



INTERNATIONAL PEPPER COMMUNITY



**Good Agriculture Practice (GAP)
Pepper (*Piper nigrum* L.)**

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**INTERNATIONAL PEPPER COMMUNITY
GOOD AGRICULTURAL PRACTICES FOR PEPPER**

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PARAMETER	REQUIRED PRACTICE	RECOMMENDED PRACTICE
1. SITE SELECTION – Pepper is best grown on well-drained land in areas with a tropical climate and adequate rainfall.		
1.1 Land Slope	The slope for any land to be planted with pepper should be less than 25°.	A slope not exceeding 10° is recommended for better soil conservation, easier harvesting and farm management.
1.2 Altitude	Pepper holdings should not be planted on land higher than 1,200 m above mean sea level.	Land with altitude of less than 1,000 m above mean sea level is preferred for good pepper cultivation.
1.3 Rainfall	Pepper should be planted in areas that receive at least 1,750mm of rainfall annually.	Pepper cultivation is best under rainfall of 2,000–3,000mm. A clear dry season is advantageous for flower induction. Where there is a prolonged dry period, irrigation may be required.
1.4 Temperature	Pepper should not be grown in areas where temperatures can fall below 10° C or rise above 40° C.	Generally temperatures should be within the range of 25° C to 35° C, with low variation within a day.
1.5 Humidity	Pepper should be grown in areas where humidity is high.	Relative humidity should be over 70%.
1.6 Location	Pepper holdings should be located on suitable land, taking into consideration the previous land use, adjacent land use and accessibility. Land adjacent to the pepper holding should be free from pests and diseases.	<p>Land previously planted with cocoa or rubber should be avoided, as some of these areas may be infected with <i>Fomes</i> spp. <i>Fusarium</i> spp. or <i>Phytophthora</i> sp..</p> <p>Avoid land where the adjacent plot has been intensively cultivated with high use of agricultural chemicals as there may be leaching of chemicals into the soil through water run off.</p> <p>Where such land is to be used, it should be kept fallow or planted with suitable annual crops for reasonable period.</p> <p>Cover crops may be planted and ploughed back to increase organic matter and beneficial microbial activities.</p>



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2. SOIL MANAGEMENT - Pepper grows best on slightly acidic sandy loam soils, with adequate essential plant nutrients.		
2.1 Soil Depth	The soil depth should be at least 0.75 m	Soil depth may be 1.0 m or more
2.2 Soil Characteristics	Soils should be analysed to determine pH, nutritional status and physical properties and soil amelioration should be based on such analysis.	Recommended soil characteristics are sandy loam clay, to clay loam or lateritic with adequate essential plant nutrients and suitable pH.
2.3 Tillage	Tillage should be kept to a minimum, to prevent disturbance of the root system and soil erosion. The area at the base of the plant should be kept free of weeds or cover crops.	There should be minimum tillage of interspaces to reduce disturbance of the root system. Cover crops should be planted in the interspaces, leaving an area at the base of the plant that is as wide as the canopy, generally about 60 cm radius, kept clean by hand weeding.
2.4 Slope Management	Slope areas should be terraced and contour bunds constructed to minimise soil erosion.	Individual terracing can be done for each vine, ensuring that the terraces slope inwards.
2.5 Soil Acidity	Soil acidity should be checked from time to time and liming done when required.	If pH is lower than 5, then liming is required, to the level where pH reaches near neutral.
2.6 Nutritional Status of the Soil	Addition of soil nutrients should be based on soil analysis and requirement.	Wherever possible, organic matter in the form of farm manure, compost or leaf litter should form a major component of nutritional inputs.
2.7 Physical Properties	Soils for pepper should be sandy loam to clay loam or lateritic, porous with good water holding capacity and should not be water logged.	Where necessary soil amelioration in the form of minimum tillage and application of organic matter should be undertaken to change the structure and texture of the soil.



