



Irrigation Solution
POTATO
With Jain Technology™



Jain Irrigation Systems Ltd.
Small Ideas. Big Revolutions.®

Potato Production Technology Under Drip and Sprinkler Irrigation

India is the 3rd largest Potato producer in the world with a production of about 23.12 million tones from about 1.27 million hectares with 18.2 t/ha productivity. The major potato producing states are UP (8.8 mt), West Bengal (7.6 mt), Bihar (1.5 mt), Punjab (1.4 mt), Gujarat (0.74 mt) and Madhya Pradesh (0.62 mt) and they jointly contribute about 90% of the total potato production of the country. West Bengal tops in potato productivity with 24.7 tones/ha followed by Haryana with 24.6 t/ha, Gujarat with 23.9 t/ha and Uttar Pradesh with 20.9 t/ha.

Potato is botanically known as *Solanum Tuberosum L.*, is one of the largest genera in the vegetable kingdom, with about 900 species. It is only six of these that grow filler potatoes at all.

Potato is a perennial but as a crop it is treated as an annual. It is vegetatively propagated by means of tubers. Now it is also propagated by true potato seed (TPS). The tuber is an enlarged underground stem produced on the end of a stolons.

Soil and Climatic Requirement

- Potato basically requires relatively mild temperature during early growth and cool weather during tuber development.
- Potato needs about 25°C at the time of germination, about 20°C for vegetative growth but between 17-20°C for tuberization and tuber development.
- It does well under well-distributed rains or moist weather situations to high temperature, humidity rains are not conducive to potatoes as these lead to insect-pest, disease, viruses epidemics.
- Impeded drainage or lack of aeration also is considered harmful as it restricts the tuber development.
- Mild frost to the extent of -1°C partially damages the potato leaves, but when the temperature falls below -2°C, the exposed parts of the most of the varieties are destroyed.
- Well drained soil with good organic matter is essential for good Potato crop. A soil pH of 6.5 to 7.5 is good for growing potato.

Varieties

Varieties available can be classified into early, mid and late season types depending on their growth duration.

Early varieties

- **Kufri Chandramukhi:** 90 days crop; 25 t/ha yield ; susceptible to early blight.
- **Kufri Ashoka:** 70-80 days; 28-30 t/ha yield; resistant to late blight.

Mid season varieties

- **Kufri Jyoti:** 80-95 days; 20-25 t/ha yield; Resistant to late blight
- **Kufri Jawahar:** 80-95 days; 30-35 t/ha yield; Resistant to late blight.
- **Kufri Sutluj:** 90-95 days; 31-36 t/ha yield; Moderate resistance to late blight.
- **Kufri Lalima:** 110 days; 30-35 t/ha yield; High keeping quality.
- **Kufri Bahar:** 110 days; 30-35 t/ha yield; Susceptible to late blight.

- **Kufri Chipsona 3:** 110-120 days; 33 t/ha; suitable for processing.

Late varieties

- **Kufri Sindhuri:** 110-120 days; 30 t/ha yield; High keeping quality.
- **Kufri Badshah:** 110-120 days; 30-40 t/ha yield; Resistant to late blight.

Land preparation

- Potato being a tuber crop, requires a soft, friable and deep seed bed for the development of uniform large smooth tubers.
- To provide this, potato often is planted on raised seedbeds / ridges, prepared with the help of potato ridger after a thorough and deep cultivation of soil, liberally fertilized with F.Y.M., compost or other organic manures including the green manures.
- Potato usually follows a Kharif fodder or grain crop of maize or rice which are not only well fertilized but also leave sizeable quantities of root-mass after their harvest thus enriching the soil
- Land preparation tillage is largely accomplished with the help of tractor operated implements, mostly through repeated use of off-set disc harrow in the initial stages followed by 2-3 cultivator operations and planking given cross-wise to break the bigger clods and pulverize them into small size aggregates.
- This is followed by planting operation wherein potato tubers are manually placed in the rows, 20 cm apart, with a row to row spacing maintained at 60 cm. Soon after, a ridger is run to cover the potato tubers by throwing the soil from both the sides and ridges pressed .

