



GOOD Agricultural Practices

Cumin



ICAR- All India Coordinated Research Project on Spices
ICAR-National Research Centre on Seed Spices
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CUMIN

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Good Agricultural Practices are a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while considering economic, social and environmental sustainability as defined by the Food and Agricultural Organization (FAO). GAP recommends addressing environmental, economic and social sustainability for on-farm production and post-production processes resulting in safe and healthy food and non-food agricultural products. A broadly accepted approach using GAP principles, generic indicators and practices will help guide debate on national policies and actions and on the preparation of strategies to ensure that all stakeholders participate in and benefit from the application of GAP in the food chain. The aim of GAP is to promote Sustainable Agriculture and Development and with effective input use, are one of the best ways to increase smallholder productivity. GAP in addition to improving the yield and quality of the products, also has environmental and social dimensions.

Practising GAP improve the safety and quality of food and other agricultural products and it helps to reduce the risk of non-compliance with national and international regulations, standards and guidelines set by Codex Alimentarius Commission, World Organisation for Animal Health and the International Plant Protection Convention IPPC regarding permitted pesticides, maximum levels of contaminants food and non-food agricultural products, as well as other chemical, microbiological and physical contamination hazards. Moreover, adopting GAP promotes sustainable agriculture and contributes to meeting national and international environment and social development objectives. Its social dimension would be to protect the agricultural workers' health from improper use of chemicals and pesticides. It is a particularly opportune time to promote GAP when second generation of reforms in agriculture which would have a Critical impact on Indian agriculture, are planned by the Indian Government. However, farmers need to be adequately informed, technically prepared and organised to meet this new challenge with governments and public agencies playing a facilitating role.

GOOD AGRICULTURAL PRACTICES FOR CUMIN

Cumin (*Cuminum cyminum L.*) (Family: Apiaceae) is an annual herb and the earliest known minor spices used by mankind. It is an important spice crop mainly cultivated for flavouring vegetables, pickles, soups. Its pleasant aroma is due to cuminol or cuminaldehyde, a component of volatile oil present in the seeds. The mean volatile oil of indigenous collections varies from 2.5 to 3.5%. The seeds are extensively used in ayurvedic medicines prescribed for stomach pain and dyspepsia. Cumin is believed to be native of Mediterranean region, mainly cultivated in India, Egypt, Libya, Iran, Pakistan, Mexico and Japan. In India, it is mainly cultivated in the states of Rajasthan and Gujarat.

SITE SELECTION

The information on soil condition, water logging, industrial waste and effluents, source of irrigation water and meteorological data need to be available with the farmers before starting cumin cultivation.

Climate and soil

Seed purpose crop is successfully cultivated in moderately cool and dry climate during winters (Rabi season) in an area free from severe frost during flowering. It does not prefer humidity during flowering and seed setting stage. Cloudy weather during flowering and fruiting stages increases incidences of pests and diseases. Germination is adversely affected at temperatures above 30°C and below 10°C, though the crop prefer low temperature during vegetative phase. It can be grown in wide range of soils, but sandy loam to medium heavy soils having plenty of organic matter with better fertility status and pH range 7.0-8.0 are most suitable. Sites where cumin crop has not been cultivated for the past 3 years should be selected.

SEEDS AND PROPAGATION MATERIAL

Varieties

There are a number of good cumin varieties suitable for different agro climate regions. Varieties selection depends primarily on its adaptation to the soil and climatic conditions and preferably should have resistance / tolerance to pests and diseases prevailing in that region. There are many varieties released for cultivation to different areas specially Rajasthan and Gujarat. Some popular varieties include:

