भाकृअनुप
ICAR

GOOD Agricultural Practices

Coriander

ICAR- All India Coordinated Research Project on Spices
ICAR-National Research Centre on Seed Spices
ICAR- Indian Institute of Spices Research

CORIANDER

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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 consideringeconomic, 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 CORIANDER

Coriander (*Coriandrum sativum L.*) is an annual herb and is one of the first spice to be used by man as common flavouring substance. It is also known as Chinese parsley, and all parts of the plant are edible, but the fresh leaves and the dried seeds are the parts most traditionally used in cooking as a spice. The stem, leaves and fruits have a pleasant aroma and the whole young plant is used in preparing chutney and leaves are used for flavouring curries, sauces and soups. Dry fruits are extensively used in preparation of curry powder, pickling spices, sausage and seasonings. The seeds are also used as a carminative, refrigerant, diuretic and aphrodisiac.

The volatile oil is used chiefly as a flavoring agent in liquor, cocoa and chocolate industry and it is also a valuable ingredient in perfumes. Good quality oleoresin can be extracted from coriander seeds. The oleoresin is used for flavouring, beverages, pickles, sweets and sausages. The other important product is Dania dal, which is a major adjunct in Pan masala.

Coriander is a native of Mediterranean region and its cultivation is limited mainly to tropics. Besides India, it is cultivated in Morocco, Rumania, France, Spain, Italy, Holland, Burma, Pakistan, Turkey, Mexico, Argentina, England and USA. In India, the main coriander growing states are Andhra Pradesh, Rajasthan, Madhya Pradesh, Karnataka, Tamil Nadu and Uttar Pradesh.

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 farmer before starting coriander cultivation.

Climate and soil

Coriander is a tropical crop and requires frost-free climate particularly at the time of flowering and seed formation stage. Germination of coriander is severely reduced at temperature above 30^0C and below 10^0C. Heavy rains are harmful for the crop and continuous cloudy weather invites diseases and aphids. For green coriander, it can be grown throughout the year provided moisture is made available. Dry as well as moderately cool weather conditions during seed formation stage increase the yield as well as quality of the produce.

For irrigated coriander, loamy soil is the best. But for unirrigated crop, where crop is grown using conserved moisture, black or heavy soil is the best. Saline, alkaline and sandy soils are not suitable for its cultivation. The pH of soil should be near 7.0 for better growth and quality of coriander.

SEEDS AND PROPAGATION MATERIAL

Varieties

Sl.No.	Variety	Salient features	Average yield (q/ha)	Recommended State/Region
1	Sadhana	Dual purpose, semi-erect variety; suitable for rainfed condition, field tolerance to diseases and white fly, mites & aphids, essential oil 0.2%. A mid late variety 95-110 days duration withstands moisture stress, responded well to input management under optimum moisture	10.25	Andhra Pradesh
2	Swathi	Plants medium size semi-erect type. Early maturing variety (80-85 days), suitable for rainfed condition, and late sown season, essential oil 0.30%. Medium size oval grain. Field tolerant to white fly, moderately tolerant to disease. It suits well to the areas where the soil moisture retentiveness is less, being early maturing type, it escapes powdery mildew disease.	8.5	Rainfed areas in Andhra Pradesh
3	Co 1	It matures in about 110 days. Tolerant to grain mould	8.0	Tamil Nadu
4	Co 2	Dual purpose variety, tolerant to drought. Crop duration 90-100 days. For leaf purpose it gives 1000 kg ha^{-1} green leaves at 40 days crop growth stage.	6-7	Tamil Nadu
5	Co 3	A dual purpose variety, good yielder, medium sized grains, suitable for rainfed& irrigated condition, rabi as well as kharif season. Field tolerant to powdery mildew, wilt & grain mould. Seed oil content ranges from 0.38 to 0.41%, duration 85-95 days	6.5-7	Tamil Nadu, Gujarat and Andhra Pradesh
6	Sindhu	Oval medium breakable grains, essential oil (0.4%); suitable for rainfed areas, tolerant to wilt, powdery mildew as well as drought condition, medium duration	10.0	Andhra Pradesh