Plant Spacing

- 90x30 cm on ridges and furrows ; ridges formed at 90 cm.
- 90 cm row to row with 2 rows on 1.2 m broad beds.

Planting material

- Select disease free tubers for seed material.
- Each seed piece should be of 25-30 g with at least 2-3 "eyes".
- On an average 3 to 3.5 t seed material is required per ha.
- Treat the pieces in a solution of Dithane M-45 at 2g/l water dilution
- Dry the treated tuber pieces under shade before planting.
- If the tubers are brought from refrigerated storage, then keep them in the open shade at least for a week before preparing for sowing.



Planting time

Rabi crop- September 15 to November 15.

Irrigation management

Water requirement of Potato

September planting

Month	Water requirement	
	Mm/day	Lt/ha/day
September	0.81-0.92	8100-9200
October	1.92-2.30	19200-23000
November	5.50-6.39	55000-63900
December	2.92-3.56	29200-35600

October planting

Month	Water requirement	
	Mm/day	Lt/ ha /day
October	0.77-0.92	7700-9200
November	1.87-2.18	18700-21800
December	4.73-5.95	47300-59500
January	3.29-3.75	32900-37500

November planting

Month	Water requirement	
	Mm/day	Lt/ ha /day
November	0.75-0.87	7500-8700
December	1.61-2.03	16100-20300
January	5.32-6.07	53200-60700
February	4.01-4.40	40100-44000

December planting

Month	Water requirement	
	Mm/day	Lt/ ha /day
December	0.64-0.81	6400-8100
January	1.81-2.07	18100-20700
February	6.49-7.12	64900-71200
March	4.85-5.31	48500-53100

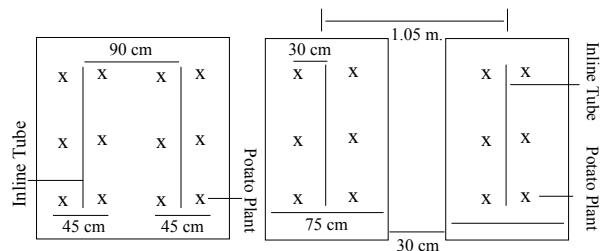
January planting

Month	Water requirement	
	Mm/day	Lt/ ha /day
January	0.72-0.83	7200-8300
February	2.21-2.43	22100-24300
March	7.84-8.59	78400-85900
April	5.31-6.02	53100-60200

Drip system lay out

Inline drip system is suitable for Potato. The drip laterals are spaced on a skip row basis i.e. at 180 cm spacing where Potato is planted on ridges at 90 cm spacing. When the ridges are spaced at 1.2 m, an inline tube is placed at every row. Potato is also planted on Broad raised beds 1.2 m wide. Two rows are planted on the bed at 90 cm space between the two rows. The drip line is placed in the centre of the bed serving the rows on either side.

In case of inline the entire strip is wetted by placing drippers at 60 cm or 75 cm (based on soil texture) along the drip line.



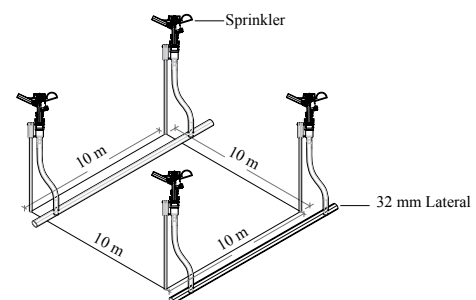
Sprinkler System layout

Different models of sprinklers of Naan Daan Jain are found suitable for Potato. One may select from Sprinkler models 5022,501U, Super 10. The placement and discharges are given below.

