Radish:

Introduction:

Radish is a fast-growing annual root vegetable in the Cruciferae family, desired for its culinary and cultural significance across many countries. The plant is valued for its thickened root and hypocotyl. Radish is associated with several potential health benefits, such as:

- Supporting Digestion
- Helping maintain healthy blood sugar levels
- Promoting skin & hair health
- Supporting liver & gall bladder function
- Aiding weight management

Season & States of cultivation:

Season-

In India, it is commonly cultivated during the Rabi season in the plains, while in hilly regions, the ideal growing season is from June to September. In areas with milder climates, like South India, radish cultivation is possible almost throughout the year, with April to June being the most suitable period for sowing.

States-

Radish is widely cultivated across various states in India: Uttar Pradesh**,** Punjab, Haryana, Bihar, West Bengal, Rajasthan, Madhya Pradesh, Maharashtra, Tamil Nadu, Karnataka, Andhra Pradesh, Telangana.

Climate:

Radishes germinate most effectively when soil temperatures range between 18–25°C. Radish prefers cool growing conditions. However, the ideal temperature for the growth of root & its development is ranging between 10 to 15^{o} C.

Soil:

Radish can grow in a variety of soil types, but it performs best in well-drained, loose, and fertile soil with a pH of 5.5 to 6.8. Sandy loam or soil rich in organic matter is ideal for proper root development. Heavy, clayey, or compacted soils can restrict root expansion, resulting in deformed, forked, or uneven radishes.

Seed Rate and Treatment:

Seed rate:

On average, about 4-6 kg of radish seeds are required per acre of land for sowing.

Seed Treatment:

Treat radish seeds with Thiram or Carbendazim @2–3g/kg of seeds and dry in shade for 30 minutes. Then apply bio-fertilizers like Azospirillum or PSB with jaggery solution. If needed, use Imidacloprid @5–7 ml/kg for pest protection. Sow within 24 hours for healthy growth and better yield.

Sowing Method:

Sowing can be done either by line sowing or the broadcasting method.
Spacing- Use row to row spacing of 45 cm and plant to plant spacing of 7.5 cm
Depth- For good growth sow seeds at a depth of 1.5 cm

Land Preparation:

Radish requires loose, friable, and well-aerated soil for proper root development. Deep tillage 20–25 cm with a mould board or disc plough, followed by harrowing, creates a fine tilth and smooth seedbed for uniform germination. In heavy soils, ridge or raised bed tillage ensures better drainage and root formation. Incorporate 7–10 tons/acre of well-decomposed cow dung during tillage to enhance soil fertility and improve soil structure.

Thinning:

Thinning is an essential step in radish cultivation to ensure proper root development and uniform growth. Once seedlings are about 2 inches tall (around one week old), thin them to 2–3-inch spacing to prevent overcrowding and poor root development.

Water Management:

Radishes thrive with consistent and sufficient moisture. Effective water management ensures the development of crisp, flavorful roots and helps prevent issues such as cracking, bitterness, and poor plant performance. Provide light irrigation immediately after sowing to ensure uniform germination. Depending upon soil type and climate, apply remaining irrigations at intervals of 6-7 days in summer and 10-12 days interval in winter month. Avoid excessive irrigation as it will leads misshape of roots and numerous hair growth. In summer season, provide pre-harvest light irrigation. It will keep root fresh and reduce pungency.

Nutrient Management:

Radish cultivation generally requires 20-40 kg of nitrogen (N)**,** 20 kg of phosphorus (P_2O_5)**,** and 20 kg of potassium (K_2O) per acre. For best results, phosphorus and potassium should be applied as a basal dose prior to sowing**,** along with half of the nitrogen @10-20 kg/acre to support early seed germination and root establishment. The remaining nitrogen @10-20 kg/acre should be applied as a top dressing 20–25 days after sowing**,** during the active root development phase, to encourage robust vegetative growth and enhance root quality. This nutrient management strategy promotes vigorous plant growth, improves root formation, and maximizes overall yield.

Weed Management:

Effective weed control in radish cultivation begins with deep ploughing and harrowing, help to eliminate existing weed seeds and roots, while soil solarization during summer can reduce weed seed viability in the topsoil. After sowing, pre-emergence herbicides like Pendimethalin can be use, mix 300-400 ml pendimethalin in 150 L of water, or Metolachlor can also be used as a pre-emergence herbicide, mix 400-600 ml of Metolachlor in 150-200 L of water. Manual weeding should be done around 20–25 days after sowing, repeated once or twice based on weed pressure, to remove any remaining weeds. Additionally, applying mulching with organic or plastic materials further helps suppress weeds and conserve moisture for healthy crop growth.

Insect Pest and their Management:

1. Aphids

Symptoms:

Aphids are small, soft-bodied insects that suck sap from leaves, leading to yellowing, curling, wilting, and stunted plant growth. Their secretion of honeydew attracts ants and encourages sooty mold formation.