		(100-110 days).		
7	Hisar Anand	A medium tall, dual purpose variety, oval medium size seeds; essential oil 0.35%, wider adaptability to different soil conditions. Resistant to lodging due to spreading habit	14.0	Haryana
8	RCr 20	Medium sized bush plant, suitable for rainfed crop or limited moisture conditions and heavy soils of south Rajasthan. Moderately resistant to stem gall, bold grains, essential oil 0.25%. Early maturity, duration 100-110 days	9.0	Southern Rajasthan including Tonk, Bundi, Kota, Baran and Jhalawar districts.
9	RCr -41	It is highly resistant to stem gall and wilt but only moderately resistant to powdery mildew. Matures in 130-140 days	9.2	Rajasthan
10	RCr 436	Plants semi dwarf, bushy type; quick early growth and bold big seeds, resistant to root rot & root knot nematodes; suitable for limited moisture condition and heavy soils of south Rajasthan, essential oil 0.33 %, early maturing (90-100 days).	11.0	Rajasthan
11	RCr-728	The plants are bushy and erect with higher number of seeds per umbel and volatile oil contents is 0.38%. Matures in 130-140 days	13.7	Rajasthan
12	RCr-446	Plants are tall, leafy, erect with higher number of seeds per umbel. Seeds are medium with 0.33% volatile oil content. Moderately resistant to stem gall and wilt under rainfed, limited moisture or irrigated conditions, medium maturity (110-130 days).	12.0	Rainfed areas in Rajasthan
13	RCr 435	Plants are bushy, erect, bold seeds, medium size, contain essential oil 0.33%; adapted for irrigated condition, moderately resistant to root knot and powdery mildew. Medium maturity, duration 110-130 days.	10.0	Rajasthan
14	RCr 684	Resistant to stem gall and less susceptible to powdery mildew. Adapted to medium heavy textured soil, essential oil 0.32% and sandy loam soil under irrigations. Seeds are bold. Plants are tall and erect with higher number of seeds/umbel. Medium maturity (110-120 days).	9.9	Rajasthan
15	Hisar Sugandh	Suitable for irrigated conditions. Resistant to stem gall disease	14.0	Haryana & Rajasthan
16	RCr-480	High yield and volatile oil content; less susceptible to aphid and powdery	18.0	All coriander growing areas of

		mildew; tolerant to frost. Volatile oil – 0.425%, Medium maturity (130-140 days)		Haryana, Chattisgarh and Bihar
17	Sadhana	Dual purpose, semi-erect variety; suitable for rainfed condition, field tolerance to diseases and white fly, mites & aphids, essential oil 0.2%. A mid late variety 95-110 days duration withstands moisture stress, responded well to input management under optimum moisture	10.25	Andhra Pradesh
18	Hisar Surabhi	Bushy erect plant type, medium size seed, oblong; oil content 0.425%, tolerant to frost, less susceptible to aphids, medium duration (130-140 days)	18.0	Haryana & other states
19	Sudha (LCC-128)	High seed yield, bold oblong shaped medium sized grains with attractive colour and is less susceptible to pests and diseases, volatile oil – 0.40%; medium duration under rainfed conditions(80-100 days), early in north Indian conditions.	7.5-10.0 (rainfed) 12.0-15.0(irrigated)	Andhra Pradesh (rainfed areas)
20	Hisar Bhoomit	Small seeded. Besides its high green leaf yield potential and oil content, Resistant to stem gall disease	14-15.0	All coriander growing areas of the country for green leaf production
21	DH 220	Variety with powdery mildew resistance. This variety has out yielded other varieties, Hisar Ananad (National check) and Local checks under coordinated varietal trials of AICRPS.	6.5-7.5	Haryana
22	Suguna (LCC – 236)	Medium duration variety with 90-95 days duration. Grain is slender, oval shaped. Yield potential is of 750-1350 kg/ha. This variety is having high volatile oil content (0.52 %).	7.5-13.5	Andra Pradesh, Gujarat, Rajasthan, Tamil Nadu, Uttar Pradesh
23	Suruchi (LCC – 234)	Off season coriander variety suitable for protected cultivation in summer with herbage yield of 4.5 t/ha.	15-18.0	Andhra Pradesh , Rajasthan, Tamil Nadu
24	CS 287	Early maturing variety, suitable for both rainfed and irrigated condition. Field tolerant to wilt and grain mould.	6.0	Andhra Pradesh
25	Narendra Dhania-2	Dual purpose variety	17-19.0	Uttar Pradesh., Rajasthan, Gujarat
26	RCr 475	Suitable for grain purpose and not for leaf purpose	17.4	Rajasthan
27	Susthira (LCC-219)	Medium duration	12-17.5	Andhra Pradesh, Telangana and Tamil Nadu
28	Rajendra Dhania RD 385	High yield potential	17.6	All the Coriander growing regions of the country

