Spices 2015;5(2):32-37.
12. Ravindrababu Y, Prajapati DB, Patel M. Characterization and evaluation of indigenous ajwain (*Trachyspemum ammi)* germplasms under North Gujarat condition. Int. J. Seed Spices 2012;2(1):59-62.
13. Sadgrove NJ, Jones GL. A contemporary introduction to essential oils: Chemistry, bioactivity and prospects for Australian agriculture. Agriculture 2015;5(1):48-102.
14. Sarada C, Giridhar K, Rao NH. Performance of ajwain genotypes in black soils of Krishna-Godavari zone. Annals Plant Physiol 2009;23(1):99-100.
15. Saxena RP, Pandey VP, Datta J, Gupta RK. Performance of coriander entries at Kumarganj, Faizabad. In: Nat. Symp. Cur. Trends in Onion, Garlic, Chillies and Seed Spices–Production and Utilization, SYMSAC-II 2005, 25-27.
16. Saxena SN, Agarwal D, Rohit S, Rathore SS. Analysis of anti-oxidant properties of ajwain (*Trachyspermum ammi* L) seed extract. Int. J. Seed Spices 2012;2(1):50-55.
17. Saxena SN, Kakani RK, Rathore SS, Meena RS, Vishal MK, Sharma LK *et al*. genetic variation in essential oil constituents of fennel (*Foeniculum vulgare* Mill) germplasm. J Essential Oil Bearing Plants 2016;19(4):989-999.
18. Singh D, Choudhary SP. Evaluation of ajowain (*Trachyspermum ammi* L.) genotypes suitable for semi arid regions. J Spices Arom Crops 2008;17(2):167-171.
19. Singh Y, Mittal P, Katoch V. Evaluation of fennel (*Foeniculum vulgare* Mill) genotypes under mid-hill humid sub-temperate conditions. Himachal J Agric Res 2003;29(1,2):48-51
20. Solemani B, Khosh-Khui M, Sadrollah R. Planting date effect on growth, seed yield essential oil content and chemical composition of ajwain. J Applied Biological Sci 2011;5(3):7-11.
21. Sontakke MD, Syed HM, Sawate AR. Studies on extraction of essential oils from spices (Cardamom and Cinnamon). Int. J Chem. Stud 2018;6(2):2787-2789.
22. Subramaniyan P, Jothi JL, Sundharaiya K, Shoba N, Murugesan S. Extraction of essential oil and Thymol from different ajowan (*Trachyspermum ammi* L.) genotypes using gas chromatography. J Pharm. Innov 2019;8(1):548-552.
23. Sunilkumar HT. Evaluation of genotypes and nutritional studies in coriander (*Coriandrum sativum* L.). M. Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad, Karnataka (India) 2010,
24. Tomar P, Malik CP. Botany, cultivation, chemical constituents and genetic diversity in *Trachyspermum ammi*. L.: An aromatic seed spice. Int. J Life Sci 2014;3(3):114-123.