- RZ-19: It takes 120 –140 days to mature and gives an average yield of 5.6 q/ha. Recommended for Rajasthan.
- RZ-209: Recommended for Rajasthan state and the variety have shown tolerance to wilt and blight diseases. It takes 120-130 days to reach maturity and gives seed yield of 6.5q/ha.
- RZ-223:Wider adaptability, with resistance to wilt. The seeds yield an oil content of 3.23% and gives seed yield of 6.0q/ha. Recommended for Rajasthan state.
- RZ-341: An early maturing variety with high volatile oil content of 3.87%. Medium maturity type (120-130 days) with seed yield of 6.0q/ha. Recommended for Rajasthan state.
- RZ-345: The plants are bushy and semi-erect with moderate resistance of wilt, blight and powdery mildew. It matures in 120-130 days and produces an average yield of 6.07q/ha.
- Ac-01-167: Variety resistant to wilt with an average yield of 5.15 q/ha. Recommended for Rajasthan.
- Gujarat Cumin-1: It matures in 105-110 days and gives an average yield of 7.0q/ha.
- Gujarat Cumin -2: It matures in 100 days and gives an average yield of 7.0q/ha. The variety is tolerant to wilt, blight and powdery mildew. Recommended for north Gujarat and Sourashtra region of Gujarat.
- Gujarat Cumin -3:Frost and wilt tolerant variety suitable for winter season. It matures in 100 days and gives an average yield of 7.0q/ha with high essential oil content of 4.4%. Recommended for Gujarat and Rajasthan.
- Gujarat Cumin -4: It gives an average yield of 8.75 q/ha and is resistant to *Fusarium* wilt.
- Gujarat Cumin -5: High yielding wilt resistant cumin with short duration (92days) and high yield (38 % higher yield than GC 4). Recommended for all cumin growing regions of the country

Seed rate

Cumin is propagated through seeds. The seed rate is about 10-12 kg/ha.

SOIL CONDITIONS/MANAGEMENT

- The soil analysis report of the selected site and analytical report on irrigation water should be available especially with respect to heavy metals and pesticide residues contents.
- The quantity, quality and type of soil amendments used for the selected site need to be recorded.
- Soil tilth need to be maintained as per the requirement of the crop and field operations performed need to be recorded.

Cropping System

Cumin is not recommended for growing as mixed or intercrop. However, in order to manage certain soil borne disease, it is necessary to follow crop rotation involving different crops in some seasons. Some of the suggested cropping systems for cumin growing areas are:

- Dhaincha - Cumin
- Dhaincha - Cumin-Green gram
- Maize - Cumin - Summer Moong
- Pearl Millet-Cumin

Land preparation

The land should be well prepared for better germination of seeds and growth of plant. A total of 3-4 ploughings are required to bring the soil to a fine tilth. At the time of sowing there should be good moisture in the soil for better germination of seed.

CROP MANAGEMENT FOR CULTIVATION

- The spacing for the crop, in terms of row to row and plant to plant distance need to be adopted as per the agronomic requirement.
- Gap filling of plants to compensate mortality losses should be carried out within a reasonable timeframe.
- Based on the soil analysis and crop requirement, organic manure preferred for the crop supplemented with mineral nutrition through inorganic source need to be applied.

- Application of mineral supplements must be based on complete soil analysis in a competent laboratory.
- Specialized nutritional application for distinct needs viz., root production or enhancement of leaf bio mass need to be taken up as per the requirement of the crop.
- In order to optimize water usage and to reduce wastage of water; irrigation management plan need to be prepared for the crop.
- Efficient system for irrigation need to be adopted so as to conserve water for the whole cropping season and to reduce the water usage.
- Records need to be maintained for irrigation schedules, fertilizer application and water requirement.
- Depending on the nature and stage of the crop, inter-cultivation practices need to be adopted to reduce the incidence of weeds.
- Comprehensive package of pest and disease management schedules including prophylactic measures required for the crop need to be adopted to minimize the crop loss and its quality.
- In order to reduce pesticide residue in produce, correct dose of pesticides, time of application and mode of application need to be ensured and recorded correctly.
- Use of bio control agents and bio pesticides is preferred and plans for this should be available.

Transplanting and sowing

In Gujarat it is sown during first week of November and in Rajasthan from 15-30th November. In order to protect the crop from seed borne diseases, the seeds are treated with *Trichoderma* (2-3 g/kg seed) or Bavistin (2-2.5 g/kg seed). The seed can also be inoculated with 10 g/kg *Azotobacter* and 10 g/kg phosphate solubilising bacteria (PSB) to improve the health of the crop. Line sowing with 25 cm row to row and 10 cm plant to plant sowing is ideal. The seed should not be sown deeper than 1.5 cm.

