Advance Production Technology of

Ajwain

(*Trachyspermum ammi* L.)

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PREFACE

India is well known as "land of spices" across the world since long back. We have been cultivating these precious spices for fulfilling our various needs since ages. The seed spices have emerged as one of the important group of spice crops in India. India is the largest producer, consumer and exporter of seed spices in the world. The seed spices account for about 45%and 18% of the total area and production of spices in the country (2019-20).

Ajwain is believed to have originated in Eastern Mediterranean region may be in Egypt. Its secondary centre of origin is in India and South west Asia. It is widely cultivated in Iran, Egypt, Afghanistan, Pakistan and other parts of North Africa beside India. The main cultivation areas today are Iran and India, but this spice is of little importance in global trade. Ajwain is having domestic medicinal as well as commercial value. In India it is mainly cultivated in Rajasthan, Andhra Pradesh, Madhya Pradesh, Gujarat, and Telangana covering an area of 0.38lakh hectares with the production of 0.28tonnes and productivity of 738kg/ha (2019-20). The productivity level of ajwain crop in the country is comparatively low. The reasons identified for low productivity are cultivation of these crops traditionally on marginal lands, lack of adoption of improved varieties, and package of practices including weed management and control of insect-pest and diseases.

The technology that has emanated out of research efforts made at NRCSS, Ajmer and different centers located in the various agro-climatic regions, under the AICRP on spices at various SAU's and NRC on Seed Spices has been complied in the form of advance production technology for ajwain in India. We are sure that this publication shall prove highly useful to various stake holders such as field functionaries, growers, exporters, students and others having interest in raising of ajwain crop scientifically.

We hope that the technical bulletin provides relevant information and suggestions if any for its improvement are welcome for future publication.

Ajmer- Authors

1st November, 2009

Introduction

Ajwain also known as carom seed (*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. The most common Indian name is ajowain and there are many other popular regional names. In Tamil is known as omum and in Telgu as vamu. The major Ajwain producing countries are India, Persia, Iran, Egypt, Afghanistan, Pakistan and North Africa. In India its production is concentrated mainly in Rajasthan, Gujarat, Andhra Pradesh, Madhya Pradesh, Bihar, Uttar Pradesh, Tamil Nadu and West Bengal. Major Ajwain growing districts with higher productivity in India are given in Table-1.

Table-1 Major ajwain producing states with zones/ districts.

State	Districts	Agro-region
Rajasthan	Chittorghar,Bhilwara, Rajsamand,Pratapgarh, Udaipur, Banswara	Central Plateau and Hills region
Gujarat	Patan, Bharuch, Banaskatha, Mehasana, Jamanagar, Ahemdabad, Amreli	Gujarat Plains and Hills Region
Andra Pradesh	Kurnool (Aluru, Aspari, Adoni, Kallur), Guntakal	Southern Plateau and Hills Region
Madhya Pradesh	Mandsaure, Neemuch, Ujjain, Shajapur, Guna	Central Plateau and Hills Region
Telangana	Adilabad,Jagtial,Nirmal, Nizamabad, Sangareddy, Vikarabad	Southern Plateau and Hills Region

During 2019-20, 27920tons of ajwain seed was produced from 37810 hectare area which is 0.30% and 0.98% of total seed spices production and area in India,. The current productivity of ajwain is 738 kg/ha. The major importing countries for Indian ajwain are USA, Canada, UK, Dubai, Yeman, Malasiya, Indonesia. Singapur, Pakistan, Saudi Arabia, UAE and.

Cultural requirements:

The Important cultural practices for successful cultivation of Ajwain are described as under.

Climate

It is a cold loving crop and mainly grown during *rabi* season in India. In some pockets of the country, it is also sown as *kharif* crop. Moderately cool and dry climate favour good plant growth and development. Avoidance of high humidity especially after flowering is beneficial. Continuous moist and cloudy weather invites insect-pests and a number of diseases. It needs a temperature

between 15-27° C with relative humidity of 60-70% during its growth period and requires preferably warm weather during seed development. Though the crop is well known for the winter season yet lower temperature hampers the growth of crop. The crop has moderate level of tolerance to drought and possesses wide climatic adaptability, as it can be grown in *kharif* season also.

