Practical manual

Spices and Condiments

Course No. HVS -202, Credit 3 (2+1)

Lavlesh
Vinod Kumar
Arjun Lal Ola

2020

College of Horticulture & Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi, (UP) – 284003

Spices and Condiments HVS 202 3(2+1): Identification of varieties: propagation, seed treatment – sowing; layout, planting; hoeing and earthing up; manuring and use of weedicides, training and pruning; fixing maturity standards, harvesting, curing, processing, grading and extraction of essential oils and oleoresins. Visit to commercial plantations.

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Roll No. .....

Batch .....

Session .....

Semester .....

Course Name : .....

Course No. : .....

Credit .....

Published: 2019

No. of copies: ……..

Price: Rs.

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Date: Course Teacher

INDEX

Practical No. 1

Objective: To study the morphological identification and description of spices and condiments

Spices & condiments: ……

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S. No.	Common Name	Scientific Name	Family	Surface	Colour of seed	Shape	Size	Other specifications
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Practical No.2

Objective: To study the classification of spices and condiments

Methods of classification:

CLASSIFICATION ON THE BASIS OF ECONOMIC IMPORTANCE:

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MINOR SPICES: ……

Groups	Spice crops
Seed spices	
Bulbous spices	
Aromatic spices	
Leafy spices	
Acidulant tree spices	

CLASSIFICATION BASED UPON THE PLANT PART USED:

Plant part	Spice crops
Seeds or nuts	
Plant bark	
Leaf spices	
Latex	
Flower bud	
Root or bulbs	
Rhizome	
Fruit	
Aril	
Flower	
Berries	
Kernel	
Tubers	

CLASSIFICATION OF SPICES BASED ON BOTANICAL FAMILIES:

Family	Spice crops
Apiaceae	
Lamiaceae	
Liliaceae	
Solanaceae	
Zingiberaceae	
Myrtaceae	
Alliaceae	
Lauraceae	
Brassicaceae	
Myristicaceae	
Piperaceae	

CLASSIFICATION BASED ON LIFE CYCLE OF CROP:

Annual: ……..

Biennial: ……

Perennial: ……

CLASSIFICATION BASED ON GROWTH HABIT:

Herbs: ……

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Shrubs: ……..

Trees: ……

BOTANICAL CLASSIFICATION

Botanical name	Common Name	Family	Habit of growth	Parts used

Practical No. 3

Objective: To study the identification and description of varieties/hybrids of spices and condiments

VARIETIES OF SPICES AND CONDIMENTS

Variety	Centre which developed	Year of release	Pedigree/ Parentage	*Av. yield (kg/ha)	Dry recovery %	Piperine %	Oleoresin %	Essential oil %	Salient features
BLACK PEPPER									
Panniyur 1									
Panniyur 2									
Panniyur 3									
Panniyur 4									
Panniyur 5									
Panniyur 6									
Panniyur 7									
Panniyur 8									
Sreekara									
Subhakara									
Panchami									
Pournami									
IISR Sakthi									
IISR Thevam									
IISR Girimunda									
IISR Malabar Excel									
Arka Coorg Excel									
Vijaya									
SMALL CARDAMOM									
Mudigere 1									
Mudigere 2									
IISR Kodagu Suvasini (CCS-1)									

IISR Avinash (RR-1)									
IISR Vijetha (NKE-12)									
GINGER									
Suprabha									
Suruchi									
Suravi									
Himgiri									
IISR Varada									
IISR Mahima									
IISR Rejatha									
Aswathy (IC NO. 0584128)									
Athira (IC No. 0584128)									
Karthika (IC No. 0584129)									
Subhada									
	TURMERIC								
Krishna									
Sugandham									
Roma									
Suroma									
Ranga									
Rasmi									
Rajendra Sonia									
Megha turmeric 1									
Pant Peetabh									

Suranjana (TCP-2)									
Suvarna									
Suguna									
Sudarsana									
IISR Prabha									
IISR Prathibha									
IISR Kedaram									
IISR Alleppey Supreme									
Kanthi									
Sobha									
Sona									
Varna									
Narendra Haldi – 1									
Duggirala Red									
Narendra Haldi – 2									
Narendra Haldi – 3									
Surangi									

Practical No. 4

Objective: To study the propagation methods in spices and condiments

Define propagation: ……

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Types of propagation: ……

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Propagation in different spices and condiments:

Spices	Method of propagation	Advantages

Name of crop: ……

Material and methods required: ……

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Procedure: ……

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Remarks: ……

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Practical No. 5

Objective: To study the seed treatment in spices and condiments

Define seed treatment: ……

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Different types of seed treatment:

Seed dressing : ……

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Seed coating: ……

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Seed pelleting : ……

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Name of crop: ……

Seed treatment : ……

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Practical No. 6

Objective: To study the different sowing methods in spices and condiments

Sowing : ……

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Different methods of sowing:

Broadcasting: ……..……..…

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Dibbling: ……..……..……..…

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Drilling: ……..……..……

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Seed dropping behind the plough: ……..……

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Transplanting: ……..……..……..…

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Hill dropping: ……..……..……

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Check row planting: ……..……

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Practical No. 7

Objective: To study the layout and planting for spices and condiments

Name of crop: .....

Procedure: .....

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Practical No. 8

Objective: To study the hoeing and earthing up in spices and condiments

Hoeing and earthing up: ……

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Advantages of hoeing :

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Advantages of earthing up :

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Name of crop: ……

Procedure: ……

Practical No. 9

Objective: To study about the manuring, fertilization and calculation of fertilizer doses in spices and condiments

What are manures and fertilizers: ……

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Calculation of fertilizer doses required for application in a crop :

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Practical No.10

Objective: To study the weed management and use of weedicides in spices and condiments

Define weed: ……

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Harmful effects of weeds: ……

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Methods of weed control

Cultural methods:……

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Biological methods : ……

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Chemical methods : ……

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Practical No. 11

Objective: To study the training and pruning in spices and condiments

Training and pruning: ……

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Types of Training:

(1) Central leader: ……

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(2) Open centre: ……

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(3) Modified leader system: ……

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(4) Single stem: ……

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(5) Multiple stem: ……

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Types of pruning:

(1) Thinning out: ……

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(2) Heading back: ……

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Name of crop: ……

Procedure: ……

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Practical No. 12

Objective: To study the maturity standards of spices and condiments

Define maturity: ……
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S.No.	Spice/ condiments	Maturity standard

Practical No. 13

Objective: To study the harvesting of spices and condiments

Introduction: ………

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Harvesting of spices and condiments