29	Gujarat Coriander (GC-3)	High volatile oil (0.52%), High linalool (72.16%) and high yield potential, less prone to aphid and powdery mildew.	16.9	All the Coriander growing regions of the country
30	Ajmer Coriander (ACR-2)	Resistance to stem gall disease, high linalool content (71.7%) and early maturing type	15.5	All the Coriander growing regions of the country
31	Rajendra Dhania 3 (RD-416)	Climatic resilient with high oil content (0.53%)	11.5-17.7	All the Coriander growing regions of the country
32	JD (SI)-1)	High volatile oil (0.67%), Protein 21.03%, good aroma and moderately resistant to powdery mildew, stem gal diseases.	13.5	Madhya Pradesh, Uttar Pradesh, Chhattisgargh, Uttarkhand, Rajasthan and Haryana
33	Ajmer coriander-3(ACr-3)	High volatile oil (0.55 %), high linalool (75.42 %) and field resistance against powdery mildew with bold seed.	16.9	All coriander growing areas of India
34	Chhattisgarh Sri Chandrahasini Dhania-2 (ICS-4)	Moderately tolerant to powdery mildew and aphids. Suitable for leafy as well as seed purpose. High volatile oil content (0.47%)	18.4	Chhattisgarh, Rajasthan, Bihar, Uttar Pradesh Madhya Pradesh, Haryana, Gujarat, Uttarakhand, Andhra Pradesh, Telagana, Tamil Nadu.

DH 220

Suruchi

Ajmer Coriander 2

SEED RATE

Coriander is commercially propagated by seeds. To achieve optimum plant density in irrigated condition, a seed rate of 12-15 kg ha^{-1} is required. Under rainfed conditions, a seed rate of 20-25 kg ha^{-1} is adopted.

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.

Land preparation

Land preparation should be done with the help of plough or cultivator, 3-4 times to bring the soil to a fine tilth. To avoid loss of soil moisture and to break the clods, the field must be planked immediately after ploughing. Under irrigated condition, if soil moisture is not sufficient, pre-sowing watering before land preparation helps in good germination of seeds. For dry land condition, field must be ploughed after rain for conservation of soil moisture. Field must be kept either fallow or grown with short duration crops. Less number of ploughing is required in light soils whereas more number of ploughing is required in heavy soils. At the time of sowing, soil must be friable for better seedling emergence and their further establishment and growth.

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, fertigation 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.

Sowing

The optimum sowing time of coriander is last week of October. Delayed sowing reduces the plant growth and increases the incidence of pests and diseases. Therefore sowing should be done early when the day temperature falls below 25^0C. Sowing should be done 30 cm apart in lines with plant to plant distance of 10 cm, whereas in heavy soils or fertile soils 40 cm spacing between rows in recommended.

Take 20-25 kg ha^{-1} seed and treat with Bavistin @ 2 g kg^{-1} seed or Thiram @ 2.5 g kg^{-1} seed or *Trichoderma* @ 4 g kg^{-1} seed after splitting the seed properly for wilt control. Use *Azospirillum* or *Azotobacter* as seed treatment and soil treatment in combination with 5 t sheep manure ha^{-1} for higher seed yield. Seed treatment with either PGPR *viz*., FK 14 (*Pseudomonas putida*) or FL 18 (*Microbacterium paraoxidans*) significantly improves seed yield and net returns. Adopt crop rotation and summer ploughing to control wilt and stem gall.

Rajasthan:	Mid of October to mid of November
Gujarat:	Last week of Oct. to first fortnight of November
Tamil Nadu:	June-July (kharif), September- October (rabi)
Andhra Pradesh:	first fortnight of November
Bihar:	first fortnight of October
Uttar Pradesh:	Middle of October to first week of November

Manures and fertilizers

- Apply 15-20 t ha^{-1} of FYM.
- Apply 50% recommended dose of fertilizer (RDF) through vermicompost + 50% RDF through chemical fertilizer for obtaining higher seed yield.
- Application of 10 to 15 t ha^{-1} vermicompost.
- Drill 20 kg N + 30 kg P_2O_5 + 20 kg K_2O ha^{-1} at sowing in unirrigated crop.
- For irrigated crop, drill 20 kg N + 30 kg P_2O_5 + 20 kg K_2O ha^{-1} at sowing, foliar spray of 20 kg N ha^{-1} at the time of first irrigation and foliar spray of 20 kg N ha^{-1} at flowering stage
- Soil + foliar application of $FeSO_4$ @ 5 kg ha^{-1} + 0.125%, $MnSO_4$ @ 12.5 kg ha^{-1} + 0.25% and $CuSO_4$ @ 12.5 kg ha^{-1} + 0.25% increases seed yield and luster.
- Application of NAA @ 50 ppm/ Triacontanol @ 1.0 mL L^{-1} twice at 40 and 60 DAS or thrice at 40, 60 and 80 DAS enhances growth and yield.

