

Potato

Plant selection

Healthy planting material

Quality of the cultivars and healthy seed tubers are the primary requirements for a successful crop.

- For planting, remove potato seeds from cold storage.
- Select healthy, medium- or small-sized tubers
- The ideal tuber size for planting is about 2.5 cm in diameter (25-40 grams).
- Smaller sized tubers should be rejected for planting as they may carry diseases.
- Treat tubers with fungicides before letting them sprout.
- Break the dormancy if necessary with chemical treatment.
- Cut large tubers for planting as the last step.

Planting

3 weeks before seeding

Sprouting tubers

Follow these recommendations to select and prepare your tubers for planting:

- Fungicide treated tubers should be let to sprout away from direct sunlight and in a well-ventilated area for one to two weeks.
- Select healthy, medium- or small-sized sprouted tubers for planting.
- The ideal tuber size for planting is about 2.5 cm in diameter (25-40 grams).
- Bigger sized tubers need to be cut into pieces.
- If your field has soil-borne diseases that have recently affected crops from the Solanaceae family (potato, tomato, pepper, and brinjal), do not use seed tubers that need to be cut. Cutting seed potatoes makes them more vulnerable to getting these diseases.

Week 1

How to cut large tuber seeds

here are simples steps to cut your large potato tubers:

- Before cutting the large seed tubers, the knife should be disinfected with Potassium Permanganate solution.

- Repeat disinfection of the knife throughout the procedure if you cut a tuber that does not look healthy from the inside. This will help avoid transmitting any diseases.
- Cut the tuber longitudinally so as to keep 2-3 eyes on each piece. The eye of the tuber is where sprouts form.

Planting and seed rate

- Open the furrows at a distance of 45-60 cm before planting.
- Place whole or cut tubers, sprouts side upwards, 15-20 cm apart on the centre of the ridge at a depth of 5-7 cm and cover with soil.
- The seed rate of potato depends on the season of planting, duration, seed size, spacing, etc.
- The average seed rate is 600- 730 kg/acre for round varieties and 800-1000 kg/acre for oval varieties.

Monitoring

Monitor fields frequently

Monitor the growth of your crop often. Walk through your field in a random manner or zigzag and check for signs of diseases, pests, or deficiencies. Deficiencies are characterized by the discoloration of leaves and the poor vigor of the plants. Diseases are often visible as discoloration and spots or streaks on leaves. Finally, remember that most of the insects present in the field are beneficial for your crop. Those that attack your crop will leave behind damage on leaves and buds in the form of holes. Make sure to talk to your neighbors and exchange information about current diseases with your local community. Also, seek support with public extension services in your area.

Site selection

4 weeks before seedling

Ideal conditions for potato cultivation

Potato, a crop native to South America, is today cultivated around the globe. It is a temperate climate crop but grows under a diverse range of climatic conditions. The crop grows best under moderately cool temperatures, at 24°C during the vegetative stage and at 20°C during tuber development. Loamy and sandy loam soils, rich in organic matter with good drainage and aeration are most suitable for cultivation of potato crop. Loose soils favour the enlargement of the tubers.

The crop can grow well in soils with a pH range of 5.2-6.4.

Week 16

Rotate crops properly

Crop rotation is the practice of growing different crops in the same field in sequential seasons. This helps to increase soil health and fertility, and also avoids the carry-over of some diseases. The simplest rule of thumb is to grow an above-ground crop and then a below-ground crop, but avoid crops of the same families.

Here are some groups of crops with recommended rotations:

- Nightshades: tomatoes, potatoes, peppers, capsicums, chilies, and eggplants
- Cole crops: cabbage, cauliflower, broccoli, brussels sprouts, and kale
- Root crops: beetroot, carrots, parsnips, salsify, and turnips
- Legumes: beans, peanuts, grams, and peas (highly recommended to replenish nitrogen levels)
- Cucurbits: cucumbers, pumpkins, squashes and marrows, and various melons
- Other crops: Swiss chard, spinach, leek, celery, lettuce, endive, and artichokes can be included anywhere, unless they make a bad companion.

Strict crop rotation is obligatory after having grown peas, potato, cucumber, cabbage, carrots, parsley, and onions.

Field preparation

3 weeks before seedling

Treat the soil if needed for healthy crops

- Make sure to mix these products well with the soil while adding organic manure during field preparation.
- Trichoderma viride 1.5% WP is applied at a rate of 2 kg per acre.
- Neem cake (1-2% oil) is applied at a rate of 1 kg per 2-3 square meter.