Treat the seed with PGPR bioformulation i.e. FK 14 (*Pseudomonas putida*) + FL 18 (*Microbacterium paraoxidans*) for better germination, growth and yield. *Azospirillum* or *Azotobacter* in combination with 5 t/ha sheep manure is suitable for organic production of cumin. Seed inoculation of cumin with AMF, *Gigaspora calospora*, *Glomus fasciculatum*, *Glomus mosseae* and *Acaulospora laevis* not only reduces the incidence of wilt but also enhances nutrient uptake.

FYM 10t/ha or compost 5 t/ha NPK @ 30:20:20 kg/ha (15 kg of N in two equal split dose at 30 at 60 DAS). *Trichoderma* as soil application (2.5 kg/ha) and neem cake as soil application (150 kg/ha) are advisable. Following crop rotation with legumes like black gram/green gram, cluster bean/, green manuring with *Sesbania aculeata*, composting and application of biofertilizers can also enhance soil quality. General recommendations to be followed are:

Use soil amendments like castor or mustard cake, poultry manure @ 2.5 t/ha before sowing for control of wilt. Application of 50.0- 75.0% of recommended dose (RD) through organic manures i.e. FYM, vermicompost and poultry manure + 25-50% of RD through inorganic fertilizers gives higher seed yield and also improves the quality of seed along with improvement in soil health. Application of NAA @ 50 ppm / Triacetonol @ 1.0 mL/ L once at 40 days after sowing increases growth and yield of cumin.

Irrigation

Depending upon soil and weather conditions of the growing area irrigation should be scheduled for cumin. If the crop is sown with pre-sowing irrigation, then the crops should be irrigated at critical stages of growth. However, irrigation depends on variety used and type of soil. Generally, cumin requires 4-6 irrigations. Sprinkler irrigation in cumin could significantly save the water.

Drip irrigation/trickle irrigation/micro irrigation or localized irrigation also save water and fertilizer by allowing water to drip slowly to the root zone, either onto the soil surface or directly into the root zone, through a network of valves, pipes, tubing and emitters. Reduction in water consumption due to drip method of irrigation over the surface method of irrigation varies from 30.0 to 70.0%. Application of irrigation with low pressure drip system at a gap of 4-5 days for 40-45 min is appropriate for better growth of cumin. Inter cultural operations can be performed easily if crops are sown in lines and irrigated by these methods.

Intercultural operations

Cumin crop is severely affected with weed competition at all stages of crop growth because of slow growth and short stature of the crop. In rainfed crop, one or two weeding and hoeing should be done so that the moisture and nutrients available in the soil can be efficiently utilized by the crop.

In irrigated cumin, 2-3 weeding and hoeing operations are necessary to keep the crop free of weeds. The first weeding and hoeing operation is required at 35-40 DAS and second at 60-65 DAS. For chemical weed management pre-plant incorporation of Oxadiargyl @ 1 mL/ L, Fluchloralin @ 0.75 to 1.0 kg/ha or pre-emergence application of Oxyfluorfen @ 0.15 kg/ha can be done for keeping the crop weed free. Sufficient moisture should be present in the soil at the time of weedicide application.

PLANT HEALTH MANAGEMENT

- Farmers are advised to identify the pest properly with the help of plant protection experts and to follow IPM strategies for sustainable production.
- Farmers shall keep a record of the plant protection chemicals used during the cropping season.
- Proper precautions should be taken while spraying chemicals to avoid contamination beyond the application area.
- Preparation of spray fluids should be carried out in a designated area away from any natural water bodies, drinking water sources, human dwellings etc.
- It is advisable to use protective clothing, face mask and gloves while preparing and applying pesticides.
- Plant protection chemicals must be stored in a dry, well ventilated facility with displayed information on hazardous chemicals inaccessible to children and unauthorized people.
- Farmers should follow the waiting period recommended by authorized Institutes for repeated application of pesticides and advised not to mix pesticides.
- Spray should not be done during peak period of bee activity to protect bees.
- It is advised to spray pesticides in the afternoon hours avoiding strong windy condition and rains.
- Avoid carrying bulk pesticides (dust/granules) on head shoulders or on the back.
- Avoid eating, drinking, smoking or chewing while preparing spray solution and the containers, buckets etc used for mixing pesticides should not be used for domestic purpose.
- Select right kind of sprayer with appropriate nozzles for spraying. It is advised not to blow/clean clogged nozzle with mouth.
- Left over spray solution and empty containers should not be disposed in ponds, water bodies etc.
- Combustible containers can be burnt if the container labels permits burning.
- Containers made of paper, cardboard & plant materials can be disposed off by burning. Non combustible containers should be broken or deformed by punching holes at several places to prevent reuse.