S.No.	Crop	Harvesting

Practical No. 14

Objective: To study the curing of spices and condiments

Introduction: ……

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Ingredient: ……

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Importance of Curing: ……

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Procedure of curing: ……

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Practical No. 15

Objective: To study the processing of spices and condiments

Introduction: ……

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Ingredient: ……

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Importance of Processing: ……

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Procedure of Processing: ……

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Practical No. 16

Objective: To study about the grading in spices and condiments

Introduction: ……

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Ingredient: ……

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Importance of Grading: ……

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Procedure of Grading: ……

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Practical No. 17

Objective: To study about the extraction of essential oil and oleoresins in spices and condiments

Different essential oil and oleoresin extraction technique: ……

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Extraction of essential oil using Clevenger apparatus

Material required: ……

Procedure: ……

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Observations:

Species for oil extraction : ----------

Quantity of biomass per batch: ----------

Time period for extraction: ----------

Yield of essential oil:

$$\text{Yield (\%)} = \frac{\text{weight of extracted oil (gm)}}{\text{weight of plant material (gm)}} \times 100$$

Any other observation: ----------

Draw a well labelled diagram of steps followed:

Practical No. 18

Objective: To study about the visit to commercial plantation of spices and condiments

Observations: ……

SPICES AND CONDIMENTS

Spices are those plants, the product of which is made to use as food adjuncts to add aroma and flavour. Condiments are also spices, products of which are used as food adjuncts to add taste only.

Classification on the basis of economic importance:

Major spices

- The spices which contribute major share in the spice trade industry of the world are called major spices.
- The spices come under this group are small cardamom, black pepper, chilli, turmeric and ginger.
- These spices contribute about 75-90% of the total foreign exchange earned through spices.

Minor spices: Excluding all these five major spices, all other are called minor spices. Minor spices are further divided into five sub groups:

Groups	Spice crops
Seed spices	Coriander, cumin, black cumin, fennel, aniseed, celery, mustard, poppy and caraway
Bulbous spices	Garlic, onion, leek and shallot
Aromatic spices	Clove, cinnamon, allspice, aniseed and nutmeg
Leafy spices	Curry leaf, mint, rosemary, bay leaf, and parsley
Acidulant tree spices	Tamarind, kokam and anardana

Classification based upon the plant part used:

Plant part	Spice crops
Seeds or nuts	Coriander, Fennel, Cumin, Fenugreek, Dill, Aniseed, Caraway, Almond, Poppy, Pepper, Tamarind, Vanilla, Celery, white mustard, cardamom, sesame
Plant bark	Cinnamon, Cassia
Leaf spices	Bay leaf, curry leaf, basil, parsley, rosemary, mint, parsley, coriander, celery, sage
Latex	Asafoetida
Flower bud	Clove
Root or bulbs	Horseradish, Wasabi, onion, garlic, celery
Rhizome	Turmeric, Ginger
Fruit	Cardamom, Black Pepper, Vanilla, All spice, Cassia, Tamarind, paprika, Pepper, coriander, star anise
Aril	Mace
Flower	Stigma Saffron
Berries	Allspice, black pepper, chilli
Kernel	Nutmeg
Tubers	Galangal

Classification of spices based on Botanical families:

Family	Spice crops
Apiaceae	Coriander, cumin, dill, celery, fennel, lovage, parsley, asafoetida
Lamiaceae	Mint, basil, rosemary, sage, thyme, savory
Liliaceae	Leek, chive
Solanaceae	Capsicum, chilli
Zingiberaceae	Ginger, turmeric, cardamom
Myrtaceae	Clove, allspice
Alliaceae	Garlic
Lauraceae	Cinnamon, cassia, bay leaf
Brassicaceae	Mustard, horse radish
Myristicaceae	Nutmeg, mace
Piperaceae	Pepper

Classification based on life cycle of crop:

Annual: basil, coriander, dill
Biennial: caraway, parsley, leek
Perennial: curry leaf, mint, oregano, thyme

Classification based on growth habit:

Herbs: Coriander, fennel, mint, fenugreek, cumin, caraway, dill, black cumin, ajowain, onion, garlic, celery, aniseed
Shrubs: Rosemary, sage, thyme
Trees: Curry leaf, Cinnamon, Nutmeg, clove, tamarind, laurel

Botanical Classification

Botanical Name	Common Name	Family	Habit of growth	Parts used
Allium cepa	Onion	Alliaceae	Annual	Green leaves and bulbs
Allium fistulosum	Welsh onion	Alliaceae	Annual	Leaf, bulb
Allium porum	Leek	Alliaceae	Annual	Leaf, bulb
Allium sativum	Garlic	Alliaceae	Annual	Green leaves and bulbs
Amomum subulatum	Cardamom (Large)	Zingiberaceae	Perennial	Fruit
Brassica juncea	Indian mustard	Brassiceae	Herb	Seed
Brassica nigra	Black mustard	Brassiceae	Herb	Seed
Coriandrum sativum	Coriander	Apiaceae	Annual	Leaf and the seed
Cuminum cyminum	Cumin	Apiaceae	Annual	Fruit
Curcuma amada	Mango ginger	Zingiberaceae	Perennial herb	Rhizome
Curcuma longa	Turmeric	Zingiberaceae	Perennial herb	Rhizome
Capsicum annum	Chilli	Solanaceae	Annual	Fruit
Cinnamomum loureirii	Vietnamese cassia	Lauraceae	Perennial Tree	Leaf, stem bark
Cinnamomum tamala	Tezpat/Cinnamon	Lauraceae	Perennial Tree	Leaf, stem bark
Cinnamomum verum	Cinnamon	Lauraceae	Perennial Tree	Leaf, stem bark
Cinnamomum zeylanicum	Srilankan Cinnamon	Lauraceae	Perennial Tree	Leaf, stem bark
Eugenia caryophyllus	Clove	Myrtaceae	Tree	Flower bud
Elettaria cardamomum	Cardamom (small)	Zingiberaceae	Perennial	Fruit
Foeniculum vulgare	Fennel	Apiaceae	Annual	Fruit
Garcinia cambogia	Garcinia, Camboge	Cusiaceae	Tree	Pericarp of fruit
Garcinia indica	Garcinia, Kokum	Cusiaceae	Tree	Pericarp of fruit
Illicum verum	Star anise	Illiciaceae	Evergreen tree	Fruit
Mangifera indica	Mango	Anacardiaceae	Tree	Immature fruit
Mentha arvensis	Japanese mint	Lamiaceae	Perennial herb	Leaf, terminal shoot
Murraya koenigii	Curry leaf	Rutaceae	Shrub	Leaf
Myristica fragrans	Nutmeg/Mace	Myristicaceae	Tree	Kernel/ aril
Nigella sativa	Black cumin	Ranunculaceae	Annual herb	Seed
Oscimum basilicum	Swwet basil	Lamiaceae	Annual herb	Leaf, terminal shoot
Piper nigrum	Black pepper	Piparaceae	Perennial climber	Fruit
Pimpinella anisum	Aniseed	Apiaceae	Annual	Fruit
Pimenta dioca	All spice	Myrtaceae	Tree	Immature fruit, leaf
Pimpinella anisum	Aniseed	Apiaceae	Annual herb	Fruit
Piper longum	Long pepper	Piperaceae	Perennial	Fruit
Piper nigrum	Black pepper, white pepper, green pepper	Piperaceae	Perennial	Fruit
Punica granatum	Pomegranate (*Anardana*)	Punicaceae	Shrub	Seed (dried with flesh)
Rosemarinus officinalis	Rosemary	Lamiaceae	Perennial herb	Terminal leaf, shoot
Trigonella foenum-graecum	Fenugreek	Fabaceae	Annual herb	Fruit pod
Thymus vulgaris	Thyme	Lamiaceae	Perennial	Terminal shoot, leaf
Tamarindus indica	Tamarind	Leguminosae	Tree	Fruit
Trachispermum ammi	Ajwain	Apiaceae	annual	Fruit
Zingiber officinale	Ginger	Zingiberaceae	Perennial herb	Rhizome

