

Conventional Potato Seed Production in India



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Importance of seed potatoes

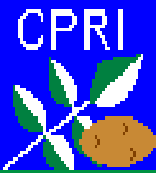
- Major input accounting for 40-50% cost of cultivation.
- Productivity in 1/3rd of area under potato (NEH, Plateau, Hills, Bihar) is very low (4-12 tons/ ha)
- Shortage of planting material – no supply chain in > 50% of the area
- Seed quality has a direct bearing on the potato productivity.
- All the potato growing areas not fit for seed production.
- Vegetatively propagated- Perpetuation of viral, mycoplasmic and other soil borne pathogens - poor yields in subsequent multiplications
- Seed potato from hills: Limited area and physiological problems for using immediately in plains.
- **Seed plot Technique:** In 1959 by CPRI, healthy seed production in the Indo-Gangetic plains **during low aphid periods** coupled with improved cultural practices
- Presently 94% of seed potatoes from sub-tropical plains and only 6% in the hills.



Means of Seed Potato Production

- Can be propagated by botanical seeds or tubers; tubers preferred.
- Seed tubers accounts for 40-50% production cost.
- Proportion of seed- sized tuber in the produce is low.
- Multiplication rate is only 1:6.
- Production cost very high due to stringent quality control.
- TPS has the problem of lateness and heterogeneity.





Quality seed potatoes:

Quality seed potatoes are **healthy** (free from diseases) and are **true to type**.

About 30 viruses in potato world over but only 7 viruses are affect the crop seriously and among them X, Y, S, M, A, PLRV and PALCV are most damaging alone or in combination.

Therefore, in seed production, precautions are taken to develop seed free of these viruses and should be true to type.

Site Requirements for Seed Production

- Freedom from soil borne pathogens like wart, cyst nematode, bacterial wilt, black scurf, and common scab.
- Low aphid or aphid free period of 75 days after planting.
- The min. & max. temperature should be within 8-28°C during crop season.
- Several seed production channels evolved.
- India is the only Asian country with a well established, scientific seed production programme.



Suitable areas for seed production:

- Areas free from serious soil borne pathogens and pests
- High hills of Himachal Pradesh (above 2300 meters amsl) free from bacterial wilt, Lahaul & Spiti area.
- Indo-Gangetic plains of Punjab, Haryana, North-western parts of U.P., Madhya Pradesh and Bihar – during low aphid period from October to January (primary source) and entire West Bengal, Odisha, Rajasthan and Gujarat are the secondary source of seed potatoes due to brown rot and aphids.
- Optimum temperature for foliar growth is 18-22°C and for tuberization is 12-16°C

Current seed requirement in Country

Total area: 2.02 mha (FAO, 2014)

Seed rate: 2.5 t/ha

Total seed requirement: 5.05 mt

Breeder seed production by ICAR-CPRI: 3000 t



Current Seed Status in Country

Production by Govt. Sector : 0.4 mt

Production by Private Sector: 0.1mt

Total seed requirement : 5.05 mt @100% SRR

Desirable seed requirement: 1.26 mt @25% SRR

Total Breeder seed production: 3000 t

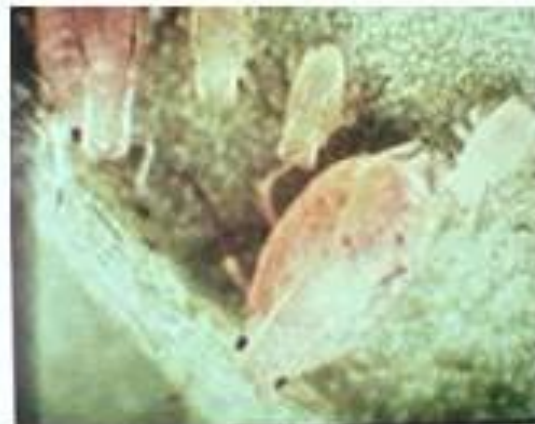


Potato crop seasons in NW hills and plains of India :

Area	Crop	Planting Time	Harvest Time
Plains (Short days)	Early crop	3 rd week Sep.	End. November
	Main crop	1 st week Oct.	Mid. January
	Spring crop	3 rd week Jan.	End March
Hills (Long days)	Spring/Summer crop	March-April	Aug.-Sep.