Pest management

Aphids

Aphid is a major pest of cumin with heavy infestation occurring between the months of December to March and causing a loss of more than 50% of yield in unprotected crop. When the aphid infestation occurs at flowering and fruit stage, the fruits are not formed and even if they are formed, they are shriveled and of poor quality.



Aphids on cumin

Higher losses in yield could be caused by a small number of aphids infesting the crop at the beginning of flowering than by a large number of aphids at the grain filling stage. *Myzus persicae* and *Aphis gossypii* are the main aphids species reported from Rajasthan and Gujarat. Adults and nymphs suck the sap from plants and also produce honey dew secretion on which the sooty moulds develop resulting in failure of seed production.

Thrips

Thrips is a major sucking pest in cumin. Usually they congregate at the leaf sheath or in the flowers.

Management:

Aphids are attacked by number of parasitoids under field conditions. Aphid's parasitoids *Aphidius* spp. is found in large number from last week of February to March. The common parasitoids are *Sturmia inconspicuides*, *Actia monticola* and *Euplectrus gopimohani*.

Coccinellids consist of major predator found feeding on various sucking pests of seed spices. Major coccinellid found predating on seed spices crops are *Coccinella septempunctata*, *Brumoides suturalis*, *Menochilus sexmaculatus* and *Adonia* sp. Predatory bird myna (*Acridotheres tristis*) was also found feeding on the aphid.

Application of neem based commercial formulation like Neemarin at 1.0% and neem seed kernel extract (NSKE) at 5.0%, reduced the aphid population by 50%

Disease management

Wilt

It is an important disease of cumin with incidence ranging from 25.7- 60.0% in some cases. Losses in yield up to 25.0% have been reported from North Gujarat and up to 60% in Rajasthan. The disease is caused by *Fusarium oxysporum* f.sp. *cumini*. Infected plants show peculiar symptoms of dropping of tips and leaves, leading to mortality of the entire plant. The disease occurs at all stages of crop. The diseased plants usually produce small, thin, shriveled seeds. The pathogen is internally seed borne as well as soil borne associated with diseased plant debris and infected soil with fungus.



Wilt affected field

The inoculum of the pathogen increases under continuous cultivation of cumin in the same field (monoculture). The pathogen survives in soil through hyphae and chlamydospore which is heat tolerant. Under moist condition the lethal temperature range is 60-62°C and under dry conditions it is 62-65°C. The wilt disease is enhanced when *Meloidogyne incognita* attacks earlier than wilt pathogen. Efficient control of this disease is not possible by the use of chemicals.

Management:

- Cumin cultivars such as RZ-223 and GC-4 are tolerant to *Fusarium* wilt. Summer ploughing, crop rotation of three years, use of healthy disease free seeds, seed treatment with suitable fungicides or bioagents are helpful for managing wilt of cumin.
- Rotation with non host crop like mustard, pearl millet reduced disease incidence
- Application of mustard cake and groundnut cake was found to reduce the disease. Application of castor cake and poultry manure before sowing reduces wilt.
- *Trichoderma harzianum* grown on sorghum grains and applied in soil 24 g/6m² reduced wilt incidence.
- Seed treatment with thiram or captan @ 2.5-3.0 g/kg seed or carbendazim @ 2g/kg is a general practice to reduce the wilt disease incidence.



Soil solarization

- Soil solarization + soil application of *Trichoderma* + FYM (5 t/ha)+ spray with mancozeb 0.25% (60 DAS) is recommended for the control of wilt and blight in cumin. Soil application of vermicompost 3.2 t/ha + Soil application of *Trichoderma viride* @10 kg/ha was found effective and economic for the biocontrol management of wilt in cumin.