VARIETIES OF SPICES AND CONDIMENTS

Variety	Centre which developed	Year of release	Pedigree/ Parentage	*Av. yield (kg/ha)	Dry recovery %	Piperine %	Oleoresin %	Essential oil %	Salient features
BLACK PEPPER									
Panniyur 1	Pepper Research Station, KAU, Panniyur, Kerala	1967	F1 of Uthirankotta x Cheriyakaniyakadan	1242	35.3	5.3	3.5	3.5	Highest yield potential. Do not tolerate shade, moderately high oleoresin (11.8%) long spikes & bold berries
Panniyur 2	Pepper Research Station, KAU, Panniyur, Kerala	1991	Open pollinated progeny of Balankotta	2570	35.7	6.6	10.9	3.4	Shade tolerant, rich in oleoresin high pipline
Panniyur 3	Pepper Research Station, KAU,	1991	F1 of Uthirankotta x Cheriyankaniyakadan	1953	27.8	5.2	12.7	3.1	Late maturing, suitable for all pepper growing region, performs well under open situation. Long

	Panniyur, Kerala								spikes & bold berries
Panniyur 4	Pepper Research Station, KAU, Panniyur, Kerala	1991	Clonal selection from Kuthiravally	1277	34.7	4.4	9.2	2.1	Stable yielder, performs well under adverse condition also
Panniyur 5	Pepper Research Station, KAU, Panniyur, Kerala	1996	Open pollinated progeny of Perumkodi	1107	35.7	5.3	12.33	3.8	Suitable for both monocropping & mixed crop in coconut/arecanut gardens. Long spikes
Panniyur 6	Pepper Research Station, KAU, Panniyur, Kerala	2000	Clonal selection from Karimunda	2127	33	4.9	8.27	1.33	Steady and stable yielder tolerant to drought and adverse climatic conditions. Suitable for open condition as well as partial shade
Panniyur 7	Pepper Research Station, KAU, Panniyur, Kerala	2000	Open pollinated progeny of Kalluvally	1410	34	5.6	10.6	1.5	Vigorous, hardy and a regular bearer, long spike, high piperine (5.6%) tolerates adverse climatic condition suitable open and shaded conditions.
Panniyur 8	Pepper Research Station, KAU, Panniyur, Kerala	2013	Hybrid of Panniyur 6 x Panniyur 5	5760	37	5	12	3.8	Suited to all pepper growing regions of Kerala. Field tolerant to drought situations and Phytophthora foot rot.
Sreekara	Indian Institute of Spices Research, Calicut, Kerala	1990	Clonal selection from Karimunda	2677	35	5.1	13.0	7.0	High quality and high volatile oil content
Subhakara	Indian Institute of Spices Research, Calicut, Kerala	1990	Clonal selection from Karimunda	2352	35	3.4	12.4	6.0	High quality and high volatile oil content with wider adaptability to all pepper growing tracts.
Panchami	Indian Institute of Spices Research, Calicut, Kerala	1991	Clonal selection from Aimpiriyan	2828	34	4.7	12.5	3.4	Late maturing variety with excellent fruit set.
Pournami	Indian Institute of Spices Research, Calicut, Kerala	1991	Clonal selection from Ottaplackal	2333	31	4.1	13.8	3.4	High yielding variety, tolerant to root knot nematode.
IISR Sakthi	Indian Institute of Spices Research, Calicut, Kerala	2006	Open pollinated progeny of Perambramundi.	2253	43	3.3	10.2	3.7	Tolerant to *Phytophthora capsici*
IISR Thevam	Indian Institute of Spices Research, Calicut, Kerala	2006	Clonal selection of Thevamundi,	2481	32.5	1.6	8.15	3.1	Vines grow vigorously, stable yielding field tolerant to Phytophthora
IISR Girimunda	Indian Institute of Spices Research, Calicut, Kerala	2004	Hybrid between Narayakodi x Neelamundi	2880	32	2.2	9.65	3.4	Recommended for rainfed conditions, suitable for high elevation
IISR Malabar Excel	Indian Institute of Spices Research, Calicut, Kerala	2006	Hybrid between Cholamundi x Panniyur-1	1440	32.3	11.7	2.4	2.8	Suitable for high elevation and plains
PLD –2	Indian Institute of Spices Research, Calicut, Kerala	1971	Clonal selection from Kottanadan	2475	-	3	15.45	4.8	Late maturity high quality cultivar, recommended for Trivandrum and Quilon districts of Kerala.
Arka Coorg Excel	Central Horticultural Experiment Station, Chettalli, IIHR	2012	Seedling Selection	-	-	-	-	-	To develop bold seeded, long spiked, high yielding pepper variety
Vijaya	KAU, Trchur, Kerala	2012							
SMALL CARDAMOM									
Mudigere 1	Regional Research Station, UAS, Mudigere. Karnataka	1984	Clonal selection from Malabar type	300	20	8	36	42	Erect and compact panicle, suitable for high density planting, moderately tolerant to thrips, hairy caterpillar and white grubs, pubescent leaf. Short panicle, pale green, oval bold capsule
Mudigere 2	Regional Research Station, UAS, Mudigere. Karnataka	1994/1996	Clonal selection from open pollination of Malabar type	475		8	45	38	Early maturing variety, suitable for high density planting, round/oval bold capsules.
PV 1	Cardamom Research Station, KAU, Pampadumpara, Idukki, Kerala	1991	A selection from Walayar collection, Malabar type	260	19.9	6.8	33	46	An early maturing type, short panicle, elongated slightly ribbed light green capsules, Long, bold capsule
PV 2	Cardamom Research Station, KAU, Pampadumpara, Idukki, Kerala	2001	Selection from OP Seedlings of PV-1,a Malabar type	982	23.8	10.45	-	-	Early maturing, lengthy panicle, Long bold capsules, high dry recovery percentage, field tolerant to stem borer and thrips, suitable for elevation range of 1000-1200 m above MSL.
ICRI 1	ICRI (Spices Board), Myladumpara, Kerala	1992	Selection from Chakkupalam collection, Malabar type	325	22.9	8.7	29	38	An early maturing type globose, round and extra bold dark green capsules ; medium sized panicle with profusely flowering , early maturing type,
ICRI 2	ICRI (Spices Board), Myladumpara, Kerala	1992	Clonal selection from germplasm, Mysore type	375	22.5	6.67	29	36	Performs well under high altitude and irrigated condition, medium long panicles, oblong bold and parrot green capsules, tolerant to azhukal disease