Soil

Ajwain is well adapted to a wide range of soils but grows well on well drained sandy loam soils. Organic matter rich clay-loam soil may also be used, provided adequate drainage facilities are available. However, the crop does not thrive well in sandy or gravely soils. Owing to high moisture retention, the heavy soils are ideally suited for minted cultivation of ajwain. Although the crop is tolerant to salinity but always gives higher yield with better quality of leaves in neutral soils having a pH range from 6.5 to 8.5.Hence, its cultivation may be avoided in acidic soils. Lower to medium fertile soil may be preferred to avoid lodging loss by high fertility on neutral to slightly saline and alkaline soils.

Cropping system:

Ajwain crop can easily be grown as mixed or intercropping with other tall growing plants. In order to maintain soil fertility and sustainability in production, it is wise to adopt efficient crop rotation ideally suitable for the region. The important crop rotations are as under:

1. Green gram or Black gram in *kharif* season followed by Ajwain in *rabi* season
2. Cluster-bean or Cowpea in *kharif* season followed by Ajwain in *rabi* season
3. Green gram in *kharif* season followed by Ajwain in *rabi* season
4. Maize or Peral-millet in *kharif* season followed by Ajwain in *rabi* season

Recommended improved varieties:

Varieties selection depends primarily on its adaptation to the soil and climatic conditions and preferably on their having resistance / tolerance to pests and diseases. There are many varieties released for cultivation in different areas. The description of some of the important cultivated varieties recommended for different states are given as under.

(A) Rajasthan

Ajmer Ajwain 1 (AA-1)

This variety has been developed at NRCSS, Ajmer through recurrent selection from Pratapgarh local. It is suitable for cultivation both under irrigated and rainfed situations. The average height

of plant is 112 cm and it bears average number of 219 umbels/plant. It is a long duration variety and takes about 165 days to maturity. The variety possesses high yield potential and gives an average yield of about 14.26 under irrigated condition and 5.8 q/ha under minted condition. It contains 3.5% essential oil.

Ajmer Ajwain 2 (AA-2)

This variety has also been developed at NRCSS, Ajmer through selection from local germplasm for earliness and matures in 147 days. It is suitable for cultivation under both irrigated as well rainfed conditions. The average height of plant is 80 cm and bears average number of 185 umbels/plant. It gives an average yield of about 12.83 q/ha under irrigated condition and 5.2 q/ha under rainfed condition. It possesses resistance to powdery mildew. It contains 3% essential oil.

Ajmer Ajwain 73:

The Ajmer Ajwain-73 (AA-73), a new variety of Ajwain, has been developed of ICAR-NRC on Seed Spies, Ajmer. It is medium maturing (165-170 days) and high yielding variety. It shows high tolerance to *Root rot* and *Sclerotium rot*. AA-73 gave 15-16 q/ha seed yield. Fully mature seeds of AA-73 contain 9.15% total oil and 6.38% essential oil**.**

Ajmer Ajwain 93:

This variety has also been developed at NRCSS, Ajmer through selection from local germplasm for earliness and matures in 120-130 days. It is suitable for cultivation under both irrigated as well rainfed conditions. The average height of plant is 80 cm and bears average number of 185 umbels/plant. It gives an average yield of about 12 q/ha under irrigated condition and 5.2 q/ha under rainfed condition. It contains 3% essential oil.

Pratap Ajwain-1

This variety has been developed by Maharana Pratap University of Agriculture & Technology, Udaipur. Pratap Ajwain-1 has seed yield potential of 8-10 q/ha. It is suitable for dryland agriculture. It matures in 150-155 days. It contains 3.9% volatile oils. The seeds are bold and greenish in colour. It is moderately resistant to prevailing diseases like leaf blight and powdery mildew.