Appearance / build up of aphids in Indo-Gangetic plains

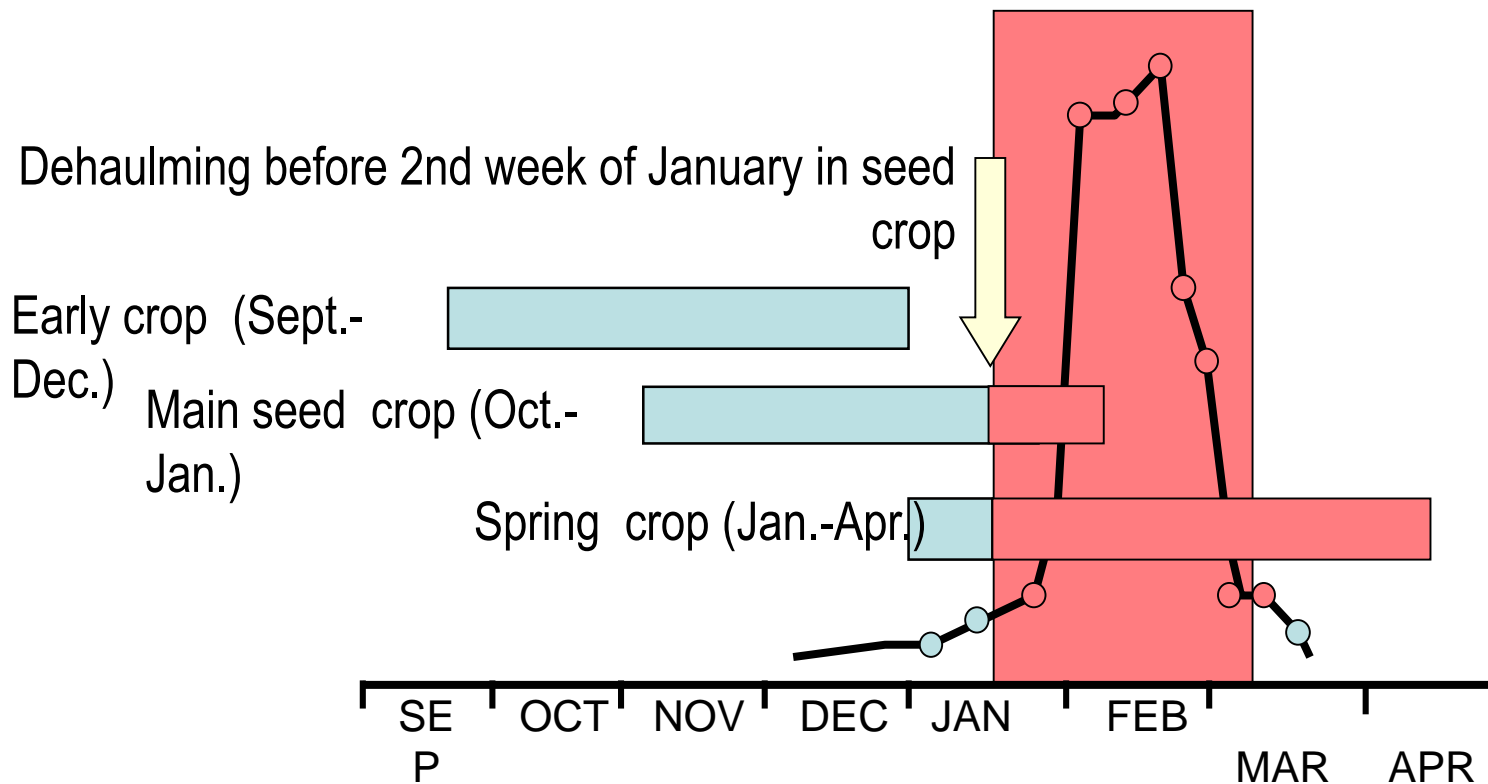
Region	Date of appearance	Critical limit time
Punjab	2 nd wk. Nov.	3 rd wk. Dec.
Western UP	3 rd wk. Nov.	4 th wk. Dec.
Tarai Region	1 st wk. Dec.	3 rd wk. Dec.
Central plains, UP	1 st wk. Dec.	4 th wk. Dec.
Eastern plains	4 th wk. Dec.	3 rd wk. Jan.



Seed Plot Technique: A way for healthy seed potato production in plains.

Low Aphid Period

High Aphid Period



Opened up possibility of producing healthy seed in the plains.