ICRI 3	ICRI (Spices Board), Myladumpara, Kerala	1994	Selection from Malabar type	440	22	6.6	54	24	Early maturing long pubescent leaves, tolerant to rhizome rot disease, oblong, bold parrot green capsules. suitable for hill zone of Karnataka
ICRI 4 TDK 4	ICRI (Spices Board), Myladumpara, Kerala	1997	Clonal selection from lower pulleys, a Malabar type	455	22.76	6.4	-	-	Early maturity, medium sized panicles, Globose bold capsules. Suitable for low rainfall areas, relatively tolerant to rhizome rot and capsule borer
ICRI 5	ICRI (Spices Board), Myladumpara, Kerala	2006	Hybrid between MCC 260 x MCC 49	1,543	23.15	7.13	-	-	First hybrid variety, Early maturity Moderately tolerant to drought, High yield under intensive management, Capsule size 68% ; more than 70 mm,
ICRI 6 (MCC – 73)	ICRI (Spices Board), Myladumpara, Kerala	2006	Selection from the germplasm (acc. MCC-73)	1,200	19.0	7.33	-		High yield, Medium maturity, Relatively tolerant to drought, High percentage of bold capsules Capsule size 71% ; more than 7mm
ICRI 7	ICRI (Spices Board),	2010	Hybrid	-	22	8.84	-	-	Suitable for Wayanad, Kerala, Semi-erect panicles Angular bold capsules, Oleoresin 7.99%
IISR Kodagu Suvasini (CCS-1)	Indian Institute of Spices Research, Calicut, Kerala	1997	Selection from OP progeny of CL-37 from RRS Mudigere, Malabar type	745	22	8.7	42	37	Early maturing, suitable for high density planting, long panicle. tolerant to rhizome, rot, thrips, shoot/panicle/capsule borer.
IISR Avinash (RR-1)	Indian Institute of Spices Research, Calicut, Kerala	2001	A selection from OP progeny of CCS-1, a malabar type	847	20.8	6.7	30.4	35.5	Dark green capsules. Tolerant to rhizome rot, and shoot/panicle/capsule borer.
IISR Vijetha (NKE-12)	Indian Institute of Spices Research, Calicut, Kerala	2001	Clonal selection from field resistant plants for Katte, a Malabar type	643	22	7.9	45	23.4	Resistant to katte virus, bold capsules. Field tolerant to thrips and borer.
GINGER									
Suprabha	High Altitude Research Station, OUA &T, Pottangi, Orissa	1988	Clonal selection from Kunduli local	16600	20.5	8.9	4.4	1.9	Plumpy rhizome, less fibre, wide adaptability, suitable for both early and late sowing.
Suruchi	High Altitude Research Station, OUA &T, Pottangi, Orissa	1990	Clonal selection from Kunduli local	11600	23.5	10.9	3.8	2.0	Profuse tillering, bold rhizome, early maturing, suitable for both rainfed and irrigated condition.
Suravi	High Altitude Research Station, OUA &T, Pottangi, Orissa	1991	Induced mutant of Rudrapur local	17500	23.6	10.2	4.0	2.1	Plumpy rhizome, dark skinned yellow fleshed, suitable for both irrigated and rainfed conditions.
Himgiri	YSPUJ&F, Solan, Himachal Pradesh	1996	Clonal selection from Himachal collection	13500	20.2	4.29	1.6	6.05	Best for green ginger less susceptible to rhizome rot disease, suitable for rainfed condition.
IISR Varada	Indian Institute of Spices Research, Calicut, Kerala	1996	Selection from germplasm	22660	19.5	6.7	3.29-4.50	1.7	High yielder, high quality bold rhizome, low fibre content. Wide adaptability and tolerant to diseases.
IISR Mahima	Indian Institute of Spices Research, Calicut, Kerala	2004	Selection from germplasm	23200	23	4.5	3.26	1.72	High yielder, plumpy extra bold rhizomes, resistant to M. incognita and *M. javanica* pathotype 1
IISR Rejatha	Indian Institute of Spices Research, Calicut, Kerala	2004	Selection from germplasm	22400	20.8	6.3	4	2.36	High yielder, plumpy and bold rhizome
Aswathy (IC NO. 0584128)	Kerala Agriculture University, Trichur	-	Single plant selection from somaclones of cultivar Rio-de-Janeiro	23000	19.7	7.45	3.5	3.32	Ideal for cultivation both as pure and intercrop. High yielding high quality clone suitable for green with high recovery of volatile oil and oleoresin. Filed tolerant to Phyllosticta leaf spot.
Athira (IC No. 0584128)	Kerala Agriculture University, Trichur	-	Selection form somaclones of cultivar Maran	21000	22.6	6.8	3.4	3.1	Ideal for cultivation both as pure intercrop. Suitable for fresh and dry ginger. Tolerant to soft rot and bacterial wilt diseases than parent cultivar. High yielding high quality clone with high zingiberence
Karthika (IC No. 0584129)	Kerala Agriculture University, Trichur	-	Selection form somaclones of cultivar Maran	19000	21.6	7.2	3.7	3.2	Ideal for cultivation both as pure and intercrop. Suitable for fresh and dry ginger. Tolerant to soft and bacterial wilt diseases than parent cultivar. Low infestation of shoot borer under field conditions. High pungency clone with high gingerol.
Subhada	High Altitude Research Station, OUA &T, Pottangi, Orissa	2009	Mutagen in EMS (40 PPM) treatment and selection of mutants	18000	22.4	10.4	3.4	2.0	Suitable for hills and plains
	TURMERIC								
CO.1	TNAU, Coimbatore,	1982	Vegetative mutant by	30.5	19.5	3.2	6.7	3.7	Bold and orange yellow rhizomes, suitable for