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<p>3. WATER MANAGEMENT – Pepper is generally a rain fed crop grown in areas with high rainfall and so does not require irrigation with good water management. With a single flowering season each year, pepper holdings do not require irrigation under normal conditions, except perhaps during the initial establishment period, in drought prone areas.</p>		
<p>3.1 Ground and Soil Water Management</p>	<p>In dry areas, maximise water infiltration and minimise run-off by proper use.</p> <p>In areas where a pronounced dry season may occur, a source of water may be needed.</p>	<p>Conservation measures include contour planting, contour bunding or terracing to prevent run-off on slopes over 10°. On level land, drainage channels of sufficient size should be dug where necessary to prevent water logging.</p> <p>Water may be required for production of planting materials, to facilitate establishment of young plants in the field and for spraying plant protection chemicals for control of pests and diseases. Water is also needed for processing pepper, particularly for white pepper production. If a river or a pond is available nearby, it can be a suitable water source; alternatively, a well may be dug to provide adequate water for on-farm activities.</p> <p>Rain water harvesting is also recommended.</p>
<p>3.2 Water Retention Capacity</p>	<p>Soil structure should be improved where possible to enhance the water retention capacity.</p>	<p>Addition of organic matter in the form of mulches, composts, and green manure and planting suitable cover crops may be undertaken to improve soil structure, permeability and water retention.</p>
<p>3.3 Water Contamination</p>	<p>Ensure that water used on the farm is free from contamination and that production inputs, including waste or recycled products of organic, inorganic and synthetic nature do not contaminate water sources.</p>	<p>Care should be taken to ensure that water used for irrigation (where needed) is free from unintentional contamination, particularly from pesticide residues and agro-industrial pollutants in surface water. Where agricultural chemicals and fertilisers are used, every effort must be made to deliver the required amount to the pepper plant without affecting water run-off from the holding. Where weeding is required, hand weeding should be adopted wherever possible, to avoid the use of chemical sprays that may be washed off into nearby water sources.</p>



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		Where white pepper production requires soaking green pepper in water for a few days, care must be taken to ensure that the waste water does not pollute water sources.
3.4 Monitor Crop and Soil Water Status	Adopt techniques to accurately schedule irrigation and adopt water-saving measures and re-cycling where possible.	A primary consideration for determining suitability of land for pepper production should be rainfall and water availability. In drier, marginal areas that have been planted with pepper, efforts to conserve water take on special significance. Clearing large tracts of land for pepper planting may have an undesirable impact on soil water status and care should be taken to preserve wind breaks and suitable shade, particularly in dry areas. Water saving measures, such as drip irrigation and pitcher irrigation may be adopted especially during the establishment phase, where required.
4. INTEGRATED CROP MANAGEMENT		
4.1 Selection of Planting Materials	<p><u>General Requirements</u> Selected planting materials should come from varieties that are disease and pest resistant, vigorous and high yielding, with good productivity with respect to the final product.</p>	<ul style="list-style-type: none"> • Varieties chosen should be disease and pest resistant / tolerant or less susceptible; • Varieties chosen should be high yielding, with good yields in terms of final output; • Chosen varieties should root and grow vigorously. • Examples of recommended varieties: <ul style="list-style-type: none"> - Petaling 1, Kuching (high yielding but susceptible to foot rot) - Natar 1 (tolerant to foot rot) - Semongok Aman (high yielding, less susceptible to foot rot, black berry & weevil)



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		-IISR Thevam, IISR Shakthi (tolerant to <i>Phytophthora</i> sp. and high yielding); -IISR Pournami (tolerant to the nematode <i>Meloidogyne incognita</i> and high yielding); -IISR Girimunda (resistant to anthracnose and high yielding). - Panniyur 1-7, Subhakara, Sreekara (high yielding) - PNM 1 (high yielding)
	Selection of planting materials should also give consideration to requirements of specific locations, such as: <ul style="list-style-type: none"> • High Elevation • Climate: dry areas • High shade (intercropping) 	Examples of recommended varieties are: IISR Thevam, IISR Girimunda; Panchami, IISR Malabar Excel, Panniyur 1, Panniyur 5 Natar 1, Natar 2, Petaling 2 (drought resistant) Panniyur 5
	The intended final product may also have specific requirements such as for: <ul style="list-style-type: none"> • Black pepper • White pepper • For extraction • Bold berries 	Examples are: All high yielding varieties: Petaling 1, Petaling 2, Chunuk RS, LDK-RS, Bengkayang LU, Kuching, Semongok Emas, Panniyur 1, Panniyur 5, Balankotta, Valiyakaniakadan With high oil/oleoresin content – PL2, IISR Malabar Excel Varieties that have good berry size and mature uniformly - Panniyur 1