Suitability of regions for seed potatoes:

State	Zone	Type of seed	Remarks
Himachal Pradesh	North high hills	Nucleus, Breeders, Foundation and Certified seed	Low aphids during cropping season and no serious soil and tuber borne disease and pests
Jammu & Kashmir	Northern high hills	Breeders seed, Foundation and Certified seed	Low aphid infestation
	Plains	Foundation and Certified seed	High population of aphids
North-Eastern states	North-eastern high and mid hills	Foundation and Certified seed	High population of aphids and infestation of brown rot
	Darjeeling region	Seed for local use	Wart disease
Punjab, Haryana, UP, MP, Bihar	Indo-Gangetic plains	Nucleus, Breeders, Foundation and Certified seed	Low aphids during October to mid January and no serious soil and tuber borne diseases
West Bengal, Orissa, eastern MP	North eastern plains	Foundation and certified seed	High population of aphids and bacterial wilt
Maharashtra, Karnataka, Andhra Pradesh	Plains and Plateau region	Seed for self use	High population of aphids and brown rot incidence
Tamil Nadu	Nilgiri hills	Seed for self use	Presence of cyst nematode and brown rot incidence

Components of seed plot technique



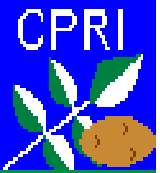


Original Components of Seed Plot Technique

- Use of disease-free seed
- Growing crop under aphid-free period
- Blind earthing up
- Systemic insecticide at planting/ earthing
- Roguing off types and diseased plants

Seed Plot Technique

- Grow the seed crop during the low aphid period coupled with other practices – crop rotation (2-3 years), isolation of 25 - 50m with ware and other solanaceous crops.
- Seed crop should be planted between 10th Oct. to 30th Oct.
- Use healthy and pre-sprouted seed tubers.
- Whole tubers should be planted without cutting.
- For weed control, use herbicides (metribuzin/sencor @ 1ml/liter watre within 3-4 days of planting.
- Nitrogen to be applied should be 25% less than ware crop.



Seed plot technique contd...

- Inspect the crop 3 times at 45 , 60 and 75 days to remove **diseased and off type** plants.
- Spray systemic insecticide (imidacloprid or confidor @ 0.4ml/litre water at 65 and 80 days after planting to control aphids.
- Kill the haulms by **end of December to 20th January** before the aphid level reaches the critical level.
- Harvest the potatoes after 15 days, dry in shade and grade.
- Treat the seed tubers with boric acid 3.0% solution for 25-30 minutes. Dry in shade, pack and cold store.

Potato Seed Production System in India:

- Two systems –
 - i) Formal (Organised /Scientific)
 - ii) Informal (Un-organised)

Formal system: Seed is produced by CPRI in collaboration with NSC, SSC, state govts by following the channel-

- *Nucleus seed
- *Breeder seed
- *Foundation seed
- *Certified seed

Seed Production Scheme:

CPRI to produce Nucleus and breeder seed



State governments to produce F1 and F2 seed



Certified growers to produce Certified seed



Farmers to produce table potatoes

Crop Scheduling for Seed Production

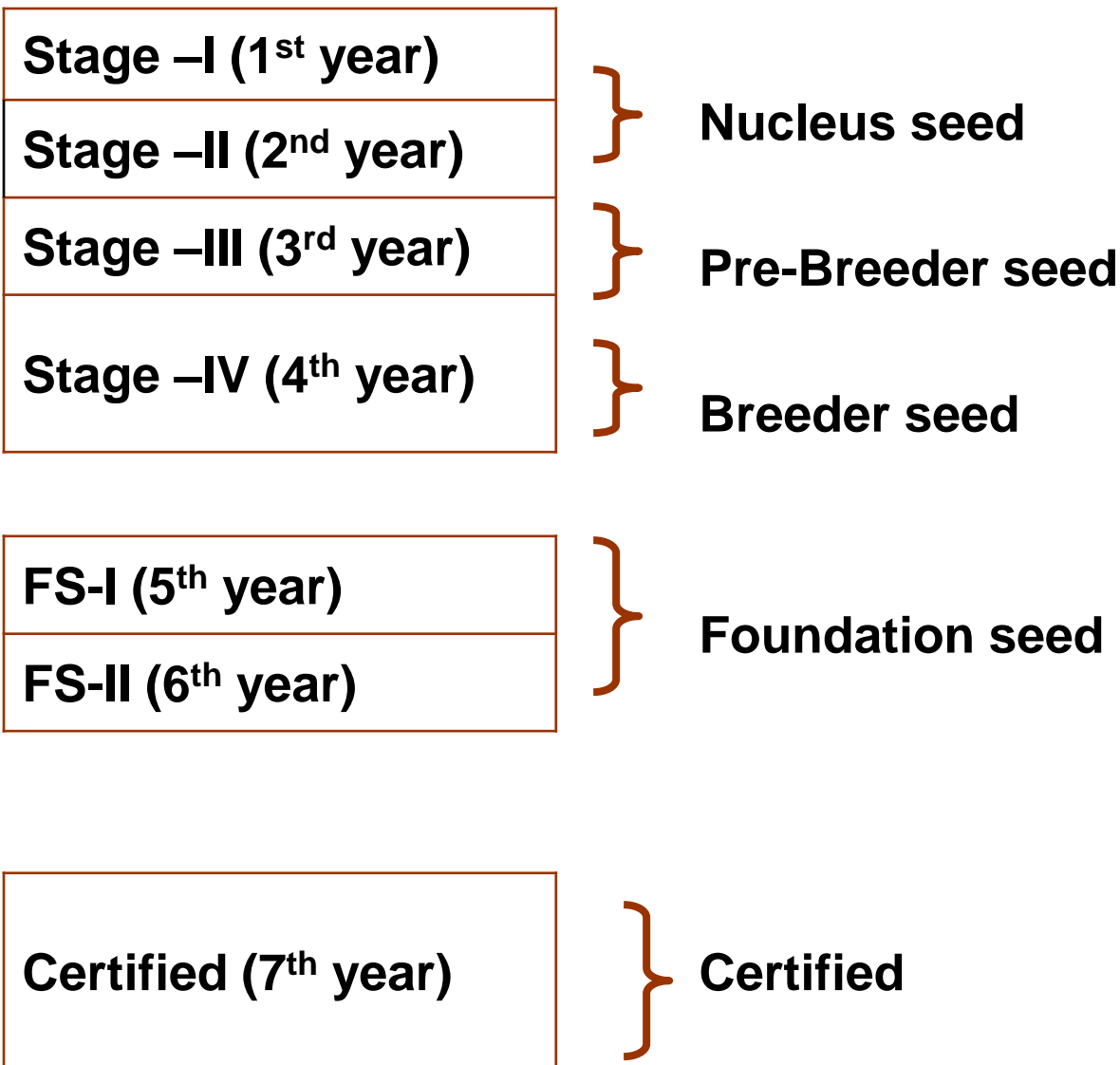
	Plant	Dehaulm	Harvest
Punjab, Haryana	Oct. 7	Dec. 31	Jan. 15
NW & Central plains	Oct. 15	Jan. 7	Jan. 25
Eastern UP & MP	Oct. 31	Jan. 15	Jan. 31
Bihar & W. Bengal	Nov. 7	Jan. 20	Jan. 31

- **1-2 Sprays of systemic insecticide + Metalaxyl + Mancozeb in December**
- **Crop rotation 2-3 years**
- **Green manuring**
- **Hot weather cultivation**
- **Tuber treatment (B. acid)**

Nucleus and Breeder seed production system:

- Two systems:
- Conventional –involves Clonal selection, Indexing and multiplication
- Hi-tech : Micro-propagation (involves production of mini-tubers from Micro-plants/ micro-tubers).

Conventional system of seed production (Clonal multiplication)



Nucleus and Breeder Seed Production

Field	70-80 plants	Singled out in growing crop(4 tubers/plant).
Stage- I	Clonal field multiplicati.	Spacing1 x1m, 200% ELISA tested, harvest individually.
Stage-II	Separate clones in rows	1x0.2m,100% tested in composite samples, bulked.
Stage-III	Bulk multipli-cation	0.6x0.2m, 300 plants/ ha tested , roguing.
Stage-IV	Breeder seed	0.6x0.2m, 150 plants/ ha tested , roguing.

VIRUSES

Potato Virus X
Potato Virus M

Potato Virus S
Potato Virus Y

Potato Leaf Roll Virus
Potato Virus A



Stage I tubers at planting



Stage I planting in field



45 days old plants in Stage 1



Stage 1 plants after 90 days



Clonal planting at Stage II at 1.0 x 0.2 m



Stage III



Stage IV (Breeder seed)



Recommended varieties

Kufri Jyoti, Kufri Chandramukhi, Kufri Kanchan (red)

Kufri Girdhari and Kufri Himalini

Land preparation:

- Try to use different fields not put under potato during last year.
- Give summer deep ploughings during May-June and leave open the fields.
- Grow daincha during July-August and burry it in fields.
- Irrigate the fields well and give 2-3 harrowings and 2-3 ploughings followed by plankings, starting 10-15 days before planting.
- Apply well rotten FYM @ 25-30 t/ha.

Seed preparation:

- Take out seed from stores during the 3rd week of September in the plains and by the end of February/ early March in the hills for Pre –sprouting.
- Spread the seed tubers thinly under shade with diffused light.
- Sort-out the diseased, rotten tubers as well as with abnormal sprouts.