(B) Gujarat

Gujarat Ajwain1

It is suitable for cultivation in Gujarat and Rajasthan. This variety produces 25% more yield than local type of Gujarat and matures in 175-180 days.

(C) Andra Pradesh

Lam selection 1

The variety has been developed at Horticulture Research Station, Lam, Guntur, Andhra Pradesh. The plants are medium tall, mature in 135 days and give an average yield of 8 q/ha.

Lam selection 2

The variety has been developed at Horticulture Research Station, Lam, Guntur, Andhra Pradesh. The plants are bushy type, produce 40-45 branches per plant and produce average yield of10q/ha.

(D) Bihar

R.A. 1-80

This variety has been developed at Rajendra Agricultural University, Pusa, Samastipur, Bihar. It is late maturing variety; it matures in about 140-160 days. The grains are small and aromatic.

R.A. 19-80

This variety has been developed by Rajendra Agricultural University, Pusa, Samastipur, Bihar from Muzaffurpur local collection. The plants are 135-140 cm tall & produce 30-40 branches and 180-200 umbels per plant. The grains are of large size but less aromatic than RA 1-80 and mature in 125-130 days.

Cultural practices:

Preparation of land

The soil should be brought to fine filth for good germination and growth. The first ploughing should be done by deep soil turning plough followed by 2-3 light ploughing by harrow or cultivator. Each ploughing should be followed by planking to conserve the moisture. In the termite prone areas add 20-25 kg/ha of endosulfan4% or quinalphos 1.5% or methyl parathion 3% powder at the time of last ploughing. There should be good moisture in the soil for better germination of seed.

Sowing time

Time of sowing is important non monitory agro technique affecting yield as well as incidence of pest and diseases. Ajwain is a cold loving crop and is mainly grown during *rabi* season in India. In some pockets, it is also grown as *kharif* crop. As a *rabi* season crop, it is sown in the months of September and October in northern plains. whereas, for *kharif* season crop, it is sown from July to August. In southern part of India, particularly in Andhra Pradesh, Karnataka and Tamil Nadu, Ajwain is usually sown in the middle of August and harvested around December and January.

The early crop of Ajwain is mostly grown as rainfed and is sown during August, whereas the main season crop is sown as rabi seasoncrop during September-October. For realising yield, it is better to adjusted sowing time in such a way that the seed development and seed maturity phase coincide with a dry and rain free period. Recommended sowing times for seed crop in different states are given in Table 2.

Table-2 Sowing time of Ajwain recommended for different states.

State	Sowing time
Rajasthan	July- August(kharif season), September October (rabi season)
Gujarat	First week of August(kharif season), September- October (rabi season)
Andra Pradesh	Middle of August
Madhya Pradesh	Last week of September to First week of October
Chhattisgarh	September - October Bihar October- November
Tamil Nadu	Middle of August
Uttar Pradesh	September- October

Seed rate

The quantity of seed required for the sowing of unit area depends on the cropping season for which the crop is sown. In order to sown one hectare area, about 2.5-3.0 kg, seed of ajwain for *rabi* season crop and 4-5 kg for *kharif* crop season is required. The initial soil moisture at the time of sowing should be adequate to ensure satisfactory germination. Seed rate recommended for different states are given Table 3.

Table 3 Seed rate of ajwain recommended for different states

State	Seed rate
Rajasthan	2.5- 3 kg/ha (irrigated condition), 4-5 kg/ha (rainfed crop)
Gujarat	2-3 kg/ha
Andra Pradesh	2.5-3 kg/ha
Madhya Pradesh	3-4 kg/ha
Chhattisgarh	2.5-3 kg/ha
Bihar	2-3ka/ha
Tamil Nadu	2.5-3 kg/ha
Uttar Pradesh	2-3 kg/ha

Seed treatment

The use of bioinoculantAzospirillum or Azotobactor as seed treatment before sowing has proved beneficial in getting higher yield. Seed should be treated with ***Trichoderma*** **culture 10**gm/kg seed for the control of seed and soil borne diseases.