Management:

- **Cultural**: Practice crop rotation, remove infested plant residues, and encourage natural enemies like parasitic wasps.
- **Physical**: Hand removal and yellow sticky traps can help detect and reduce their population.
- **Chemical**: Use insecticides such as Malathion or Monocrotophos, following proper safety guidelines.
- **Biological**: Introduce beneficial predators like lady beetles and lacewings for natural control.

2. Flea Beetles

Symptoms:

Flea beetles are small, jumping insects that chew tiny round holes in radish leaves, affecting photosynthesis and plant vigor.

Management:

- **Cultural**: Maintain strong, healthy plants with balanced fertilization and irrigation to reduce vulnerability.
- **Physical**: Use row covers to prevent beetle access and diatomaceous earth as a barrier around plants.
- **Chemical**: Apply insecticides like Malathion or Spinosad, adhering to label instructions and re-entry intervals.
- **Biological**: Beneficial nematodes and entomopathogenic fungi can help reduce larvae in the soil.

3. Root Maggots

Symptoms: The larvae of certain flies, root maggots burrow into radish roots, causing internal damage, rotting, and overall poor root development.

Management:

- **Cultural**: Rotate crops, delay planting until the soil warms, and use maggot-resistant radish varieties.
- **Physical**: Raised beds and row covers act as barriers, preventing adult flies from laying eggs.
- **Chemical**: Soil drenching with imidacloprid can be effective, but should be used cautiously to protect beneficial insects.
- **Biological**: Apply beneficial nematodes (e.g., *Steinernema* spp.) that parasitize root maggot larvae.

4. Mustard Sawfly

Symptoms: Irregular holes in leaves especially on young seedlings. In severe attack, leaf gets defoliated which leads to stunted growth. Larvae found on the underside of leaves. Plants look weak, pale and yellow.

Management:

- **Cultural & Mechanical Control:** Monitor crop regularly during early vegetative stage. Handpick larvae during early morning to destroy them. Avoid late sowing. Maintain field sanitation.
- **Biological Method:** Spray Neem oil 5% @30 ml, Apply wood ash or soap water spray.
- **Chemical Management:** Apply one of the following insecticides:
- Chlorpyrifos 20 EC @ 2.5 ml/litre
- Malathion 50 EC @ 2 ml/litre

Nutritional Deficiency and Their Management:

1. Nitrogen

Symptoms:

- Plants show stunted growth.
- Older leaves turn pale green to yellow
- Reduced root size, and may bolt prematurely.

Management:

Apply nitrogen-rich fertilizers such as urea or ammonium sulfate, or incorporate organic manure such as FYM, Vermicompost, Green manure crops. Split applications are recommended for efficient nitrogen uptake.

2. Phosphorus

Symptoms:

- Slow & stunted root growth
- Purplish or reddish discoloration on older leaves
- Delayed maturity
- Weaker plant vigor

Management:

Use phosphorus-based fertilizers like triple superphosphate (TSP) or diammonium phosphate (DAP), Single Super Phosphate (SSP)**.** Add Gypsum or organic matter to alkaline soil, Avoid overwatering.

3. Potassium

Symptoms:

- Marginal leaf yellowing or scorching
- Weak and thin leaves
- Weak root systems, and increased susceptibility to diseases.

Management:

Apply potassium sulfate or potassium chloride. Maintaining an optimal soil pH is crucial for effective potassium uptake.

4. Magnesium

Symptoms:

- Yellowing between leaf veins (interveinal chlorosis)
- Leaf curling or upward rolling
- Purplish tint found on leaves
- Premature leaves shredding

Management:

Apply magnesium sulfate (Epsom salt) or dolomitic lime. Magnesium deficiency often occurs alongside high potassium levels, so balance nutrients accordingly. Maintain uniform, moderate moisture.

5. Iron

Symptoms:

- Interveinal chlorosis,
- Slow growth and reduced leaf size
- Reduced chlorophyll formation

Management:

Apply chelated iron to the soil or use foliar sprays with ferrous sulfate. Since iron deficiency is frequently caused by high soil pH**,** correcting pH is essential.

Disease and Their Management:

1. **Alternaria Blight**

Cause Organisms: *Alternaria* spp.

Symptoms:
Initial symptoms appear as yellow to dark brown or black circular spots with concentric rings on leaves, petioles, stems, and flowers. The center of these lesions may dry and fall out, giving the leaves a shot-hole appearance. As the disease progresses, spots merge to form large necrotic patches, often leading to premature leaf drop.

Favorable Conditions:

Warm, humid weather

Management:

- Use only certified, disease-free seeds
- Pre-treat seeds with hot water before planting (50°C for 20–30 minutes)
- Practice crop rotation with non-brassica crops
- Irrigate in the morning to allow foliage to dry during the day
- Apply Mancozeb 75% WP at 2.0–2.5 g per litre of water at 10–15 day intervals depending on disease pressure

2. Clubroot

Causal Organism: *Plasmodiophora brassicae*

Symptoms:
Infected plants exhibit stunted growth and yellowing leaves that wilt during the day and partially recover at night. The roots become swollen, distorted, and form galls, severely affecting water and nutrient uptake. Taproots become club shaped or deformed.