Sprinkler models and discharge		
Models	Sprinkler placement (m)	Discharge (lph)
5022 U	10 x 10	360-720
501 U	6 x 6	168-288
Super 10	10 x 10	360-850

Using sprinkler water is applied every 3 or 5 days depending upon the soil texture and water holding duration of the soil. But irrigation with this system will create cyclic water excesses and shortages; both of which affect the growth and production of the crop. Irrigation efficiency is also lower (60%) than that of drip.

Nevertheless this system is less expensive and farmers may find this more affordable than drip system.



Critical stages of water requirement

In Potato, following stages are considered critical from point of view of maintenance of adequate moisture in the root profile; as even small shortages at any of these stages could result in proportionally very high loss in yield.

1. Germination (Immediately after sowing)
2. Stolonization (30-35 days after sowing)
3. Tuberization (45- 65 days after sowing) Any let up in irrigation during this phase may give rise to variable size of tubers, with large proportion of chats & fewer ware grade tubers; which results both from uneven growth and uneven (non-synchronous) maturity of tubers at harvest.

Application of fertilizer

- A basal dose of 25 t/ha of farmyard manure to be applied along with the last plough.
- Sheep penning (2500-3000 sheep/ha) is also recommended.
- Neem cake at 300-400 kg/ha preferably along with basal fertilizers at the time of final ploughing.
- Green manuring can be practised by sowing cowpea or sunhemp with early rains and incorporating it after 40 days growth.
- The requirement of NPK varies for different soil types; 180:40:170 to 240:80:306 NPK.
- Potassium sulphate (SOP) is preferred over Potassium chloride (MOP)

Fertigation Schedule

Along with irrigation water fertilizers dissolved in water can also be given through the drip lines. This process is known as fertigation. A detailed schedule is given below for fertigation of Potato.

Table fertigation Schedule using water soluble special grade fertilizers.

Time of application	Type of fertilizer	Quantity (Kg per ac)	Fertigation Schedule
One week after sprouting	Urea 12:61:0	10.0	5 kg/3 days
		10.0	5 kg/3 days
2-3 weeks	Urea 19:19:19	25.0	7.5 kg per 3 days
		30.0	6.25 kg per 3 days
4-5 weeks	Urea 12:61:0	20.0	5 kg per 3 days
		15.0	3.75 kg per 3 days
6-8 weeks	Urea 0:52:38	15.0	2.5 kg per 3 days
		25.0	6.25 kg per 3 days
9-11 weeks	13:0:45	20.00	3.3 kg per 3 days
12-13 weeks	0:0:50	12.5	3.12 kg per 3 days

Micronutrients

In soils where Zinc deficiency is noticed, Zinc sulphate @ 50 kg/ha should be applied.

Inter cultivation and weed control

- Potato requires frequent inter cultivation.
- In the direct sown crop blade harrow is to be worked starting from 30th day of sowing. Four inter cultivations are needed at 10 days intervals alternated with blade harrow and tied harrow Junior-how.

- Final inter cultivation is to be given by the country plough.
- Inter cultivation is to be followed by hand weeding to check the weed growth.
- Weedicides are also used to control weeds in Potato.

The two major weedicides are Metribuzin at 0.5 kg a.i/ha or Isoproturon at 1.0 kg a.i applied at 1-3 days after sowing. Dissolve the chemical in 500 l water and uniformly spray over the sown plots.

Pest and disease management

Pests Of Potato

Green Leaf Hopper

- Jassid is the most destructive pest of many plants including Okra, brinjal, potato and cotton etc. It causes damage to potato in autumn season
- Spray the crop with 300 ml of rogor or metasystox or 75 ml of dimecran in 80-100 liters of water per acre. If necessary repeat the spray after 10 days.

Green peach aphid

- During winter and spring season, the potato is attacked by various aphid species like M.persicae, Aphids gossypyi and A. fabae. Out of them M. persicae causes serious damage to potato crop by transmitting various viral diseases.
- Spray 300 ml of Metasystox or 200 ml of Rogar or 75 ml of Dimecran in 100 liters of water. In case of seed crop, apply 5 kg of Thimet 10G to the soil at the time of the first earthing up.