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	<ul style="list-style-type: none"> • Green pepper <p>A mixture of varieties / lines should be planted in a holding, to safeguard against crop loss in the absence of resistant varieties.</p>	<p>All varieties that have good berry size and mature uniformly.</p> <p>Varieties recommended by national agencies, as being suitable for the local agro-climate, soil conditions and production constraints, should be planted where possible.</p>
4.2 Quality Planting Material	<p>Planting material should be sourced from healthy plants from pest and disease-free areas.</p>	<p>Planting material (cuttings) should be carefully selected from healthy vines from pest and disease-free areas, preferably from vines that are less than 3 years old.</p> <p>Preferably, terminal (orthotropic) shoots should be used for planting after rooting in nurseries. Cuttings from terminal shoots bear fruits earlier and are likely to be more vigorous.</p> <p>Runners may be used for rapid multiplication of new varieties.</p>
4.3 Rooting of Cuttings in Nurseries	<p><u>1. Taking cuttings:</u> Shoots for rooting should be taken from pest and disease-free vines from disease-free gardens.</p> <p><u>2. Type of shoots:</u> Base runner shoots or orthotropic, single-node cuttings with one leaf from orthotropic shoots may be used for initial rooting.</p> <p><u>3. Rooting:</u> Cuttings should be rooted in nursery beds or propagated by other appropriate methods before transfer to the field.</p> <p><u>4. Rooting mixture:</u> Soil, sand, and organic matter should be mixed to form the rooting mixture. Adopt suitable procedures to ensure that the rooting mixture is free of pathogens, at least by soil solarisation.</p>	<p>Preferably cuttings should be taken from vines that are less than 3 years old.</p> <p>3-5 node orthotropic shoots are preferred.</p> <p>Cuttings may be soaked in a suitable rooting agent (1-2% sugar solution or IBA) to enhance rooting. Where specific pest or disease conditions prevail, appropriate steps should be taken to ensure that cuttings are free of infections.</p> <p>Appropriate compositions of rooting mixtures may be used such as 2:1:1 or 1:1:1 (soil:sand:organic matter) depending on the clay composition. Solarisation or steam sterilisation may be used to ensure that the mixture is pathogen free. Immediately after soil sterilisation, fortification of rooting mixture may be done, using beneficial organisms e.g. <i>Trichoderma</i> spp., <i>Pseudomonas fluorescens</i>, vesicular arbuscular mycorrhizal (VAM)</p>



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		fungi, <i>Azospirillum</i> spp., phosphorous solubilising bacteria (PSB).
	<u>5. Nursery sheds:</u> Rooting should be done in nursery sheds to protect against sun and rain and provide adequate humidity.	Nursery sheds should allow between 60-70% light transmission. Nurseries may have insect-proof netting to ensure protection of planting materials. Nursery sites should be changed preferably after 2-3 years.
	<u>6. Nursery hygiene and maintenance:</u> Nurseries should be disease and pest-free. Constant monitoring and inspection should be carried out including inspection of root systems. Disease-infected or pest-infested cuttings should be removed and destroyed. After removing the affected cuttings and pests, appropriate treatment should be applied to prevent further spread. Nurseries and surrounding areas should be weed-free. Regular watering is required to ensure that adequate soil moisture is maintained in nursery mixtures. <u>7. Transfer to the field:</u> Rooted single-node orthotropic shoot should have 5-7 nodes at time of field planting.	Where pest or disease incidence is noted, recommended treatments include: <ol style="list-style-type: none"> 1. Neem products 2. White oil 3. Copper-based fungicides such as Bordeaux mixture Where specific pest or disease conditions prevail, appropriate steps should be taken to ensure that nursery plants are not affected. Transfer to the field is done when 5-7 nodes have developed. Cuttings raised from runner shoots should be 50cm long with 5-10 leaves before field planting.
4.4 Records	Comprehensive records of all chemicals and treatment schedules applied in the nursery and during planting should be maintained.	
4.5 Supports	<u>Live Supports</u> Live supports used should be at least 2 m long with a minimum of 5 cm diameter girth. Live supports should be planted well before planting pepper at a depth of 30 cm. The distance between the live support and the pepper plant should be adequate to prevent root competition, depending on the type of live	Recommended live supports are: <ol style="list-style-type: none"> 1. <i>Gliricidia</i> spp. (vegetatively propagated) 2. <i>Ailanthus malabarica</i> (seed propagated) 3. <i>Grevillea robusta</i> (seed propagated) 4. <i>Garuga pinnata</i> (seed propagated)