	Tamil Nadu		x-ray irradiation						drought prone areas, water logged, hilly areas saline and alkaline areas
BSR.1	TNAU, Coimbatore, Tamil Nadu	1986	Clonal selection from Erode local irradiated with x rays	30.7	20.5	4.2	4	3.7	Bright yellow rhizome suitable for problem soils and drought prone areas of Tamil Nadu.
BSR.2	TNAU, Coimbatore, Tamil Nadu	1994	Induced mutant from Erode local	32.7	-	-	-	-	A high yielding short duration variety with bigger rhizomes, resistant to scale insects
Krishna	Maharashtra	1983	Clonal selection from Tekurpeta collection	9.2	16.4	2.8	3.8	2	Plumpy rhizomes, moderately resistant to pests and diseases
Sugandham	Sardarkrushinagar Dantiwada Agricultural University, Junagarh	1984	Clonal selection from germplasm	15.0	23.3	3.1	11	2.7	Thick, round rhizomes with short internodes. Moderately tolerant to pest and diseases
Roma	High Altitude Research Station, OUA &T, Pottangi, Orissa	1988	Clonal selection from T. Sunder	20.7	31	6.1	13.2	4.2	Suitable for both rainfed and irrigated condition. Ideal for hilly areas and late sown season.
Suroma	High Altitude Research Station, OUA &T, Pottangi, Orissa	1989	Clonal selection from T. Sunder by x- ray irradiation	20.0	26	6.1	13.1	4.4	Round and plumpy rhizome, field tolerance to leaf blotch, leaf spot and rhizome scales.
Ranga	High Altitude Research Station, OUA &T, Pottangi, Orissa	1992	Clonal selection from Rajpuri local	29.0	24.8	6.3	13.5	4.4	Bold and spindle shaped mother rhizome, suitable for late sown condition and low-lying areas. Moderately resistant to leaf blotch and scales
Rasmi	High Altitude Research Station, OUA &T, Pottangi, Orissa	1992	Clonal selection from Rajpuri local	32.0	23	6.4	13.4	4.4	Bold rhizomes, suitable for both rainfed and irrigated condition, early and late sown season
Rajendra Sonia	RAU, Dholi, Bihar	1989	Selection from local germplasm	42.0	18	8.4	-	5	Bold and plumpy rhizome
Megha turmeric 1	ICAR, R.C..NEH Region, Shillong, Meghalaya	1996	Selection form Lakadong type	23.0	16.37	6.8	-	-	High curcumin content and bold rhizomes, suitable for North east hill region and North west Bengal.
Pant Peetabh	GBPUA&T, Pantnagar, Uttarakhand	2001	Clonal selection from local type	29.0	18.5	7.5	-	1	Resistant to rhizome rot
Suranjana (TCP-2)	Uttar Bangal Krishi Viswa Vidyala, North Bangal, Pundibari	2000	Clonal selection from local types of west Bengal	29.0	21.2	5.7	10.9	4.1	Tolerant to rhizome rot and leaf blotch; resistant to rhizome scales and moderately resistant to shoot borer suitable for open and shaded condition
Suvarna	Indian Institute Spices Research, Calicut, Kerala	1987	Selection from germplasm, collected from Assam	17.4	20	4.3	13.5	7	Bright orange coloured rhizome with slender fingers, field tolerant to pest and diseases.
Suguna	Indian Institute Spices Research, Calicut, Kerala	1991	Selection germplasm, collected from AP	29.3	20.4	4.9	13.5	6	Early maturing, field tolerant to rhizome rot.
Sudarsana	Indian Institute Spices Research, Calicut, Kerala	1991	Selection from germplasm, collected from Singhat, Manipur	28.8	20.6	5.3	15	7	Early maturing, field tolerant to rhizome rot.
IISR Prabha	Indian Institute Spices Research, Calicut, Kerala	1996	Open pol linated progeny selection	37.0	19.5	6.5	15	6.5	High yielding variety
IISR Prathibha	Indian Institute Spices Research, Calicut, Kerala	1996	Open pollinated progeny selection	39.1	18.5	6.2	16.2	6.2	High yielding variety
IISR Kedaram	Indian Institute Spice Research, Calicut, Kerala	2004	Clonal selection from germplasm	34.5	18.9	5.5	13.6	-	Resistant to leaf blotch.
IISR Alleppey Supreme	Indian Institute Spices Research, Calicut, Kerala	2004	Selection from Alleppey Finger turmeric	35.4	19	5.55	16	-	Tolerant to leaf blotch.
Kanthi	KAU, Trichur	1996	Clonal selection from Mydukur variety of Andhra Pradesh	37.65	20.15	7.18	8.25	5.15	Erect leaf with broad lamina, big mother rhizomes with medium bold fingers and closer internodes
Sobha	KAU, Trichur	1995	Clonal selection from local type	35.88	19.38	7.39	9.65	4.24	High Yielding Variety with high curcumin content (7.39%), Erect leaves with narrow lamina. Mother rhizome big with medium bold figures and closer internodes. Inner core of rhizomes is dark orange like Alleppey. More territory rhizomes.
Sona	KAU, Trichur	2002	Clonal selection from local germplasm	21.29	18.88	7.12	10.25	4.4	Orange yellow rhizome, medium bold with low territory fingers. Best suited for central zone of

									Kerala. rhizome medium bold. Field tolerant to leaf blotch.
Varna	KAU, Trichur	2002	Clonal selection from local germplasm	21.89	19.05	7.87	10.8	4.56	Bright orange yellow rhizome, medium bold with closer internodes, territory fingers present. suited to central zone of Kerala. Field tolerant to leaf blotch
Narendra Haldi – 1	NDUA&T, Kumarganj, Faizabad	2007/ 2010	Selection	-	-	-	-	-	High yield potential, good size and colour of rizhomes, high amount of cur cumin and essential oil
Duggirala Red	Dr. Y. S. R. Horticultural University Turmeric Research station, Kammarpally	2013	Mass selection	25	23.5	4.1	-	-	High yielding variety, Rhizomes are long, plumpy, strong and very deep orange in colour.
Narendra Haldi – 2	NDUA&T, Kumarganj, Faizabad	-	-	-	-	-	-	-	High yield potential, good size finger
Narendra Haldi – 3	NDUA&T, Kumarganj, Faizabad	2012	Selection	-	-	-	-	-	Highyielding, Root knot resistant, Moderate resistant against leaf spot and leaf blotch
Surangi	High Altitude Research Station, OUA&T, Pottangi, Orissa	2009	Clonal selection	23	28	4.5-6.5	12.7	4.6	Suitable for hills and plains
	MANGO GIGNER								
Amba	High Altitude Research Station, OUA &T, Pottangi, Orissa	-	Selection from local germplasm	21.9	-				Oleoresin 6.48 %, essential oil 0.8 %, dry recovery 18.7%. No major disease and pest problem.