Irrigation

Depending on the climatic conditions, soil type and variety used, 4-5 irrigations are required after germination for irrigated coriander. First irrigation should be given at 30-35 days after sowing (DAS), second at 60-70 DAS, third at 80-90 DAS, fourth at 100-105 DAS and fifth at 110-150 DAS. Drip irrigation is better than other methods.

Intercultural operations

Thinning, first hoeing and weeding should be done 30 DAS as initial growth of coriander is slow. Second hoeing and weeding in irrigated coriander may be done between 50-60 DAS depending upon the regrowth of weed. Pre-plant herbicide Fluchloralin 0.75 kg ha^{-1}, pre- emergent Oxyfluorfen @ 1.0 kg ha^{-1} supplemented with hand weeding once at 50 DAS gives effective control of weeds.

Off season leafy coriander

Production and nutrient management in off-season leafy coriander: Planting of coriander variety CS 11 during March- April under 50% agro shade net gives high yield of physiologically matured leaf on 45th day of sowing with a BC ratio: 5.80. Application of 30:40:20 kg NPK per ha combined with spraying of GA 15 ppm at 20 DAS recorded the highest leaf yield per ha (4824 kg/ha) with high benefit cost ratio of 2.37 and 25% of yield increase over control.

Intercropping/mixed cropping

Intercropping coriander with brinjal is an effective IPM component to reduce fruit borer infestation and reduction insecticides used by farmers. Mixed cropping of coriander and chickpea also helps to reduce the attack of pod borer in chickpea. Mixed cropping of coriander, chilli and garlic help to manage wilt in chilli. The smell of garlic and coriander act as insect repellent besides fetching additional income of coriander leaf from time to time to farmers. Coriander can also be intercropped with onion, garlic, carrot, fenugreek, French radish, knolkhol, pea, chillies, cabbage etc.

Some of the common cropping systems followed are,
Green gram/ Black gram- Coriander
Summer moong - Coriander
Cluster-bean/ Cowpea –Coriander
Cluster bean- Coriander - Summer Maize
Maize – Potato – Coriander

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

Aphids *(Hyadaphis coriandri)* colonize on leaves, tender apical shoots and umbels where both nymphs and adults suck cell sap and devitalize the plant. Infestation in early stages causes distortion in plant growth, yellowing of leaves and reducing their vigour. The heavy infestation of aphid on coriander occurs between December to March and reduces yield by more than 50% in unprotected crop.

Aphids on coriander

Management:

- Timely sowing of crop between 15-30th October helps avoid heavy infestation.
- Crop should be free from weeds. Clean cultivation in coriander field and surroundings by removal of alternate host to minimize aphid infestation.
- Avoid judicious use of nitrogenous fertilizers and water.
- Use of yellow or blue sticky traps for aphid management.
- Use botanicals like neem seed kernel extract (5.0%), neem oil (2.0%) and bio-pesticides like Verticillium lecanii as foliar application.
- Need based application of safe chemical insecticides.
- Conserve natural enemies and pollinators by judicious application of insecticides. Coriander crops attract large numbers of Coccinellid predators and other parasitoids. Honey bees are major source of pollination to coriander crop.

Seed wasp

Systole albipennis causes damage in field conditions but the immature stage present inside the seed emerges at storage. The larva damages the seed and survives inside the fruits.

The infestation of this insect continues in the seeds till storage. Female adults lay eggs inside the developing seeds. The eggs hatches inside seed and the larva feeds and destroys the embryo and/or endosperm, thereby reducing seed viability. Adults emerge by making exit hole in the seed. They complete their life span within 25 days from egg to adult stage. In general, yield loss of approximately 30% is expected. However, if infestation is more severe, yield loss of 50% can be expected.

Seed wasp

Damage due to attack by wasp

Management:

Timely sowing of coriander reduces the *S. albipennis* incidence, late sown crop invited more infestation. Crop should be grown in specified crop geometry. Apply botanical products ie. neem products like neem seed kernel extract (5.0%) or neem oil (2.0%). Intercropping with sesame helps in lower infestation.

Thrips

Amongst the species of thrips attacking seed spices, *Thrips tabaci* is the major species found on most of the seed spice crops. Both nymphs and adults feed on umbel, leaf sheath and stems of plants. Both nymphs and adults congregate in between the leaf sheath and stem of plants which results in drying of the leaves. Severe infestation results in drying of flowers and production of shriveled fruits.