Hadda Beetles

- Two species of hadda beetles attack different solanaceous vegetables, like brinjal, tomato and potato.
- Application of Neem, Mahua, ground nut cakes are efficient in suppressing the pest population.
- Spray of Malathion 50 EC in 200 liters of water per acre provides up to 82 percent kill of this pest.

The Greasy Cutworm

- The greasy cutworm has been reported from almost all the potato – growing regions of Northern India.
- It feeds on potato, tobacco, peas, wheat, lentil, mustard, linseed, maize, sugarcane, cucurbits, vegetable seedlings and several weeds.
- Control measures include; Break the sods in the fields. Flood the infested fields. On a small area, collection of caterpillars from soil around the plants can be done. Collection of moths in the light traps.
- Use of chlorpyrifos @ 2 l / ha to the soil before planting potato tubers.

Tobacco Caterpillar

- This polyphagous feeds on tobacco, potato, tomato, cabbage, cauliflower, peas, cowpea, and castor.
- The leaves, which have egg masses and young larvae in the gregarious phase, should be plucked and destroyed. The pest can be killed by spraying 300-400 ml of Ekalux 2 S or Thiodan in 100 liters of water per acre.

Potato Tuber Moth

- It is distributed in Bihar, Karnatak, Maharashtra, Himachal Pradesh, Kumaon hills of west Bengal, Nilgiris (Tamil Nadu), Maharashtra and submountainous areas of Punjab. This pest occurs especially in hot and dry climates. It is

destructive to potatoes and also attacks tomato, egg-plant, tobacco..

- Construct potato stores away from the fields. Cover tubers lying in stores with a thin (2.5-5.0 cm) layer of dry sand. The surface of sand cover of the potatoes should be dusted with one percent malathion dust. Carry out disposal of infested potatoes.

Whitefly

- Apart from cotton, this pest also feeds on potato, brinjal, okra, cabbage, cauliflower and some weeds.
- This pest can be controlled by spraying 300 ml of rogor or metasytox or 75 ml of dimecran in 80-100 liters of water per acre.

Diseases Of Potato

Early Blight (*Alternaria solani*)

- This is one of the common diseases of potato and is world-wide in its distribution. In India it is found on potato crops grown in the hills as well as in the plains.
- On the leaves, spots of varying size appear. The spots are irregular, brown to dark brown in colour, and with concentric lines inside the spots.
- The tuber infection is carried to the storage godowns where it may spread to cause storage-rot, resulting in considerable damage.
- The pathogen is mostly air-borne and the primary source of infection may be through tubers, though not much evidence has been obtained to substantiate this.
- Collateral hosts such as tomato may also play a significant role in the perpetuation and dissemination of the fungus.
- Fungicidal sprays, preferably with copper fungicides or Zineb given at 15 day intervals effectively control the disease.
- Since the same spray schedule controls late blight also, it has become a regular practice among potato growers in many tracts to spray the crop with copper fungicides at least three or four times, starting from about six weeks after planting.

Late Blight (*Phytophthora infestans*)

- This is one of the worst diseases of potato, which takes a heavy toll year after year in many countries.
- In India it was mostly confined to the northern hills until a decade ago, since then it has been reported from the Gangetic plains of Uttar Pradesh, in parts of West Bengal, and in some parts of South India, including the Nilgiris, the Pulneys and southern Karnataka State.
- The disease first appears as water-soaked, light brown lesions on the leaf blade. If the climatic conditions are favourable with humid and cloudy weather these lesions spread fast over the entire leaflet and petiole.
- Characteristic lesions are roundish with concentric markings on the margin, and generally involve the leaf margin.
- The severely diseased plants wilt within a few days after the first symptoms are seen on the leaves and in the field the disease spreads like wild fire, causing severe damage to the crop yield.
- The primary infection of the plants is through infected tubers.
- The disease can be controlled by adopting certain

prophylactic measures.