METHODS OF PLANT PROPAGATION

Spices	Method of propagation	Advantages
Black pepper	Single node rooted cutting using bamboo method	Multiplication rate of 1:40 per year. Good anchorage due to presence of two root systems
	Serpentine method	The recovery percentage is higher compared to rapid multiplication technique
	Pit method	Simple, less costly, quick and ready for planting within 4 - 4 ½ months
Cardamom	Trench method of sucker production	Multiplication rate of 1:20 per year
Clove	Inarching on clove seedling.	Earliness, dwarfness and high productivity
Nutmeg	Epicotyl grafting, top working.	Female plants are propagated, conversion of male plants to female plants. Rapid multiplication of elite plants per unit area.
Cinnamon	Cottage, air layering (rapid multiplication techniques).	Earliness, more plants per unit area
Cassia	Air layering, cottage.	True to type plants
Allspice	Cuttage, layering.	Management of rhizome rot
Ginger and turmeric	Rhizomes	Crop rotation, solarization and disease-free rhizomes.

SEED TREATMENT

The processed seeds are treated with fungicides and insecticides to protect the seed against storage pests and diseases.

Purposes of seed treatment:

Seed disinfection: To eliminate pathogens which have penetrated into the living cells of the seed infected it and become established, the fungicidal treatment must actually penetrate the seed.

Seed disinfestations: Seeds are commonly contaminated on the surface by spores or other forms of pathogenic organisms without being penetrated or infected by the organisms (*i.e.*,) destruction of surface borne organism.

Seed protections: To protect the seed and young seedlings against the pathogenic organisms either under storage or in the soil.

Types of seed treatments:

Seed dressing is the process of treating **seeds** with antifungal or antimicrobial chemicals prior to sowing them.

Seed coating is the application of exogenous materials onto the surface of seeds with the aim of improving seed appearance and handling characteristics (e.g., seed weight and size) and/or delivering active compounds (e.g., plant growth regulators, micronutrients, and microbial inoculants) that can protect the seed against phytopathogens and increase germination and plant growth

Seed pelleting is the process of adding inert materials to seeds increasing their weight, size and shape. This improves plantability allowing for precise metering, spacing and depth of seed in the field.

Conditions of seed that need seed treatment

- **Injured Seed** – invasion of pathogens.
- **Diseased seed** – infected from harvest to storage.
- **Undesirable soil conditions** – cold storage, damp soil endemic to diseases like wilt, root rot etc.
- **Disease free seed**.

Advantages of seed treatment

a) **Protects the seed from seed rot and seedling blights:** *Pythium* and *rhizoctonia* will rot the seed even before it emerges. Mechanical injury can be protected using fungicide coating.
b) **Improves germination:** Controlling seed borne fungi.
c) **Provides protection from storage pest:** 20% loss due to storage pest.
d) **Controlling soil insects:** Nematodes, maggots, roots grub.
e) **Addition of nutrition:** Addition of nutrients to the seeds by seed pelleting.
f) **Facilitate easy sowing:** Increasing the size of seed signluation of fuzzy seeds.
g) **Inoculation of bio-fertilizers / or bio-control agents:** To increase nitrogen fixation. *Trichoderma viride* to control wilt disease in pulses.
h) **To remove dormancy factors:** Removal of hard seed coat – acid heat treatments.

Precautions to be taken in Seed Treatment

- Most products used in the treatment of seeds are harmful to humans. Extreme care is required to ensure that treated seed is never used as human or animal food. To minimise this possibility, treated seed should be clearly labelled as being dangerous, if consumed.
- Care must also be taken to treat seed at the correct dosage rate; applying too much or too little material can be as damaging as never treating at all. Seed with a very high moisture content is very susceptible to injury when treated with some of the concentrated liquid products.
- If the seeds are to be treated with bacterial cultures also, the order in which seed treatments should be done shall be as Chemical treatments, Insecticide and fungicide treatments and Special treatments.

Seeds: Plant propagation is made in two ways, Sexual (by seeds) and asexual (by vegetative means). Biologically, seed is a ripe, fertilized ovule and a unit of reproduction of flowering plants.
Seed rate: The required number of plants/unit area is decided by calculating the seed rate. The seed rate depends on spacing or plant population, test weight, germination percentage. The formula is as follows.

$$\text{Seed rate (kg/ha)} = \frac{\text{Plant population (per ha) x No.of seeds/hill x Test weight (g) x 100}}{\text{1000 x 1000 x Germination percentage(\%)}}$$

SOWING METHODS

Broadcasting: Broadcasting is otherwise called as random sowing. Literally means 'scattering the seed. Broadcasting is done for many crops. Broadcasting is mostly followed for small sized to medium sized crops. This is the largest method of sowing followed in India, since; it is the easiest and cheapest and requires minimum labours. To have optimum plant population in unit area certain rules should be followed.

• Only a skilled person should broadcast the seeds for uniform scattering.
• The ploughed field should be in a perfect condition to trigger germination.

The seeds are broadcasted in a narrow strip and the sowing is completed strip by strip. To ensure a good and uniform population, it is better to broadcast on either direction. This is called criss-cross sowing. If the seed is too small, it is mixed with sand to make a bulky one and for easy handling. seeds are mixed with sand at 1:15 or 1:10 ratio and sown. In certain cases, the person sowing will be beating the seeds against the basket for uniform scattering. After broadcasting, the seeds are covered gently either using a country plough with a very shallow ploughing or some wooden planks (boards / levelers) are used to cover the surface. In some cases, tree twigs or shrub branches are used. If the seeds are large, levelers collect the seeds and leave in the other side. Comb harrow is the best used one.

Disadvantages
- All the seeds broadcasted do not have contact with the soil. 100% germination is not possible.
- Enhanced seed rate is required.
- Seeds cannot be placed in desired depth. Desired depth ensures perfect anchorage. Lodging (falling down) is common in broadcasting.

Dibbling: This is actually line sowing. Inserting a seed through a hole at a desired depth and covering the hole. Dibbling is practiced on plain surface and ridges and furrows or beds and channels. This type of sowing is practiced only under suitable soil condition. Rice fallow cotton is dibbled on a 2-plain surface. The seeds are dibbled at 2/3rd from top or 1/3rd at bottom of the ridge. Before sowing, furrows are opened and fertilizers are applied above which seeds are sown. The seeds do not have contact with the fertilizers. This is done for wider spaced crops and medium to large sized seeds. Both beds and

channels; and ridges and furrows come under line sowing. While earthing up, the plant occupies middle of the ridge. Earthing up is essential for proper anchorage of the root system. Advantages of line sowing are, (i) uniform population, (ii) better germination, (iii) reduced seed rate.

