

Integrated disease management of potato in the northeastern Himalayan region of India

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Potato (Solanum tuberosum L.) is an important crop after rice and wheat is being grown worldwide. India is second largest producer of potato in the world after China. Potato is also a staple crop of the north eastern Himalayan region of India contributing nearly 10% of the country's total potato area. The main reasons for the low productivity are inadequate availability of healthy seed potato vis-a-vis poor management practices and presence of economically important diseases, viz. late blight, bacterial wilt/brown rot etc. More than 150 potato diseases caused by fungi, bacteria, viruses and physiological disorders are known throughout the world. In the north eastern Himalayan region, foliar diseases are predominant like late blight, early blight and leaf spots but soil and tuber borne diseases are also present in very low incidence, viz. bacterial wilt/brown rot, common scab of potato.

Key words: Bacterial wilt, Integrated disease management, Late blight, Potato

Late blight of potato

Late blight of potato caused by *Phytophthora infestans* is perpetuated problem faced by potato growing farmers in NEH region of India. It occurs in epiphytotic proportions every year in hills. The disease spreads rapidly on susceptible varieties and may kill entire plant within a week leading to heavy potato yield loss.

Symptoms

Late blight affects all parts of the potato plant including leaves, stems and tubers. It is primarily a foliar disease but readily infects the tubers under severe infestation. The characteristic foliar symptoms on any susceptible plant are irregular to circular lesions. Initially, in wet weather, lesions may appear water soaked but in dry weather; the centers tend to dry out. A white mildew (cottony growth) ring forms around the dead areas on the lower side of leaves. The dark centre is often surrounded by yellow, chlorotic tissue or brown, collapsed tissue.

These spots often occur at the tips or edges of leaves. If moist weather condition prevails, the leaf spots enlarge rapidly to blight areas of the foliage. Dark brown discolouration of leaf stalks and stems is also affect commonly. The disease also affects the tubers badly in susceptible cultivars than the resistant ones. Infected tubers develop reddish brown, dry rot lesions.

Integrated disease management

Under conducive conditions for disease development, the late blight disease can spread from one infected leaf to entire field within a short period of time. It is caused by *Phytophthora infestans*. The pathogen shows great plasticity and adapts very quickly to different management practice. It is able to overcome host resistance in 4-5 year in hills and capable of developing fungicidal resistance. A single strategy to manage late blight might not prove effective in long run. Hence, integrated management of the disease through combinations of cultural,

host resistance and chemical is advisable.

Cultural practices

Late blight infected tubers are believed to be the initial source of inoculum for the pathogen in the field. Hence, clean cultivation of potato should be followed. The field should be free from volunteer plants which often serve as source of late blight. The planting material should be healthy and disease free. The disease usually appears in Meghalaya hills at the mid of May. Early planting during first week of February with assured irrigation will be helpful in avoiding the disease occurrence during peak crop growth. Further, high ridges and proper earthing will avoid exposure of seed tubers to pathogen that is washed from the leaves with rainfall. When 75% crop foliage damage, haulms should be cut and removed from field.

Host resistance

The disease resistance varieties are the most economic and eco-friendly

way to manage late blight disease. The cultivars like *Kufri Giridhari* and *Kufri Megha* have high level of late blight resistance and are suitable for growing in hills. *Kufri Himalini* and *Kufri Himsona* are newly released varieties that showed field resistance to late blight.

Chemical practices

Late blight infestation of potato is very likely in wet growing season with the onset of rains. Under such situations, spraying with fungicides become necessary to protect crop from infection. A preventive spray should be applied to the crop with any contact fungicides (mancozeb 0.2%) when the plants in adjacent rows start touching each other (canopy closure). Sticker should be added to the fungicide solution for better retention on leaf surface. A second spray is given to the plant at the beginning of infection with any systemic fungicide (metalaxyl or cymoxanil based). Subsequent spray should be need based application. If disease severity is high, two more sprays with contact and systemic fungicide can be given alternatively at 7-10 days intervals. Since *Phytophthora infestans* has developed resistance against metalaxyl based fungicides, new compound are being identified for its control. At present, cymoxanil based fungicides, viz. cymoxanil+mancozeb (0.3%) and dimethmorph (0.3%) + mancozeb (0.2%) are found effective to manage the late blight.

Early blight and leaf spots of potato

The early blight (leaf spots) is high in the crop raised with imbalanced doses of NPK particularly low nitrogen. It is common in all growing areas specially in central India, plateau of Bihar and Maharashtra. The disease reported to cause significant losses up to 20% in plateau region. In north western, north eastern hills and plains, the disease appears regularly but in lesser importance since late blight takes over. It is caused by *Alternaria solani*. Leaf spots caused *Phoma exigua* and *P. sorghina* also occurred widely in both in plains and hills. It depends upon severity and caused significant yield losses. Leaf spots also caused by

Alternaria alternata and *cercospora solani-tuberosi* but do not cause significant yield losses.

Integrated management of early blight and leaf spots of potato

- Use only disease free seed tubers for planting of potato.
- The crop must be given balanced doses of fertilizers, especially nitrogen.
- If the crop sprayed with 1.0% urea at 45 days and given one more spray after 8-10 days may escape the appearance of early blight and leaf spots.
- Fungicides, viz. Dithane M-45 (0.2%)/ Copper oxychloride (0.3%)/ recommended for control of early blight and leaf spots in hills and plains.
- Avoid the cultivation of solanaceous crops like collateral hosts near potato fields.
- Removal and burning of haulms of the affected potato crop help in reducing the inoculum in the potato field.