Management:

- Timely sowing of crop between 15- 30th October helps in avoiding heavy infestation.
- Crop should be free from weeds. Clean cultivation in coriander field and surroundings by removal of alternate host minimizes aphid infestation.
- Avoid injudicious use of N fertilizers and water.
- Use yellow or blue sticky traps.
- Treat seeds with Imidacloprid 0.5 g kg^{-1} seeds.
- Use botanicals like neem seed kernel extract (5%), neem oil (2.0%) and bio-pesticides like *Verticillium lecanii* as foliar application.
- Need based use of safe chemical insecticides.
- Conserve natural enemies, coccinellid predators, other parasitoids and pollinators by judicious application of insecticides.

Natural enemies or beneficial insects

Coccinella (Lady Bird beetle)

Coccinella on coriander

- This is very important predator found on all seed spice crops.
- Coccinella adult and grub feed on numbers of insect which causes damage and yield loss to the crops.
- In coriander crop it is one of important natural control agents of aphids and other sucking pests.
- It is found in significant numbers when aphid population is at a peak.
- Conservation of coccinella and further multiplication on the crop is possible through good agricultural practices and application of Integrated Pest Management practices.

Disease management

Wilt

Wilt is caused by *Fusarium oxysporum.* The infected plants dry up due to wilting. The wilt infection may appear in patches at any stage of growth.

Management :

- Use varieties that are tolerant to wilt disease (eg. CO3, Sindhu, RCr-41, RCr-446, CS-287 etc)
- The complete control of this disease is difficult but the incidence can be reduced by using certified healthy and disease free seeds.
- *Pseudomonas fluorescens* and *Trichoderma* may be applied to the soil before sowing as prophylactic measure (5 kg/ha).
- Summer ploughing and soil solarization in summer and proper crop rotation will reduce wilt incidence.

Powdery mildew

Powdery mildew (*Erysiphe polygoni*), in the initial stage appears as a white powder mass on the leaves and then on the stem and other parts such as umbels.

Management :

- Use varieties that are tolerant to powdery mildew disease (eg. CO3, Sindhu, RCr-41, DH 220, GC-3, ACr-3 etc)
- Seed treatment with *Pseudomonas fluorescens* @ 10 g kg^{-1} and foliar spray of @ 2 g L^{-1} or spraying. Wettable sulphur 1.0 kg ha^{-1} at the time of initial appearance of the disease and 2nd spray at 10 days interval.
- Spray neem seed kernel extract (5.0%) thrice (1st spray immediately after the appearance of disease, 2nd and 3rd at 10 days interval).
- The disease can also be managed by dusting sulphur powder @ 20-25 kg ha^{-1} or spraying karathane @ 0.1%. Second spray should be repeated after 15-20 days.

Powdery mildew disease

Blight

Blight caused by *Alternaria poonensis* appears in the form of dark brown spots on the stem and leaves.

Management :

Spraying of 500-700 L ha^{-1} solution of 0.2% mancozeb or 0.1% thiophanate methyl helps in managing the disease.

Module for integrated management of pests and diseases

Soil application of vermicompost 5 t ha^{-1} + seed treatment with neem seed kernel extract (5.0%) and spray of neem seed kernel extract (5.0% on appearance of powdery mildew and aphid at 10 days interval (twice/thrice). Using 5.0% onion leaf extract as foliar spray three times can also protect the plants from powdery mildew.

Frost damage

Coriander crop is most vulnerable to frost damage at the flowering and early seed formation stage. The frost damage can be minimized by spraying 0.1% solution of sulphuric acid, irrigating the crop prior to the incidence of frost, using wind breaks and creating smoke cover in the early morning.

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 coriander

To obtain good luster of seed with yield, harvesting should be done when 50% seeds turn yellow. To obtain extra income, leaf plucking to the extent of 50% at 75 days after sowing without reductions in seed yield may be done. The harvested material should be dried in shade to retain seed colour and quality. If it is not possible then the harvested material should be kept in bundles upside down to avoid direct sun rays on the seeds which reduce the quality of product. After drying the harvested material, the seeds are separated by light beating with sticks and winnowing. With good management practices and use of high yielding varieties, an average yield of 12-25 q ha^{-1} under irrigated condition and 7-8 q ha^{-1} under rainfed conditions can be obtained.

Post-harvest management

Clean and dried coriander seeds are filled in bags and stored in damp free aerated store houses. On a commercial scale, seeds are cleaned with the help of vacuum gravity separator and de-stoner and spiral gravity separator. To get good price and easy marketing, the produce should be categorized in different grades and stored properly.

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 coriander cultivation

Mancozeb		Slightly toxic
Thiophanate methyl		Slightly toxic
Wettable sulphur		Slightly toxic
Imidacloprid		Moderately toxic
Oxyfluorfen		Moderately toxic
Fluchloralin		Moderately toxic