Sowing method

The seeds are sown by broadcasting method or drilled in rows 45 cm apart under irrigated conditions and 30 cm under rainfed production system. The seed germinates in about 10-12 days. The plant to plant spacing should be maintained to 20-30 cm. Ajwain is generally sown by broadcasting method but to facilitate inter culture operations, line sowing is appropriate. The Ajwain seed is small in size thus depth of seed should be kept around 1.0 to 1.5 cm in the soil for getting good germination. It is better to maintain uniform spread of seed through mixing of seed with dry sand before sowing.

Manures and Fertilizers

The manure and fertilizers should be applied based on soil testing report of fertility status. In general, for raising good irrigated crop of Ajwain, 10 tonnes of well decomposed F.Y.M. or compost may be applied and evenly spread in the field before ploughing. At the time of last ploughing 40 kg N, 50 kg P_20_5 and 50 kg K_2O /ha may be applied in soils. An additional dose of 40 kg nitrogen may be given in two equal splits one at 45 days after sowing and second before flowering, if soil is poor fertile. There is no need to apply any fertilizers in medium to high fertile soils. Potassium fertilizer is not required in most of the Rajasthan and Gujarat soils. In the rain fed farming area of ajwain 10 ton of well decomposed FYM or compost may be mixed in soil once in 2-3 years. In addition to this 40 kg N, 20 kg P_2O_5 and 20 kg K_2O /ha should be applied at the time of sowing.

Irrigation

Ajwain is cultivated both as rain fed and irrigated crop. In irrigated production system about 5light irrigations are required. If initial moisture is less after sowing, a light irrigation is given after 4-5 days to facilitate germination and checking crust formation. Depending on climate and soil type subsequent irrigations are applied at interval of 15-25 days. Application of irrigation at 0.8 IW/CPE ratios has been found better for realising higher yield.

Weed management

Initial growth of Ajwain crop is very slow, therefore, it is necessary to keep the field free from weeds. A total of 2-3 manual weedings and hoeings are required, the first weeding should be done after 30 days of sowing accompanied by thinning from rows after maintaining suggested intra row spacing. The subsequent weeding is done at 30 days intervals as per requirement. Weeds can also be controlled by a pre-emergence application of Oxadiargyl @0.075 kg/ha or spraying

Pendimethalin @ 1 kg /ha after sowing or Oxadiargyl@0.075 kg/ha + one hand weeding at 45 DAS is good techniques for weed control in ajwain. Care must be taken that there is sufficient moisture in the soil at the time of application of weedicides for enhancing effectiveness of weedicides.

Plant protection

Ajwain crop is generally affected by sucking insect-pests and diseases. The important insect pests and diseases of ajwain includes aphids, jassids, seed bug, seed borer, root rot and powdery mildew. The plant protection measures should include selection of resistant varieties, crop management practices such as time of sowing, balanced nutrition, crop rotation, green manuring etc. for reducing the incidence of diseases and pests and adoption of control measures.

Insect-pests

A- Sucking Pests

Aphids (*Myzuspersicae*)

Ajwain crop is infested by aphid from vegetative to seed maturity stages. Aphids mostly colonize on leaves and umbel of the plant. It sucks the sap from leaves and developing seed.It greatly affect the physical appearance of seed by deposition of sooty mold on them. Germinations of seed is also affected on heavy infestation on the crop.

Jassid (*Empoasla* Spp.)

Jassid develops on ajwain crop at early vegetative stage. Nymph and adult suck the leaf sap causing browning of leaves.

Seed Bug (*Nysus* spp.)

It found on the crop during seed formation stages and it feeds on developing seed. Heavy infested plants produce less seed yield.

Control

- Trapping and monitoring with yellow stick trap
- Timely sowing of crop help in lower build up of pests' population. Late sown crops are more prone to heavy attack by number of insect pests.
- Crop should sow in desired geometry.
- Recommended doses of nitrogenous fertilizers should be applied. Because higher application of nitrogenous fertilizers causes more succulent to the crop.