3 weeks before seedling

Prepare your field for potato

When preparing the fields, make sure to follow the recommendations listed below:

- Carry out a good ploughing at a depth of 20-25 cm to incorporate any remaining plant debris and weeds into the soil.
- Collect and remove small stones, weeds, and crop stubble to facilitate good seed-soil contact at sowing.
- Later on, harrow 3-4 times to reduce clod size and compaction, and obtain a fine tilth.
- Add 12-16 t/acre farmyard manure before the last harrowing.
- Level and drain the field properly to avoid flooding problems later in the season.

Week 4

Earthing-up your crop

- Earthing-up consists of mounding the soil from between the rows around the main stem of the potato plant.
- This practice keeps the plants upright and the soil loose, prevents insect pests such as a tuber moth from reaching the tubers; and helps prevent the growth of weeds.
- It should be done when the plants are 15-22 centimetres tall.
- A double mouldboard plough or a ridger can be used.
- If necessary, a second earthing may be done after two weeks of the first one to cover the growing tubers.

Week 16

Conduct proper field management after harvest

Make sure to remove all the crop waste after harvest to avoid the possible reintroduction of a disease in the same field. In the case of pests, plow the land with soil-turning to expose the insects to predators and solar radiation (solarization). Consider the use of cover crops between seasons to increase the organic carbon content and the moisture of the soil. Finally, consider leaving the field as fallow for a period of time to enhance its potential.

Weeding

Week 2

Pre- emergence herbicides

- Pre-emergence herbicides can be effective for the prevention and control of weed growth.
- Commonly used pre-emergence herbicides for potato are Pendamethilin 30% EC (1 liter per acre diluted in 200 liters of water) or Oxyfluorfen 23.5% EC (700 ml per acre diluted in 200 ml of water).
- Herbicides are poisonous to humans and animals.
- Label them clearly and keep them out of children's reach.
- Remember to wear proper protective equipment (i.e., gloves, breathing mask, goggles, and protective clothing) when spraying.
- Always mix clean water with herbicides before application.
- Refrain from using muddy water, as this reduces herbicide efficacy.
- Ensure that all equipment, such as spray tanks, booms, and nozzles, are well-cleaned after every use.
- Do not mix different herbicides together unless recommended.
- Apply herbicides at the recommended dose.

Week 3

Manage weeds for potato crop

For best growth, control weeds within the first 4 weeks after planting. Weeding can be done by hand if labour is available, mechanically by a bullock-drawn three-tine cultivator and alternatively by spraying herbicides. To manage weeds around your potato crop, 2-3 hand weedings should be done along with the earthing up operations.

Week 5

Post emergence herbicides

Broad-leaf weeds and grassy weeds are very different kinds of plants that require different treatments.

Post-emergence herbicide sprays are optimal for the weeding of the fields at an early stage of weed growth.

Here are some recommendations:

- Paraquat dichloride 24% SL is a broad-spectrum herbicide for the control of broadleaf and grass weeds.
The proper dose is 80 ml/ acre diluted in 200 liters of water
- Oxyflourfen 23.5% EC is a broad-spectrum herbicide for the control of annual broadleaf and grass weeds.
The proper dose is 170-340ml /acre diluted in 200-300 liters water.
- 2,4-D Dimethyl Amine salt 58% SL is a selective herbicide for the control of broadleaf weeds. The proper dose is 140 ml per acre diluted in 400 liters of water.
- Ask your extension officer or cooperative about the best product for your specific case.
- Use a hand-operated sprayer fitted with a deflecting or fan-type nozzle.
- Use the proper eye- and skin-protection equipment when spraying.
- Target the bottom of the furrows and avoid the ridges and plant base.
- Check that sufficient moisture is present in the soil at the time of herbicide application.

Irrigation

Week 2

Irrigation for potato

- Potato plants have a shallow and sparse root system, so regular and uniform irrigation is essential.
- The first irrigation should be light and done 5-7 days after planting.
- Subsequent irrigations should be done at an interval of 7-15 days depending upon the climatic conditions and soil type.

- Withhold irrigation 10-15 days prior to digging up the potatoes for harvest.

Week 11

Irrigating during tuber bulking

The fruiting stage of potato growth (also known as tuber bulking) is when the tubers have the greatest expansion by accumulating carbohydrates, nutrients, and water.

Due to the high rate of growth, tubers have the highest water requirements at this stage. Irrigation during this time also helps to keep soil temperatures low. Minor water deficits during this stage will negatively impact yield, while larger deficits can affect the shape of the tubers.

Fertilization organic

1 week before seedling

Add farmyard manure during plowing to support plant growth

During the first month, seedlings need a lot of nutrients.