Dibbling (Line sowing)	Broadcasting (Random sowing)
Costlier	Cheaper
Takes considerable time	Quickest and time saving
Fixed seed rate	Higher seed rate
Mechanization is possible, e.g. weeding, harvesting	Not possible
Uniform utilization of resources (land, water, light, nutrient, etc.)	Resource utilization is un-uniform

Sowing behind the plough: Sowing behind the plough is done by manual or mechanical means. Seeds are dropped in the furrows opened by the plough and the same is closed or covered when the next furrow is opened. The seeds are sown at uniform distance. Manual method is a laborious and time-consuming process. A seed drill has a plough share and hopper. Seeds are placed on hopper. Different types of seed drill are available.

Advantages: i) The seeds are placed at desired depth covered by iron planks, ii) except very small, very large seeds most of the seeds can be sown.

Drill sowing (or) Drilling: Drilling is the practice of dropping seeds in a definite depth covered with soil and compacted. In this method, sowing implements are used for placing the seeds into the soil. Both animal drawn Gorus and power operated (seed drills) implements are available. Seeds are drilled continuously or at regular intervals in rows. In this method, depth of sowing can be maintained and fertilizer can also be applied simultaneously. It is possible to take up sowing of inter crops also. It requires more time, energy and cost, but maintains uniform population per unit area. Seeds are placed at uniform depth, covered and compacted.

Transplanting: This method of planting has two components, a. nursery and b. transplanting. In nursery, young seedlings are protected more effectively in a short period and in a smaller area. Management is easy and economical.

Advantages

- Can ensure optimum plant population
- Sowing of main field duration, i.e., management in the main field is reduced
- Crop intensification is possible under transplanting

Disadvantages

- Nursery raising is expensive
- Transplanting is another laborious and expensive method

Age of seedlings is 1/4th of the total duration of the crop. If the total duration is 16 weeks, four-week period (1 month) is under nursery beds. Nursery age is not very rigid, e.g., thumb rule – 3 months crop – nursery duration 3 weeks, minimum 4 months – 4 weeks minimum period; 5 months 3 – 5 weeks. After the nursery period, seedlings are pulled out and transplanted. This is done on the main field after thorough field preparation or optimum tilth. The seedlings are dibbled in lines or in random. Closer spaced crops are mostly raised in random method even after nursery, Ex. rice and finger millet. For vegetables, desired spacing is required during transplanting. Transplanting shock is a period after transplanting, the seedlings show no growth. This is mostly due to the change in the environment between root and the soil. The newly planted seedlings should adjust with new environment. It is for a period of 5-7 days depending upon season, crop, variety, etc. At higher temperature, dehydration is possible and leaves dried out. Area required for nursery normally is 1/10th of the total area.

Germination

- Germination is a protrusion of radicle or seedling emergence.
- Germination results in the rupture of the seed coat and emergence of seedling from embryonic axis.

Factors affecting seed germination

1. **Soil:** Soil type, texture, structure and microorganisms greatly influence the seed germination.
2. **Moisture:** When the seeds do not get required moisture in the soil, the viability is lost. When the moisture is excess after germination, it will lead to rotting of the sprouts.
3. **Temperature:** When it is above and below the optimum temperature, the germination rate will be affected.
4. **Light:** The most effective wavelength for promoting germination is red (662 nm) and 730 nm inhibits germination.
5. **Soil condition:** (a). Tilth is the most important soil factor influences on germination of seed. Small seeds require fine tilth whereas, moderate and larger seeds require medium and coarse tilth soils, respectively. (b). Depth of sowing: The seeds should be placed at optimum depth. When the seeds are placed at deeper layer, they have to spend more energy for germination. When it is placed on soil surface, it will be taken away by birds/worked away. The thumb rule is to sow seeds to a depth of approximately 3 to 4 times diameter of the seed. The optimum depth of sowing for most of the field crops ranged between 3 and 5 cm depth. The seeds sown should be protected from rodents or birds before germination by employing labourers to scare the birds at least for three days after sowing.

Crop stand establishment: Good crop establishment is one of the most important features in better crop production. The better crop establishment is in turn expressed as optimum plant population in fields. Number of plants per unit area in the cropped field is called as plant population.

Optimum plant population: It is the number of plants required to produce maximum output or biomass per unit area. Any increase beyond this stage results in either no increase or reduction in biomass. Importance of plant population

- Yield of any crop depends on final plant population.
- The plant population depends on germination percentage and survival rate in the field.
- Under rain fed conditions, high plant population will deplete the soil moisture before maturity, whereas low plant population will leave the soil moisture unutilized.
- When soil moisture and nutrients are not limited high plant, population is necessary to utilize the other growth factors like solar radiation efficiently.
- Under low plant population, individual plant yield will be more due to wide spacing.
- Under high plant population, individual plant yield will be low due to narrow spacing leading to competition between plants.
- Yield per plant decreases gradually as plant population per unit area is increased, but yield per unit area increases up to certain level of population. That level of plant population is called as optimum population.
- So, to get maximum yield per unit area, optimum plant population is necessary. So, the optimum plant population for each crop should be identified.

EARTHING UP AND HOEING

Earthing up: A technique where soil is drawn up around the base of a plant to keep it stable in windy weather or for better tuberisation in tuber or root crops or from avoiding pest attack.

Hoeing is the act of digging, weeding, etc. with a hoe. This allows shallow hoeing to kill the weeds without bringing new seeds to the soil surface. Shallow hoeing also reduces root damage to the crop.

Advantages of hoeing and earthing up

1. Earthing up creates ridges and furrows in the crop field which later on serves the purpose of irrigation channel.
2. Earthing up reduces weed growth and population.
3. Earthing up increasing the number of tubers in potato and prevents solarization of developing tubers.
4. The initiation of rhizomes in turmeric and ginger are restricted.
5. The stolons and the tubers of potato are covered with earth.

GRADING

Grading is the process of dividing the products into lots which are similar characteristics in shape and size, type, weight, quality and performance etc. Products of different qualities should be separated into groups or lots and similar quality products are put into a grade. There are two types of grading; one is fixed grading which refers to storing out of goods on the basis of standard (size, quality etc) already set, to be followed from year to year. Next, variable grading refers to various standards for goods from year to year.

The importance of grading is similar to the importance of standardization. They are easy sales, wider market, no risk, satisfaction, goodwill, easy claims against losses, easy loan facility, reasonable price, low transport cost, reduce sales cost, product information, mass production etc.