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	<p>support and the type of pepper cutting used, approximately between 10 – 60 cm.</p> <p><u>Other Supports</u> Dead wood, concrete, brick or other supports may be used in specific locations or circumstances, but are not encouraged.</p>	<p>Trees with economic value such as arecanut, coconut or jackfruit may also be used.</p>
4.6 Spacing	<p>Spacing should be determined based on the type of planting, type of support and topography.</p>	<p>Where live supports are used, spacing should be 2.5m x 2.5m (1,600 vines/ha) or 3.0m x 3.0m (1,100 vines/ha).</p> <p>Closer spacing may be used for non-living supports.</p>
4.7 Land Preparation	<p>The size of planting pits should be at least 45cm x 45cm x 45cm.</p>	<p>Recommended planting pit size is 45cm x 45cm x 45cm to 60cm x 60cm x 60cm. Pits should be dug and solarised together with top soil and organic manure for at least 40 days before planting.</p> <p>Dolomite may be added when necessary. Soil in planting pits may be improved by addition of organic matter such as leaf mulch, farm manure and superphosphate/rock phosphate and fortified with beneficial microorganisms such as <i>Trichoderma</i> spp., VAM and <i>Pseudomonas fluorescens</i> and phosphorus solubilising bacteria in appropriate doses. Where VAM is applied, phosphates should not be applied.</p>
4.8 Cover Crops	<p>Cover crops should be planted in the inter-spaces between pepper vines to reduce soil erosion and to improve soil structure.</p>	<p>The type of cover crop to be planted is dependent on the terrain and soil conditions. Recommended cover crops include:</p> <ol style="list-style-type: none"> 1. <i>Arachis pintoi</i> 2. <i>Centrosema pubescens</i> 3. <i>Calapogonium muconoides</i> <p>Fodder crops and other economic crops that can provide soil cover are also recommended.</p>



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4.9 Other Economic Crops	To ensure economic sustainability of pepper holdings, other economic crops should be planted with pepper.	In mono-cropped areas, other suitable economic crops that require minimum tillage may be planted in the inter-spaces when the pepper vines are still young. Where there is adequate space between vines or on the boundaries, other plants that give returns to farmers may be cultivated.
4.10 Planting	<p>Rooted cuttings should be planted in prepared pits at the onset of the rainy season. Young vines should be tied loosely to the support, and shaded with suitable plant material.</p> <p>Mounding should be carried out after planting, to prevent water stagnation and root exposure.</p>	In areas with low rainfall, or if there is absence of rain after planting, provide supplementary irrigation for the first 6 to 9 months. Where areas become water-logged after planting, provide adequate drainage.
4.11 Management of Young Vines	<p>Pruning should be done to encourage lateral shoot production to obtain a thick and uniform canopy and to remove unwanted shoots.</p> <p>Unwanted water-shoots should be pruned.</p> <p>Terminal shoots should be tied to the supports to prevent dislodging of the shoots.</p> <p>The first flush of flowers should be removed to encourage vegetative growth.</p> <p>Clean weeding by hand should be carried out at the base of the young plant.</p> <p>Severely diseased vines should be removed and replanting done.</p>	<p>Three rounds of pruning should be carried out during the immature phase of vine growth. First pruning of terminal shoots is done 6-8 months after planting. The second pruning is done when the vines are about a year old, and the third pruning when the terminal shoots have reached the top of the supports.</p> <p>An area of about 60 cm radius around the base of the pepper vine should be kept free of weeds or any cover crop. Application of leaf mulch or other organic matter to the base of the plant may also prevent the growth of weeds.</p> <p>Where vines may have died because of disease, ensure that dead vines are uprooted and destroyed. The sites may be drenched with appropriate</p>