Alternaria blight

The blight is caused by a fungus *Alternaria burnsii*. Affected plants show minute brownish necrotic spots, which later turn to blackish. It is spread by seed, air and soil. Now, it is a common disease in all the cumin growing areas favored by humid and cloudy weather.



Alternaria blight

In seed as well as in debris the pathogen remains viable for 10-12 months. Temperature ranging from 23-28°C is optimum for disease development. Cumin plants are generally attacked by *A. burnsii* after flowering. The plants infected with blight disease develop tiny necrotic spots, which becomes blackish later on. Most of the diseased plants do not produce seeds and even if they produce seeds, the quality is inferior. The highest blight incidence occurs in October sown crop.



Blight disease affected cumin fields

Management:

- Till date none of the available varieties show resistance to this disease. Crop rotation with non-host crops, deep ploughing and summer fallowing is effective in reducing the disease.
- This disease can be managed chemically by spray of 0.2% solution of mancozeb, zineb or carbendazim (0.1%). Spraying should be done 4 times at 10 days interval starting from 40 days after sowing and treatment of diseased seeds. Spraying with propiconazole (0.1%) or carbendazim + iprodione (0.2%) reduced disease incidence and fetched higher yield.
- To reduce the pesticide residue of mancozeb, avoid two continuous sprays of mancozeb and use alternate chemicals *i.e.* first spray of mancozeb, then use another chemical as second spray or use 1:1 ratio of mancozeb+ carbendazim

Powdery mildew

This is caused by *Erysiphe polygoni*. The fungus is ectoparasite on aerial plant parts resulting in yield losses up to 50% under favorable weather conditions. Application of neem oil and garlic extract is also effective to reduce the disease. The disease appears in February and March at flowering. The disease spreads fast under warm (27-35°C) and moist conditions. The incidence is characterized by appearance of whitish spots on surface of leaves, petiole, stem pedicel and seeds in the early stages. Gradually seeds become white, shrivelled and light in weight. The late sown crop under irrigated condition gets severely affected. The fungus perpetuates as dormant mycelium on the seed. Under severe disease situation total failure of the crop has been observed.



Powdery mildew in cumin

Management:

Prevention of this disease can be done through dusting plants with 300 mesh sulphur dust @ 25 kg/ ha as soon as the symptoms are noticed. Single dustings of 300 mesh sulphur 20-25 kg/ha at the time of flowering in January is essential. Dinocap (0.1%), carbendazim (0.1%), tridemorph (0.05%) and wettable sulphur (0.2%) are also effective.

New emerging problems in cumin

Yellowing

Cumin yellowing a new viral disease reported for the first time in cumin. The virus associated with the disease has been identified as Vanilla distortion mosaic virus (Potyvirus group). New disease showing root decaying symptoms caused by nematodes *Hoplolaimus* spp and *Tylenchorhynchus* spp in coriander, fennel and nigella has also been reported

Reddening

Reddening of the plants is also seen as a new and emerging problem in all the cumin growing areas. This problem starts since early stage of the growth and continues up to maturity. Primary studies explain that this is a physiological and environmental problem in cumin.



Yellow disease in cumin



Reddening in cumin

Module for integrated management of cumin diseases

S.No.	Treatment	Treatment details
1.	Selection of variety	Resistant variety against blight and wilt disease should be grown according to agro climatic zones
2.	Selection of seeds	Use certified seeds. If certified seeds are not available then use own seed and treat them
3.	Use of weedicide	Spray of Oxadiargyl 23.5% (Raft) @ 50g a.i/ha or 833ml/ha on moist soil surface (pre-emergence) after sowing to reduce the weeds which served as alternative and collateral hosts of several pathogens.
4.	Practices to minimize the soil borne inoculums of different pathogens	a) Burning of crop debris b) Summer ploughing c) Adopt 2-3 years crop rotation with resistant/non-host crop. d) Adopt optimum seed rate, depth of sowing, row spacing, plant to plant distance, fungicides dosage and irrigation time and numbers.
5.	Protective step to prevent the infection.	a) First spray schedule start at 35 DAS with difenoconazole 0.25EC @ 0.05% followed by second spray at 45 DAS b) Preventive spray with Dimethoate 0.1% for aphid infestation c) Third spray starts after 55 DAS with propiconazole
		0.1% for control of blight and powdery mildew infection. f) If the environmental conditions are favorable for disease, then the third spray will be repeated. Harvest the crop at proper maturity and thresh it carefully. g) Proper drying of seeds 8-9% seed moisture and then store it.