Farm yard manure is not only a source of nutrients, but also contains a wealth of organic matter and water, thus helping in maintaining a good soil structure for drainage and aeration. Here are some recommendations:

- Fully-decomposed farmyard manure or compost should be added to the soil after the last plowing and before making the furrows.
- The recommended amounts vary depending on the crop but it is usually in the range of 8-10 tons/acre.
Make sure to mix well and dig the mixture.
- Ask your extension officer or local retailer which animal manure is best-suited for your purposes and which exact amount corresponds to your case.

Week 6

Apply liquid manure to support plant growth

Animal manures or plant extracts have a high nutrient content and this makes them a great source of fertilization for plants. As liquid fertilizers, they are very handy to apply to the fields at this stage, and they will support flower and fruit development. Here are some recommendations:

- Apply liquid manure in the morning hours, before the sun heats up.
- Make sure to dilute your plant extracts, at least 10 times (1 part of manure/9 parts of water).
- Make sure to dilute your animal manure, at least 15 times (1 part of manure/14 parts of water).
- Apply the manure around the base of the plant but avoid to spread it on the plants.

- Ask your extension officer or local retailer which mixture is best-suited for your purposes.

Fertilization chemical

Week 1

Basal fertilization for potato

Basal fertilization is done during field preparation while ploughing the soil. The addition of farmyard manure is complemented by the application of mineral fertilizers containing the main nutrients, nitrogen (N), phosphorus (P), and potassium (K). For a successful crop, the recommended rates of NPK are recommended:

- Add farmyard manure (12-16 tons/acre) and incorporate well during the last ploughing.
- In light soils and places where organic manures are not easily available, green manuring is beneficial.
- Add, two-thirds of the total amount of N and full amounts of P and K before planting.
- This amounts to 40 kg/acre of urea, 55 kg/acre of DAP and 80 kg/acre of MOP.
- In case of known micronutrient deficiencies apply gypsum (5 kg/ac) for sulfur deficiency, and zinc sulfate (2 kg/ac) for zinc deficiency.
- In acidic soils, boron should be applied at a rate of 2 kg/acre.
- Ask your extension officer or local retailer which nutrient mixture is best suited for your purposes.

Week 6

First split nitrogen fertilization

- This split fertilizer application should be done 1 month after planting, before earthing up.
- Apply the remaining third of nitrogen as a side dressing. As urea, this is 60 kg/acre.

Preventive measure

Week 1

Prevent leafhoppers in your plants

Low numbers of leafhoppers are usually harmless.

However, severe infestations may result in the stunting or death of young plants. On mature leaves, they cause "hopper burn" injuries, visible as patches of discolored plants in the field. Fruit set is also significantly affected, causing reduced yield and fiber quality. To prevent leafhoppers, make sure to:

- Monitor the fields by searching for empty larval skins on leaf undersides.
- Hand-pick and remove eggs or infected plant parts.
- Use yellow sticky traps that are very attractive to green leafhoppers.
- Promote a good environment for beneficial insects such as ladybugs and lacewings.

Week 2

Prevent black cutworm in your crops

Young caterpillars forage near the ground, leaving small irregular holes on tender leaves. Their older counterparts emerge from the soil at night to feed at the base of the plants. Stems can be severed (cut') at ground level, leading to impaired growth or death. Tunneling into the stem results in wilting and lodging of older plants. To prevent black cutworm in your chickpea crop, be sure to:

- Clear weeds in and around the field before planting and after emergence.
- Use light and pheromones traps to monitor or catch moths.
- Cultivate frequently to injure and expose cutworms to predators.
- Bury plant residues deep in the soil after harvest.
- Keep the field in fallow for some weeks before planting.
- Plow the field to bury larvae or expose them to predators 3 to 6 weeks before planting.

Prevent nematodes in your plants

Symptoms are very similar to drought stress or nutrient deficiency. Usually, plants show stunted growth and leaves turn yellowish with signs of wilting and deformation. Sometimes, knots or galls are present on roots. To prevent nematodes on your vegetables, make sure to:

- Use trap crops (e.g. clover) to attract nematodes away from your plants.
- Keep susceptible weeds in check, in the field and surroundings.
- Apply proper fertilization to optimize plant growth.
- Do not spread nematodes with equipment and tools.
- Plow and rid the field of plant residues after harvest.
- Cover the field with plastic mulch for several weeks (solarization).
- Practice a fallow period to break the life cycle of the nematode.
- Clean tools and tillage equipment after use.
- Plan a crop rotation for at least two years.

Week 3

Prevent early blight in vegetable plants

Symptoms are characterized by dark spots with a white halo on the leaves. Dark, concentric circles (having a common center) appear on the stems and later on the fruits.

Later in the season, infections result in the rotting of fruits. To prevent early blight in vegetable plants, make sure to:

- Allow for good drainage of the soil.
- Use stakes to keep plants upright.
- Remove the lower leaves of plants (to a height of 40 cm).
- Control susceptible weeds in and around fields.
- Avoid excess irrigation and overhead irrigation.
- Plan balanced fertilization.
- Remove all plant debris after harvest.
- Rotate with non-host plants for a few years.