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		treatment to suppress diseases and solarised to ensure that they are pathogen free. Replanting may be done 6 months after treatment.
4.12 Shade Management	Live supports should be pruned at least twice a year.	Live supports should be pruned as often as necessary. It is recommended that pruning of live supports be done before fertiliser application to maximise exposure to sunlight so as to encourage maximum uptake of nutrients.
5. NUTRITION - Soils should be analysed for nutrition status to determine nutrient requirements for growth and productivity of vines.		
5.1 Organic Nutrition (a) for young vines (b) for mature vines (vines with stable yields)	For organic nutrition of pepper, adequate green manure in the form of loppings from pruning of live supports and farm manure should be applied to the young vines in two applications before the rainy season. For organic nutrition of pepper, adequate green manure in the form of loppings from live supports, as well as other farm manure should be applied to the mature vines in two applications before the rainy season.	For young vines, 5-10 kg of organic manure may be applied in two or more applications, preferably at the onset of the rainy season. Wood ash may be added as a supplement for potassium and rock phosphate for phosphorous. Bio-fertilisers such as <i>Azospirillum</i> sp., <i>Azotobacter</i> sp. and PGPRs (Plant Growth Promoting Rhizobacteria) may also be used for better crop health. For mature vines, 10-15 kg of organic manure may be applied in two or more applications, preferably at the onset of the rainy season. Wood ash may be added as a supplement for potassium and rock phosphate for phosphorous. Bio-fertilisers such as <i>Azospirillum</i> sp., <i>Azotobacter</i> sp. and PGPRs may also be used for better crop health.
5.2 Integrated Nutrition (a) for young vines	Adequate nutrition to ensure vegetative growth and plant health must be applied to the young vines, based on the soil requirements.	Generally, during the first year of growth, 5 kg of organic matter may be applied to the vines. Bio-fertilisers such as <i>Azospirillum</i> sp., <i>Azotobacter</i> sp. and PGPRs may also be used for better crop health. At least a total of 300g/ year of inorganic fertiliser, such as 12:12:17 plus TE (Trace Elements) may be applied in 4 split applications of 30g, 60g, 90g, and 120g at 3 month intervals. This may vary from location to location.



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(b) for immature vines (bearing vines that are not fully grown)	Adequate nutrition to ensure vegetative growth and flower initiation must be applied to the immature vines, based on the soil requirements.	Generally, for immature vines, 5-10 kg of organic matter may be applied to the vines. Bio-fertilisers such as <i>Azospirillum</i> sp., <i>Azotobacter</i> sp. and PGPRs may also be used for better crop health. At least a total of 600g/ year of inorganic fertiliser, such as 12:12:17 plus TE, to be applied in 4 split applications of 150 g each at 3 month intervals. This may vary from location to location.
(c) for mature vines (vines with stable yields)	Adequate nutrition to ensure plant health and flower initiation must be applied to the mature vines, based on the soil requirement.	Generally, for mature vines, 10-15 kg of organic matter may be applied to the vines. Bio-fertilisers such as <i>Azospirillum</i> sp., <i>Azotobacter</i> sp. and PGPRs may also be used for better crop health. At least a total of 1-1.5kg/ year of inorganic fertiliser. The inorganic fertiliser, such as 12:12:17 plus TE, should be applied in 4 split applications at 40% , 30% , 20% , and 10% at monthly interval upon the onset of the rainy season. This may vary from location to location.
5.3 Application of Fertiliser	Fertiliser application must be done carefully to avoid damage to roots of pepper vines.	When compost or organic fertilisers are to be applied, scrape the soil surface around the circumference of the canopy. Broadcast the fertiliser along with the bio-fertilisers with the recommended dosage and then cover it with soil taken from the inter-spaces. Ensure sufficient moisture availability during fertiliser application.
6. PEST AND DISEASE MANAGEMENT - Integrated Pest & Disease Management principles need to be applied at all stages to maximise productivity and minimise crop loss.		
6.1 Surveillance, Identification and Immediate Action	Constant surveillance is necessary to identify problems at an early stage and take immediate control where any incidence of disease or pest is noticed.	Farmers should be trained to recognise disease symptoms and pest damage that affect pepper vines. Careful inspection of the vines should be done regularly. Where any incidence of disease or pest is noted, steps must be taken to treat and remove the affected part or vine.