- Spraying of Neem Seed Kernel Extract (NSKE) @ 5 % or Neem oil 2% effectively cheek the early population build up of aphids on the crop.
- Application of entomopathogen *Verticillium lecanii* (10^8spores/g) powder formulation @5.0 g/lire of water gives good result.
- At high aphid population any one of the synthetic insecticides should he sprayed i.eDimethoate 0.03%, Metasytox - 0.03%, Emamectin benzoate @ 10 g ai/ha, or Imidachlorprid - 0.005%.

B-Seed Borer: (*Systole albipennis*)

Nature of Damage: Larva feeds in side and destroys the embryo and/or endosperm consequently. Calcid wasp does not cause much of yield reduction but presence of insect body part inside the seed make unfit for export purposes. Approximately seed damage of 20% seed damage has been observed in ajwain.

Management: foliar application of insecticides at flowering stages at 10 days intervals can manage the pests. Insecticides like neem oil (2%) thiamethoxam (0.025%), imidachlorprid (0.005%) are effective against this pest.

Diseases

Root rot (*Rhizocatoniasolani* Kuhn.)

This is a soil-borne disease. The symptoms include varying degrees of rotting of the root leading of foliage yellowing generally in 30-45 day-old plants. The affected plants later on wither and dry up. It is a serious problem in ajwain growing areas and drastically reduces the yield.

Control

- Seed treatment with Thiram or Captan @ 3 g/kg of seed.
- Soil application of neem cake a 150 kg/ha and seed pelleting with antagonistic fungi like *Trichoderma viride, T. harzianum* (Talc based formulation @ 4 g/kg of seed) can be used to mange the disease.
- Seeds treatment (10g/kg seed) and soil application (2.5 kg/ha mixed in 50 kg FYM or vermi compost) with consortia of *Trichoderma viride* and *Pseudomonas fluorescence* prove effective in control of disease.
- Drenching of Carbendazim (0.1%) once appearance of disease and after one month.
- Deep summer ploughing of field and adoption of crop rotation practice.
- Use of bio-inoculants Azospirillum or Azotobactor plays significant role in reducing incidence of root rot to 8.2%.

Powdery mildew (*Erysiphepolylgoni* D. C.)

The disease generally appears late in the season and is of minor importance. The symptoms include the appearance of whitish fungal growth on leaves.

Control

- Dusting with Sulphur (25 kg/ha) or by spraying wettable Sulphur twice at flowering stage at 15 days interval.

Harvesting and yield

The crop matures in 130-180 days depending upon the variety and season. The harvesting is usually done from February to May. At maturity flowering ceases and seed begin to develop and become brown in umbels. The crop is harvested with sickles or manually and stacked for drying, keeping the bundles upside down and then threshed to separate the fruits by beating with sticks. An average yields of 4-6 q under rain fed and 12-15 kg/ha under irrigated conditions could be obtained.

Cleaning, packaging and storage

Seeds are stored in gunny bags lined with polythene film. Vacuum gravity separator is used for cleaning ajwain seeds. The properly cleaned ajwain seeds are stored with an initial moisture level of 7-8% and at an equilibrium relative humidity of 40%. Ajwain seeds well packed are stored in ventilated dry and cool place under ordinary conditions till sowing of next season crop.

Processing

The mature dried seeds are distilled to obtain the essential oil. Hydro or steam distillation method is generally used for extraction of essential oil. It is better to use fresh seeds for more recovery of oil. On an average, the dry seeds yield 2.5-5 % oil and about 26% of fatty oils. The essential oil (2.5 to 5% in the dried fruits) is dominated by thymol (2-isopropy-5-methylphenol, 35 to 60%); furthermore, a-pinene, p-cymene, limonene and d-terpinene have been found.

Products and Adulteration:

Products: Seed and essential oil.