- they should be examined carefully before planting and also should be pre-treated by dipping in 1 per cent Bordeaux mixture or other fungicides.
- The plants must be sprayed with copper fungicides., zineb or phenyl compound at 15 day intervals, starting from about a month after planting until the crop matures.
- Ridomil at 7 kg/ha in combination with Dithane M-45 has given encouraging results.

Black Heart disease

- The black-heart of potato is a non-parasitic disease commonly found in storage godowns. This is due to high storage temperature and low oxygen supply.
- Due to high temperature the tissues break down, resulting in high respiration and failure of gas-exchange. If the affected tubers are cut to examine the cut surface turns pink, then dark brown to black. No microbial agent is associated with the disease. Providing sufficient aeration and storing the tubers in thin layers on racks help to avoid the damage.

Brown Rot (*Pseudomonas solanacearum*)

- There are two major bacterial diseases of potato which are destructive, causing vascular infections. They are (i) ring rot caused by *Corynebacterium sepedonicum* (Spick & Koth.) Skapt. And Bink. And (ii) brown rot caused by *Pseudomonas solanacearum* I.E.F. Sm.
- The first symptom of the disease in the field is dwarfing of the shoots accompanied by bronze discolouration of the leaves, followed soon by plant wilt. If the diseased plant is cut open a whitish bacterial ooze comes out of the cut ends of the stem.
- The organism persists in soil for more than 12 months. In the field the infection may take place through incidental wounds caused to the plants at the time of various cultural operations. The bacteria may spread in the field through irrigation and rainwaters, implements and tools, and by various other means.
- The disease can be checked by selecting disease-free seed tubers and by adopting various field sanitation measures.
- A crop rotation to avoid potato, tomato and egg plant in the field for not less than two and preferably three years would help in starving out the pathogen.

Harvest

With proper water management, fertigation and pest control and timely cultivation an yield of 35 t/ha is possible.

Benefits from drip irrigation

- Yield increases by 30-40%
- Irrigation water is saved up to 40-50%
- Increases fertilizer use efficiency.
- Saving of power, labour costs.
- Lesser incidence of diseases and insects.
- Potato quality improves

Dos

- Ensure good drainage in the field.
- Adopt drip or sprinkler
- Compulsorily apply organic manure as per recommendation

- Select high yielding, disease and pest tolerant variety suitable for each location.
- Practice drip irrigation from the beginning.
- Strictly follow the irrigation schedule given by the engineer.
- Follow the drip system maintenance schedule given by the engineer.
- Compulsorily weed/ inter-cultivate, timely operation helps in crop growth.
- Follow fertigation schedule as given by the engineer.
- Follow the precautions while operating the drip system as explained by the engineer.
- Apply micronutrient as and when needed.
- Follow disease and pest control measures timely and effectively.
- Apply sprays in the evening or early morning only.

Don'ts

- Don't over irrigate the crop at anytime.
- For fertigation don't mix solid fertilizers and dissolve them together. Prepare individual solutions and mix them for application.
- Don't spray the crop under hot sunlight.
- Don't use the fertigation unit for bulky organic manure and

fertilizers that are not soluble in water

- Don't add solid fertilizer from the bag directly to the fertilizer tank. Prepare solution separately and pour the solution to the fertilizer tank. Prepare solution only in plastic buckets. Don't use metal container.
- Don't stir the solution with naked unprotected hand. Use wooden spoon or stick.
- Don't heat the fertilizer solution to increase solubility.

Frequently asked questions (FAQ's)

1. Whether the meagre quantity of water supplied through drip irrigation is enough?
 - Irrigation rate in Drip method is estimated based on the Evapotranspiration of the location and therefore it is enough. With conventional flood / channel irrigation water completely replaces the air in root zone thereby suffocating the plant. The last few days of the irrigation cycle the crop also suffers from water stress. The periodical water logging and stress affects growth and production of Potato.
2. Can I prefer Sprinkler method of irrigation for Potato?
 - Sprinkler system is less expensive and suitable. But it spreads water over the canopy and possibility of diseases are more. Moreover wastage of water per irrigation will be high.



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