Bases for standardization and grading

a. Quantity: Quantity is one of the important bases for the standardization and grading of the product. The standard weights and measures are kilo, meter, litre etc. That determine quantity, which ensure smooth marketing operation. They are enforced by the government and its local bodies.

b. Size: This is another important base for the standardization and grading of the product. Size helps to determine the standard and grade of the product. Readymade garment, shoes, nut-belt, pipe, screw, etc. are sold in size standards.

c. Quality: Another base for the standardizatation and grading of the product is its quality. It is difficult to establish the standard. However high, medium and low quality are the bases for this purpose. Furniture, food items, cotton and medicines etc. are classified under this basis.

d. Colour: Some of the products are also standardized and graded on the basis of their colour. Mostly, agricultural products such as vegetables and fruits are standardized and graded on this basis.

Grade designations and quality of Cardamom Whole Capsules

Grade designation	Quality (Special characteristics)								
	Organic Extraneous matter	Inorganic extraneous	Empty and malformed	Immature & shrivelled	Blacks and splits	Mass in g/1	Moisture % (m/m)	Total ash on dry	Volatile oil % (ml. 100

	% (m/m) (Max.)	matter % (m/m) (Max.)	capsules per cent by count (Max.)	capsules % (m/m) (Max.)	per cent by count (Max.)	(Min.)	(Max.)	basis % (m/m) (Max.)	gm) (Min.)
Special	1.0	0.5	2.0	2.0	Nil	435	11.0	8.0	3.5
Standard	2.0	1.0	5.0	5.0	10.0	385	12.0	9.5	3.0
General Characteristics									

(1) Cardamom capsules shall be dried, nearly ripened fruits of *Elettaria cardamomum* (L).
(2) Capsules shall be oblong in shape with a rounded part or three cornered and having ribbed appearance.
(3) Capsules shall be well formed and contain sound seeds.
(4) Capsules shall have characteristic odour and shall be free from foreign odour or flavors, including those of rancidity and mustiness.
(5) Color of the capsules may be (a) Light Green (b) Green (c) Deep Green or (d) pale Brownish, Capsules shall be packed according to the color group and it shall be indicated on the label. At least 95% of the capsules shall correspond to the respective color group.
(6) In addition to grade, cardamom may be marked as described below. This marking shall be done only when the product is produced only in the particular area.

(a) Alleppey Green Extra Bold (AGEB)	when retained on sieve 7.0 mm having holes of diameter	
(b) Corg Green Extra Bold (CGEB)	-do-	8.0”
(c) Alleppy Green Bold (AGB)	-do-	6.0”
(d) Corg Green Bold (CGB)	- do-	7.5”
(e) Alleppy Green Superior (AGS)	-do-	5.0”
(f) Corg Green Superior (CGS)	-do-	6.0”

(7) Capsules shall be free from added coloring matter
(8) It shall be free from mould growth and living insects and practically free from dead insects, insect fragments and rodent contamination.
(9) It shall comply with restrictions in regard to Aflatoxins, Metallic Contaminants, Insecticide or Pesticide residue, poisonous metals, naturally occurring Contaminants, Microbial load and the like as specified by the Codex Alimentarius Commission or as per buyer requirements for Export purposes and the Prevention of Food Adulteration Rules, 1955 for domestic trade.

EXTRACTION OF ESSENTIAL OILS

Distillation or Hydro distillation: It is most commonly used method of extraction. It is defined as separation of the components of a mixture of two or more liquids by virtue of differences in their vapour pressure. There are three methods of hydro- distillation.

(i) **Water distillation:** In this method plant material comes directly in contact with the boiling water. Through this method, powdered material like almond and others like rose petals and orange blossom are distilled.
(ii) **Water and steam distillation:** In this method plant material is supported on a perforated grid with some distance above the bottom of still, which is filled with water. In this method steam is fully saturated, wet and never super-heated. It is employed for seeds and roots.
(iii) **Steam distillation:** In this method saturated or super-heated steam is introduced through open or perforated coils below the charge or above the grid. This method used for herbs and leaf material.
(iv) **Combination** is the process of preparation of raw material for distillation. The thick and woody plant material is fragmented before distillation. Combination apparatus necessary for this operation are of various designs.

Enfleurage or Cold Fat Extraction: This process is applied where the distillation may have deleterious effect on the essential oil through hydrolysis, polymerization and resinification. Where delicate oil is lost in high volume of water or where flowers continue to produce fragrance after the harvest e.g. Jasmine and tuberose. An enfleurage process is carried out in cool cellars and fat base (corps) is prepared for adsorption of fragrance. Rectangular wooden frame with glass fittings are coated with fat for spreading the fresh flowers in lower surface and fat adsorption on upper surface. Normally mixture of one part of highly purified tallow (ox or sheep fat) and two parts lard (Fat of swine) gives required corps. Flowers are charged after 24 hours and saturated fat is removed, which is called pomade.

Maceration or Hot fat extraction: The flowers, which stopped their fragrance after harvest like rose, orange, violet and *Acacia* are extracted by maceration. In this process batch of hot fat is systematically treated with several batches of flowers until it becomes quite saturated with flower fragrance. Fragrant fat is called pomade. For every batch, extraction lasts for one and half hours. On commercial scale 80 kg of corps is heated to about 80^0C temperature and charged with 20 kg of fresh flowers each time.

Solvent extraction: It is comparatively a recent process in which all types of perfumes are extracted with the help of volatile solvents like petroleum ether, chloroform. Fresh flowers are charged into specially constructed extractor at room temperature and treated carefully with purified solvent. Solution is pumped out in an evaporator and condensed.

Expression: This method involves squeezing any plant material at great pressure in order to press out the oils or other liquids e.g. Citrus oil from rinds and juices. Oil is separated from juice by centrifuging.

Super critical fluid extraction (SCFE): It is most recent method of extracting essential oils from the material of plant origins, where fragrance and flavour ingredients resemble their source. The raw material is enclosed in a cylindrical container with porous ends, which is located in the extraction chamber. The temperature and pressure are selected (above its critical temperature at 31^0C and pressure 73.8 bars) according to the material and desired end product. Super critical carbon dioxide circulates through the plant material, dissolving the essential oil. SCCO is an excellent solvent for a wide range of natural substrates.

Terms related to essential oils:

Absolute: It is a perfume material highly concentrated and it is entirely alcohol soluble.

Concrete: It is non-purified form of essential oil obtained mostly by means of solvent extraction; plant pigment and waxes are present. From concrete 45-55% absolute is recovered.

Extrait: It is an alcoholic solution of odorous part of pomade. This is an intermediate product in the preparation of absolute from pomade.

Fixative: The materials which slow down the rate of evaporation of more volatile material in perfume composition e.g., Sandal wood, Patchouli.