Week 4

Prevent aphids in your plants

Low to moderate numbers are usually not harmful to crops. Severe infestation can cause damage on leaves and shoots and stunted plant growth. Honeydew secreted by the aphids also leads to additional infections and worsening of symptoms. To prevent aphids in your plants, make sure to:

- Monitor fields regularly for signs of aphid infestation.
- Hand-pick and remove infected plant parts.
- Not over-water or over-fertilize your crop.
- Control insecticide use in order to not affect beneficial insects.
- Control ant populations that protect aphids with sticky bands.
- Hold weeds in check, in and around the fields.
- Plow the field immediately after harvest to prevent their spread.
- Plan a rotation with resistant crops.

Week 5

Prevent leaf eating beetles in your potato plants

Feeding damage appears on the leaf tissue between the veins, and in severe cases, only the hard veins are left behind (skeletonization). Seedlings can be destroyed. On older plants, shallow holes can appear on the fruit surface. Infestation leads to stunted plants and heavy defoliation. To prevent leaf-eating beetle in your potato fields, be sure to:

- Monitor fields for signs of the pest.
- Handpick and destroy larvae and adults found in the seedbeds or fields.
- Remove weeds and alternative hosts in and around the field.
- Use thorough irrigation to drown the beetles in the soil.
- Remove or destroy infested plants and your waste by burning.

Week 6

Prevent potato scab

This bacterial disease survives in infected root tissue in the soil. It spreads through water, on infected plant material, and in wind-blown soil. Usually, the first signs of the disease are visible on the surface of young tubers and expand as they mature. These symptoms are a superficial reddish-brown corky tissue layer that covers large areas of the skin, and dark-coloured, shallow to deep holes, and a net-like series of cracks.

To prevent potato scab in your crop, make sure to:

- Maintain good soil moisture with regular irrigation and avoid over-watering.
- Keep soil pH levels low with a specific fertilization scheme. For example, apply elemental sulfur, gypsum or ammonium sulfate to maintain a low soil pH and reduce the severity of the disease.
- Do not lime before planting.
- Ensure well-coordinated field rotation.

Plant protection chemical

3 weeks before seedling

Fungicide tuber treatments

Treat your seed tuber for added protection against diseases:

- Treatment is done before the sprouting initiates.
- Make sure there is no soil on the tuber as this will reduce the efficacy of the fungicide.
- Mercurial fungicides are used to prevent black scurf disease and rotting diseases of seed potatoes.
- Quantities below are for seed tubers used for planting 1 acre.
- Prepare a solution of Agallol 0.5% by dissolving 500
- grams of Agallol in 100 liters of clean water.
- Or prepare a solution of Aretan or Tafasan 0.25 % by dissolving 250 grams of Aretan or Tafasan in 100 liters of clean water.
- Place tubers in one of these solutions for 2-10 mins.
- After treatment, remove tubers from the solution and place tubers in a clean, well-ventilated area and out of direct sunlight.

Harvesting

Week 15

Harvesting potato crop

- The timing of harvesting is very important for potatoes, as the tubers continue to grow until the vines die.

- The main crop is ready for harvest within 75-120 days of planting when most of the leaves turn yellow-brown.
- Cut the tops near ground-level.
- The potatoes should be dug out from the field by ploughing after 8-15 days.
- Dry the tubers in the shade for 10-15 days to allow for the skin to be cured.
- The tubers should not be exposed to direct sunlight as they become green.
- Store the tubers in a cool, dry, and dark place.

Post harvesting

Week 15

Tuber grading

Grading is an important factor in the marketing process of potato. Depending on the methods used for grading (by hand or mechanical graders), potatoes are most often sorted into 4 categories: below 25 g, 25-50 g, 50-75 g, above 75 g. The rubber roller type of mechanical potato grader can sort potatoes in 6 categories: less than 10 g, 10-25 g, 25-50 g, 50-75 g, 75-100 g, and more than 100 gms. Grading your potatoes helps you and the buyer determine the price.

Week 16

Storage conditions for potato

Ideally, your harvest is stored in a place that meets the following criteria:

- Temperature of 6-8°C degrees.
- High relative humidity (85 to 90 percent).
- For regular tubers, in a dark and well-ventilated environment.
- For seed tubers, under diffused light (natural indirect light) and in a well-ventilated environment to maintain their germination capacity.

In general, all tubers should be kept in an area with:

- Protection from insects, rodents, and birds.
- Good hygienic conditions.
- Easy loading and unloading.
- Efficient use of space.
- Easy maintenance and management.