Favorable Conditions:

The pathogen thrives in moist, acidic soils and is spread via contaminated soil, irrigation water**,** and farming tools**.** It can survive in soil for more than 10 years**.**

Management:

- Use only certified, disease-free seeds
- Avoid field-grown transplants unless produced in fumigated or pathogen-free beds
- Apply lime at 2–5 tons/ha to raise the soil pH above 7.2**,** which significantly reduces pathogen activity
- Maintain well-drained soil conditions
- Crop rotation alone is not effective against clubroot
- Although no specific fungicide fully controls clubroot in the field, soil drenching with fungicides like Fluazinam 500 SC at 0.6–0.8 ml per litre of water may help reduce infection in seedbeds under protected conditions

3. Downy Mildew

Causal Organism: *Peronospora parasitica*

Symptoms:
Early signs include small, angular lesions on the upper leaf surface that enlarge into yellow or orange necrotic patches. A white, fluffy fungal growth appears on the underside of infected leaves. Young leaves may curl distort.

Favorable Conditions:

Cool, moist, and poorly ventilated environments

Management:

- Avoid Overhead irrigation
- Use- disease free seeds
- Maintain crop sanitation
- Use fungicide like Metalaxyl 8% + Mancozeb 64% WP @ 2-2.5 gm/L of water

4. Fusarium Wilt (Yellows)

Causal Organism : *Fusarium oxysporum*

Symptoms:
One side of the plant shows yellowing and wilting, followed by leaf drop, leaving behind a bare stem. The infection spreads rapidly through soil and water. Browning of vascular tissue inside root. Plant growth becomes uneven.

Favorable Conditions:

Survives in soil for many years and spreads via infected transplants, equipment, or water

Management:

- Plant resistant radish varieties
- Prevent further spread by sanitizing tools and machinery regularly
- Avoid planting susceptible crops in previously infested soils
- No effective fungicide for field control, but seed treatment with Carbendazim 50% WP at 2.0 g/kg seed can help reduce initial infection
- Maintain Soil pH near 6.5 to 7.0

5. White Rust

Causal Organism *: Albugo candida*

Symptoms:
White pustules appear on cotyledons, leaves, stems, and flowers, often merging into large infected areas. Affected leaves may roll and thicken, reducing photosynthetic efficiency.

Favorable Conditions:

Thrives in dry conditions and spreads via wind

Management:
• Practice crop rotation with non-host crops
• Use only certified, disease-free seeds
• Apply fungicides like Mancozeb 75% WP at 2.5 g/litre or Copper oxychloride 50% WP at 3.0 g/litre at early stages of infection

6. Wirestem / Damping-off

Causal Organism: *Rhizoctonia solani*

Symptoms:
Seedlings die shortly after germination. Brown to black rot develops at the soil line, and the stem

becomes thin, twisted, and constricted—called wirestem. Seedlings may remain upright despite infection.

Favorable Conditions:

Cool, wet soils

Management:
• Use pathogen-free seeds or transplants raised in sterilized soil
• Treat seeds with Thiram 75% WP at 2.0–3.0 g/kg seed or Captan 70% WP at 2.0 g/kg seed
• Avoid deep sowing and delay planting until soil temperatures rise

7. Black Rot

Causal Organism: *Aphanomyces raphani*

Symptoms:
Small black-blue lesions form on the roots, which expand and girdle the taproot. Roots become constricted and black discoloration may extend deep into the root tissue.

Favorable Conditions:

Moist, poorly drained soil

Management:
• Plant resistant radish varieties
• Practice crop rotation with non-brassica crops
• Treat seeds with Metalaxyl 35% WS at 6 g/kg seed to minimize initial infection

8. Scab

Causal Organism: *Streptomyces scabies*

Symptoms:
Brown to yellow circular lesions develop on roots. Lesions may become sunken, cracked, and irregular in shape, reducing root quality.

Favorable Conditions;

Prefers neutral to alkaline soil, thrives in dry soil during root formation, warm temperature favors disease development.

Management:
• Rotate to non-host crops for at least four years
• Maintain high soil moisture levels, especially during tuber/root formation
• Avoid soil amendments that raise pH; keep soil pH below 5.2 to reduce severity
• No specific bactericide is fully effective, but seed treatment with Streptocycline at 0.01% (1 g/10 litres water) may reduce seed-borne bacterial load

Harvesting and Yield:

Harvesting

Radishes should be harvested when the roots reach the desired size—typically 1 inch or more in diameter—and before they become pithy or woody, which can affect quality and taste. Harvesting is carried out manually by uprooting the entire plant. To facilitate easier lifting of roots, a light irrigation is recommended a day prior to harvesting, as it helps loosen the soil. After harvest, the roots are thoroughly washed, cleaned, and graded based on size and quality.

Yield

Radish yield varies by variety, with Asiatic types producing 10-14 tonn/ acre in 40–60 days, while temperate varieties yield 6-8 tonn/ acre within 35–40 days.