Seed

Ajwain seed is reddish brown to brown in colour. It possesses a characteristic bitter and pungent taste. The seed is used either whole or as powder.

Essential oil

Ajwain oil is distilled from the seeds which contains 35- 60per cent thymol and is the major source of this compound. The oil is colourless with characteristic sharp and burning taste. On standing, part of thymol may separate from the oil as crystals, which is sold as ajwain ka pool or sat ajwain and is much valued as medicine.

Adulteration

Seeds of ajwain may be adulterated with the exhausted (distilled) seeds, older seed or other similar type of seeds. The oil may be adulterated with the inferior quality oils.

Uses

Usage of ajwain is almost confined to Central Asia and Northern India. Ajwain isparticularly popular in savoury Indian recipes like savoury pastries, snacks and breads. Omam (Ajwain) is used to make a special food called the 'omapodi'. It is also mixed in several snacks of north and south India.

Medicinal uses

Ajwain is much used as a medicinal plant in Ayurvedic medicine for its antispasmodic, stimulant, tonic and carminative properties. The seeds are used to ease asthma and indigestion. It is also widely used to treat diarrhea and flatulence. In the West, thymol is used in medicines against cough and throat irritation. The thymol content makes ajwain a potent fungicide.

According to Ayurveda, it is digestive, tasty, pungent, light and bitter. It is useful in flatulence, colic, diarrhea, indigestion, cholera, hysteria and a tonic dyspepsia. Other uses are:

- Teaspoonful of seeds with a little salt is a common domestic remedy for indigestion, flatulence and low appetite.
- For stomachache, cough and indigestion, seeds are masticated and swallowed, followed by a glass of water.
- It is a remedy for different diseases and more popular prescriptions are Jeevan RakshakSudha and AgnivardhakChurna. AgnivardhakChurna is used in constipation, indigestion, bilious disease and chronic diarrhoea where as Jeevan RakshakSudha is used for massage in headache, chest and waist pain.
- It is used in prolong cough to remove phlegm.
- Ajwain powder is used with warm water in diseases related with respiration.
- Ajwain powder with rock salt is used in dyspepsia and other stomach troubles.

- For alcoholic, when they feel desire, few seeds are given to chew. This repels their desire and avoids them from taking liquor and it leads to give up the habit of drinking liquor for ever.
- Decoction of ajwain is useful against hook worm and teeth pain.
- *Sat ajwain, sat piperment*and camphor is used in cholera.
- Ajwain leaves are used to make paste which is applied in insect bite.
- Sat ajwain destroy the worms.
- Hot poultice of seed is used as a dry fomentation to the chest in asthma and to hands and feet in cholera and fainting.
- Seeds should be kept in mouth day and night in tonsillitis.The seed is useful for production of thymol, which is a valuable anthelmintic.
- Ark prepared from the tender leaves is used as vermicide.
- Taking of one teaspoon powder of ajwain and jaggery in equal quantity gives relief in polyuria and cures pain in kidneys.
- Take one teaspoon ajwain with hot water in morning and evening to reduce sputum.
- Drinking boiled water with 3gm ajwain seed and cinnamon for 3 to 4 days thrice a day cures influenza.
- Prepare ajwain water by boiling one teaspoon ajwain powder with little salt in water. Gargling with lukewarm of this water gives relief from throat pain.
- Apply poultice of crushed ajwain seed on painful rheumatic joints to get relief.
- Application of ajwain paste prepared in hot water is useful in curing ring worm and itching.
- Taking 6gm ajwain powder with hot milk regulates the menstrual flow of blood.
- Taking ajwain powder with jaggery after delivery for a few days relives back-ache, cleans the uterus, stimulates digestion, increases appetite and gives strength.
- Prepare paste by mixing 20g ajwain powder, 5g rock salt and 60-70g honey. Taking l g paste thrice a day is useful in curing whooping cough.
- Thymol, a major constituent of ajwain oil is used in toothpaste and perfumery.

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