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6.2 Preventive Measures	<p>Diseased plants or affected portions of the plant should be removed from the holdings, and burned.</p> <p>Prophylactic measures must be taken for the plants surrounding the infected plant for diseases such as virus disease, foot rot, root rot, yellow wilt and slow decline. Steps should be taken to prevent contamination of healthy holdings.</p>	<p>Phytosanitary measures, such as physical removal of pests, affected plant parts, infected plants (virus-infected plants, severely disease-infected or pest-infested plants, including plants affected by <i>Phytophthora</i> sp. or slow decline/yellow wilt), should be undertaken. Implements used to remove the affected plants or plant parts should be cleaned or sterilised before use on other plants.</p> <p>Movement of workers in infected areas should be restricted. Fencing can be done to restrict movement into healthy holdings. Drains may be constructed to prevent disease spread between holdings and to prevent water stagnation. Farm implements used in one holding should not be used on other holdings.</p>
6.3 Host Resistance	Every effort should be made to use resistant or tolerant varieties where available.	Varieties that have been found to be resistant or tolerant and that are suitable for specific locations should be planted.
6.4 Cultural Practices for Pest and Disease Control	Various cultural practices that are known to help in preventing and controlling pests and diseases should be implemented in all pepper holdings.	<p>Shade regulation should be done to allow optimal light penetration, with pruning of live support trees done regularly.</p> <p>Limited weeding by hand may be carried out when necessary, in the inter-spaces before the cover crop is fully established and at the base of the plant.</p> <p>Cover crops should not be allowed to grow excessively.</p> <p>Pruning of the leaves at the base of the plant to 30cm above the ground surface should be practiced.</p> <p>Provision and maintenance of drains should be undertaken when and where necessary.</p>
6.5 Biological Control	Biological controls should be the first line of control for pests and diseases, when incidence is noticed and where an appropriate biocontrol agent is available.	<p>Maintain an environment conducive to the proliferation of biocontrol agents of pests and pathogens.</p> <p>Regular application of <i>Trichoderma</i> spp., <i>Pochonia chlamydosporia</i>,</p>



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		<p><i>Pseudomonas fluorescens</i> and other antagonistic microorganisms may be done.</p> <p>Recommended plant products and biocontrol agents for insect pests are: - Neem, tuba (<i>Derris</i> sp.), parasitoids, predators and entomopathogens.</p>
6.6 Chemical Control	Chemical control should be used as a last resort, and care should be taken to ensure that it does not affect the environment and it does not leave any pesticide residue. Chemicals used should be compatible with biological control agents.	Agrochemicals for control of pests and diseases may be used only when all other measures have been exhausted. Chemicals used should comply with permitted lists in the respective countries. Application of chemicals should follow recommended practices to ensure that the final product is free of residues, users are not affected by the chemicals and no environmental contamination takes place.
7. HARVESTING AND POST-HARVEST PRACTICES		
7.1 Harvesting and Handling of Green Pepper	<p>For black and white pepper, only mature pepper berries should be harvested.</p> <p>Spikes should be picked selectively.</p> <p>Harvesting rounds should be carried out frequently during the season.</p> <p>Berries that have fallen to the ground should be collected separately and should not be mixed with pepper berries from the vines. These should be processed separately for appropriate end uses.</p> <p>Harvested green pepper should be handled hygienically, collected and transported in clean bags or baskets to where it is to be processed.</p>	<p>For black pepper, spikes with one or two berries beginning to change to yellow may be picked.</p> <p>For white pepper, spikes should be fully mature, with one or two ripe berries.</p> <p>Greater frequency of harvest during the season will ensure that berries that are picked are more uniform. If picking is done only once or twice during the season, there will be greater likelihood of picking immature as well as over-ripe berries.</p> <p>Baskets or bags that have been used to hold agricultural chemicals should not be used for green pepper. Any container that is used should be cleaned thoroughly to ensure that it is free from any contaminants.</p>