Seed inspection at planting

- Plant only the healthy tubers with good sprouts.
- Do not plant the blind tubers.
- Do not plant the tubers with hairy sprouts.
- Do not plant the infected tubers.
- Plant uniform tubers in each bed to ensure uniform germination and crop.

Abnormal sprouts



Tubers with healthy sprouts



Advantages of Pre-sprouted seeds

Early emergence → Weed control → **Early tuberization**

(Crop matures before late blight and aphid appearance)

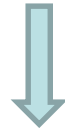
More stems → more tubers → **uniform tuber size** →
Less cracking → Higher yield → Extra income

Fertilizer requirement in seed potatoes

Use **25% less N** than ware crop.

- Try not to keep the seed tubers in touch with fertilizer directly.
- If FYM added @30 tones/ha, then no need to add P and K fertilizers.

Always use **less N** in seed potato crop than Ware



Early tuberization and Maturity



Small sized & healthy tubers





Potato planting

- Most suitable tuber size suggested for planting is 35-50gm (size of an egg).
- Make 3-4 inch deep rows at a distance of 60cm from row to row, across the slope.
- Put the fertilizer mixture uniformly in the rows.
- Mix the fertilizer with soil so that it does not come in direct contact with tubers.

Planting operations:



Planting operations contd...



Roguing of diseased plants:

- Rogue out the **virus infected/ off type and volunteer plants** along with the tubers formed if any during three field inspections at **45, 60 and 75** days after planting.



PLRV



Irrigation:

- Give one irrigation before land preparation and planting.
- Irrigate immediately after planting.
- Ensure that water level should not be more than 2/3 part of the ridge.
- After top dressing and earthing up irrigate the fields.
- Irrigate as per the crop requirement to avoid any drought stress.
- Stop irrigation at least one week before haulms cutting.

Crop	Time interval Initially	Time interval at later stage
Early crop	Weekly interval	10 days
Main crop	8-10 days	12-15 days
Spring crop	12-15 days	8-10 days

Erratic irrigation: Knobbiness and cracking:



Harvesting:

- The crop should be harvested only 10-15 days after haulm cutting when skin is suitably mature.
- Harvesting should be done under suitable soil moisture conditions.

Harvesting:

- The tubers should be partially dried in the field then shade dried.
- The harvest should be properly graded in both cases to get remunerative prices.

Seed treatment, grading, packing and storage

- Potatoes should be graded in 4-5 grades like Large, Medium, Small, Seed Size and Chatts.
- After washing in water, treat only the seed potatoes in 3% boric acid solution for 25-30 minutes. Same solution for 20 times.
- Dry in shade and pack grade wise in gunny bags.
- Store in cool and dark place.



Present Constraints in Seed Production

- Low rate of multiplication and high seed rate.
- Lack of low cost and low risk technology.
- Failure of State Department to multiply the Foundation seed.
- Inadequate infrastructure support, Mechanization.
- Increasing Labour problem.
- Non-adoption of tissue culture based seed production as per DBT/Scientific guidelines.



Future Challenges in Seed Production

- Impact of Climate Change on Vector dynamics and shortening of growing window
- Emerging New Vectors like white fly, thrips, *A.gossypi* aphids, hoppers, Psyllids.
- Emerging new virus diseases like PALCV, CMV, PAMV, PVYn.
- Increasing pressure of soil & tuber borne diseases like common scab, russet scab, black scurf, brown rot, Sclerotium wilt, Sclerotinia stem rot , Verticillium wilt and nematodes.
- Monoculture of potato as well as Increasing cropping intensity.
- Production of quality seed in non-traditional areas.
- Scarcity of Labourer in main seed potato regions .

Limitations of Conventional Seed Production System

- Low rate of multiplication
- Development of 100 % healthy seed stock from infected material is not possible
- Progressive accumulation of degenerative viral diseases
- Several field multiplications of initial disease-free material (7 years)

Why High-tech Seed Production System

?????

- ✓ For countries where no isolated and virus free potato growing areas.
- ✓ Countries having explosive increase in new potato growing areas.
- ✓ Early supply of pre nucleus/nucleus seed to commercial growers by reducing the field exposure time.
- ✓ Improved tuber quality.
- ✓ Reducing the load of degenerative diseases.
- ✓ Utilize the resources and trained manpower year the round.
- ✓ Taking critical decision like choice of propagules, tuber inducing agent, environment, medium components and economics of scale.
- ✓ Vertical growth and reduce pressure on land.



Thank you