HARVEST AND POST HARVEST MANAGEMENT

- Harvesting season is determined and followed on the basis of qualitative parameters set for the end product rather than the total vegetative yield.
- Clear instruction should be available for farm worker to use proper cutting devices and avoid harvest of unwanted plants.
- A documented procedure should exist for cleaning containers and avoiding mixed up and contamination of produce.
- Washing and cleaning methods need to be ensured for the freshly harvested materials to ensure removal of soil particles adhering to the materials.
- Processing area must be clean with a proper platform and shade.
- Proper drying techniques need to be adopted for drying and storage of harvested crop produce. Drying procedure and the temperature employed should be in conformity with the quality needs of the farm produce.
- Sorting procedure need to be carried out after the completion of drying phase and before the material is packed.
- Selection of packaging material must be based on the quality requirements and possible length of storage before consumption/processing and need to be kept clean, dry and undamaged.
- Storage area must be kept clean and free from insect pests. Proper separation need to be implemented to keep different products of the crop separately.

Harvesting of cumin

Cumin crops take 110-120 days to reach at maturity. Under scientific management condition 8-12 q/ha cumin seed of improved varieties can be obtained.

Post-harvest management

- Threshing floor should be neat and clean.
- Threshing should be done on concrete floor.
- Use innovative dryers, which quicken the process of drying.
- Processing and drying should be done on concrete floor.
- Storage at appropriate moisture level.
- Sort and grade the produce.
- Store in a cool and dry place.

IDENTIFICATION AND TRACEABILITY

- The final produce need to be legibly labelled with the product name, month and year of harvest and the name of farmer/farming agency.
- If the produce was tested before, an appropriate label may be used indicating quality approval.
- The products need to be traceable back to the registered farm (and other relevant registered areas) from where it has been grown.

PERSONNEL AND EQUIPMENT

- Key resource persons engaged at the site (such as farm owner/ supervisor) must be familiar with all aspects related to the crop such as, quality requirements of the end product, crop husbandry etc.
- The personnel engaged in cultivation should have basic exposure to subject matters like safety and hygiene.



Protective clothing for workers

- The machinery used for fertilizer and pesticide application must be calibrated at prescribed schedules and calibration certificates / records should be maintained.
- Equipments must be clean and mounted wherever applicable, in an easily accessible manner. Scheduled servicing procedures must be adhered to keep them in working order. Additional care should be taken for cleaning those machine parts that get into direct contact with the harvested produce.
- Workers need to be equipped with suitable protective clothing. Complete sets of protective clothing, (e.g. rubber boots, waterproof clothing, protective overalls, rubber gloves, face masks, etc.) with label instructions and legal requirements as authorized by a competent authority need to be complied.

- All workers handling and/or administering plant protection chemicals, disinfectants, biocides or other hazardous substances and all workers operating dangerous or complex equipment should have certificates of competence .
- Permanent and legible signs indicating potential hazards, e.g. waste pits, fuel tanks, workshops, access doors of the plant protection product / fertiliser / any other chemical storage facilities as well as the treated crop etc. must be made available.



Inputs storage shed

Toxicity class of fungicides/insecticides/herbicides recommended for cumin cultivation

Mancozeb		Slightly toxic
Captan		Slightly toxic
Wettable sulphur		Slightly toxic
Carbendazim		Slightly toxic
Zineb		Slightly toxic
Copper oxychloride		Moderately toxic
Thiram		Moderately toxic
Propiconazole		Moderately toxic
Carbendazim +iprodione		Moderately toxic
Tridemorph		Moderately toxic
Dinocap		Moderately toxic
Difenoconazole		Moderately toxic
Oxadiargyl		Moderately toxic
Oxyfluorfen		Moderately toxic
Fluchloralin		Moderately toxic