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7.2 Black Pepper Processing	Pepper spikes should be threshed to separate berries from the stalks.	<p>Threshing of green pepper spikes may be done mechanically or manually. Where the quantity of pepper to be threshed is significant, mechanical threshing using one of the many types of threshers available is recommended.</p> <p>Care should be taken to ensure that berries are not damaged during threshing and that stalks are separated from the berries.</p> <p>Ensure that threshers are properly cleaned before use especially if they have not been used for a long period of time. Threshers should also be cleaned after use, at the end of the day.</p>
7.2.1 Threshing and Sieving	Threshed green pepper should be washed in clean water to remove field dirt, insects or other contaminants that may be present.	Washing pepper in clean running water is advisable. Where adequate water is not available, extra care must be taken to ensure that the harvested pepper is free from leaves, stems, stalks and other field matter.
7.2.2 Hot Water Treatment	Threshed green pepper should be sieved to separate small, immature berries and pinheads as these affect the quality of black pepper.	Sieving can be done mechanically or manually, using a 4mm mesh, with berries that pass through the mesh being set aside for drying separately.
7.2.3 Drying	Clean pepper should be soaked for between 1 to 2 minutes in water of 90° C to reduce contaminants, facilitate drying and improve appearance of the dried pepper.	Soaking of pepper can be done in wire mesh or rattan baskets immersed in boiling water. The water should be changed as necessary, as it becomes dirty with each immersion.
	Pepper should be dried at temperatures below 60° C, to prevent loss of volatiles, in clean surroundings, free from any possible contact with dust, dirt, farm animals and/or other possible sources of contamination. Black pepper should be dried to a moisture level below 12% if it is to be stored.	<i>Sun Drying:</i> Pepper may be dried in the sun, on clean drying platforms raised above the ground. The drying area should be fenced or otherwise protected from any pests or farm animals. Care must be taken to ensure that pepper is adequately dried and to prevent spoilage from mould or other contaminants, particularly when there is no sun.



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7.2.4 Packing	<p>Dried pepper should be packed in clean, dry bags that are free from any material that may contaminate the pepper.</p> <p>Where any substance to enhance product appearance or improve shelf life is applied, it must be food safe and should be declared to buyers.</p>	<p><i>Solar Dryers:</i> Solar dryers may be used to speed up the drying process and protect from dust and other contaminants without significantly increasing costs.</p> <p><i>Solid fuel dryers:</i> Dryers using wood chips, coconut waste and other on-farm waste materials may be used to hasten the drying process and prevent contamination. Care must be taken to ensure that the temperatures do not exceed 60^o C and that there is no smoke contamination.</p>
7.3 White Pepper Processing 7.3.1 Threshing and Sieving 7.3.2 Soaking	<p>Only fully matured pepper berries should be used to make white pepper.</p> <p>The pepper spikes should be threshed to separate the berries from the pepper stalks and then sieved to separate smaller berries.</p> <p>Green pepper berries should then be soaked in clean running water for up to 14 days or till the skin (pericarp) is soft and can be washed away.</p>	<p>Fresh pepper for making white pepper should be fully matured with at least one or two ripe berries on each spike.</p> <p>Mechanical threshing, with the threshed berries falling into a container with water, is recommended as this will prevent discolouration of the pepper.</p> <p>Small berries may be dried to make black pepper.</p> <p>Soaking may be done in bags or baskets placed in streams or in tanks with weights placed on the containers to ensure that they are fully immersed. If soaking is done in streams, there should be no upstream activity which can become a source of contamination to the pepper being soaked downstream.</p> <p>If soaking is done in tanks, the water should be changed at least every two days. Soaking for longer periods in stagnant water may cause the</p>



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		pepper to have an unpleasant smell. Bags should be turned over from time to time to ensure that all the pepper in the container fully undergoes the retting process.
7.3.3 Decortication	Pepper may also be decorticated mechanically after a short period of soaking to soften the skin.	Decorticating can be done using various types of equipment. Care must be taken to ensure that the berries are not damaged in the process. It is best that decorticating is done in water, or with flowing water, to prevent discolouration.
7.3.4 Washing	<p>Equipment for decorticating should be thoroughly cleaned before and after use.</p> <p>In cases where processing aids or specific chemical or biological treatments are used, they must be food-safe and should be declared to the buyers of the final product.</p> <p>After the skin has been removed, the pepper should be washed in clean water to remove any remnants of skin, before drying.</p>	During washing care must be taken to remove any remnants of skin that are left on the berries.
7.3.5 Drying	White pepper should be dried in the sun to get the desired creamy white colour. The drying area should be kept free of any source of contamination. In areas where the sunshine hours are inadequate or where rain can disrupt drying, other forms of drying may be used (solar dryers, solid fuel dryers, tray dryers, etc.) to complement sun drying. White pepper should be dried to at least 14% moisture before packing.	Adequate air flow is important to prevent mould and musty smells from developing. Where solid fuel or other dryers are used, care must be taken to ensure that temperature is kept below 60° C, to prevent browning and discolouration. During drying the pepper should be turned frequently to ensure uniform drying. Pepper that is to be stored should be dried to below 12% moisture level



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7.4 Cleaning, Packing, Storage and Handling	<p>Dried black or white pepper should be winnowed, sifted and cleaned to remove pieces of skin, stalks or other foreign matter.</p> <p>Clean dry pepper should be packed in clean dry bags or other suitable containers for storage and transport.</p> <p>Pepper should be stored in clean, dry, well ventilated stores, on pallets or raised floors, in areas free from pests such as rodents and insects.</p> <p>Care must be taken at all times to prevent contamination of the pepper during handling, particularly microbiological or chemical contamination.</p>	<p>When cleaning black or white pepper, care must be taken to ensure that all utensils and equipment used are clean and free from any possible source of contamination. Pepper may be winnowed to remove light pieces of skin or dust and sieved to remove pieces of leaf and stalks as well as small or broken berries.</p> <p>Care must be taken to ensure that pepper is not contaminated through the use of bags that have been previously used for fertilisers, agricultural chemicals or other materials. Bags should be thoroughly cleaned if necessary and carefully inspected to ensure that they are free of dirt or foreign matter. Pepper that is adequately dried, (i.e. below 12% moisture level) may be put in bags with polythene liners to prevent absorption of moisture.</p> <p>Pepper should not be stored together with agricultural chemicals or fertilisers that may lead to contamination. Pepper stores should be well ventilated but free from high humidity. Stored pepper should be regularly inspected for signs of pest damage or contamination.</p> <p>Workers handling pepper must take care to ensure that all equipment and utensils that come into contact with the pepper are clean and safe. Hands should be thoroughly washed before pepper is handled and clean gloves should be used where possible.</p>
7.5 Grading	<p>Pepper should be graded at farm level before sale, to ensure that the price received is commensurate with the quality.</p>	<p>For black pepper, moisture level, bulk density (grams per litre), mouldy berries and foreign matter content are the main considerations in determining grade or quality of pepper.</p> <p>For white pepper, quality may be determined by colour of the pepper, content of black or grey berries, moisture level and foreign matter content. IPC Standards for untreated black or white pepper, together with the relevant testing methods, may be used as a guide in determining quality of pepper.</p>



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PARAMETER	REQUIRED PRACTICE	RECOMMENDED PRACTICE
7.6 General Maintenance	All equipment, utensils and materials used for processing pepper should be cleaned before and after use and maintained in good working condition. Processing areas, drying areas and stores should be kept clean and free from contamination.	