Bacterial wilt and brown rot of potato

The bacterial wilt and brown rot disease of potato is common in tropical and subtropical regions. Bacterial wilt is endemic in West coast from Thiruvananthapuram in Kerala to Khera in Gujarat; Karnataka; western Maharashtra; Madhya Pradesh; eastern plains of Assam, Orissa and West Bengal; Chota Nagpur plateau; North-western Kumaon hills (~ 2,300 meters above mean sea level), eastern hills of West Bengal, Meghalaya, Manipur, Tripura, Mizoram, and Arunachal Pradesh; Nilgiris, Annamalai and Palni hills of Tamil Nadu; and Andaman and Nicobar islands.

Symptoms

In early symptom, slight wilting of the top leaves, soon followed by total wilting of plant. If the stem base is cut and squeezed, bacterial mass is seen to ooze out as a dull white slimy mass on the cut surface. Vascular tissues look like a water soaked circle which later may turn brown. When the cut tuber is left for 3-5 minutes, dirty white slime bacterial mass

appears on the circle. Bacterial mass may appear in the form of ooze on the tuber eyes. Initially water soaked spots developed which enlarge forming pitted lesions.

Host range: Pathogen attacks more than 200 plant species, viz. potato, tomato, brinjal, chillies, jute, cotton, ginger etc.

Source of inoculum

- i) Infected seed tubers
- ii) Infested soil

Disease development is mainly influenced by temperature. High temperature promotes bacterial wilt development and the bacterial population is reduced in cold soils. The optimum temperature for bacterial culture *in vitro* is around 28°C. In the field, disease symptoms usually appear when days are above 20°C and average soil temperature above 14°C. Highly soil moisture promotes survival, infectivity, disease development and spread of the bacterial inoculum.

Integrated disease management strategies

- Seed production may be undertaken only in disease free areas.
- Use of healthy and disease free seed for planting.
- Do not use cut seed potato tubers.
- Apply stable bleaching powder @12 kg/ha mixed with fertilizer in furrows at the time of planting.
- Follow 2-3 years crop rotation, viz. maize, cereals, millet, garlic, lupin, onion and cabbage.
- Deep ploughing twice at 20-30 days interval after harvesting in winter of hills.
- Early planting in February in North Eastern hills reduces wilt incidence.
- Collect and burn the diseased plant and tubers after harvesting.

Common scab of potato

The disease usually does not cause yield losses but disfigures the tubers so that reduces market value and quality. It is caused by *Streptomyces sp.* Infected tubers are unfit for planting, reduced sprouts and germination.

Symptoms

The disease mainly affects the

young tubers and its infection stops with the ripening of tubers. Occasionally, it also attacks stolons and roots. The early symptoms on tubers appear as small circular to irregular lesions around the lenticels with periderm turning brown and rough. With the break of periderm, the lesions appear rough and depressed. They consist of corky tissues, which arise as a result of elongation and division of invaded cells. In India, five to six types of common scab lesions are observed (i) a brownish roughening or abrasion of tuber skin, (ii) proliferated lenticels having hard corky deposition around them, gradually forming star shaped lesions (iii) irregularly concentric series of wrinkled layers of cork arranged around the central core which is generally in the form of a brown spot (iv) raised rough and corky pustules (v) 3-4 mm deep pits.

Integrated disease management

- Use of disease free seed potato tubers for planting
- Give tuber dip treatment with 3%

boric acid for 25-30 minutes or before and after cold storage. Dry in shade before storage and planting.

- Irrigate the crop repeatedly to keep moisture in field.
- Maintain high soil moisture in ridges at least for few a weeks during initial tuberization phase.
- Follow crop rotation with wheat, pea, oats, barley, lupin, soybean, sorghum, bajra and green manuring.
- Deep ploughing when the field is fallow.

Integrated management strategies for soil and tuber borne diseases

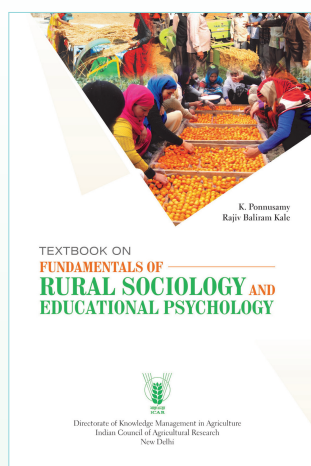
- Use disease free potato seed, preferably from disease free area/ field.
- Treat seed potato with 3% boric acid for 25-30 minutes dip. Same solution can be used for at least 7-8 dips.
- Follow crop rotation with crops like cereals, millets and non-solanaceous crops.
- Follow hot weather cultivation or

soil solarization in plains and plateau and cold weather cultivation in hills.

- In plains and plateau, harvest potato crop before soil temperature rises above 28°C i.e. by the end of February.
- Harvest the potato at full maturity because immature tubers are more prone to injuries.
- Avoid wounds/injuries to the tubers during harvest, handling and transportation
- Store potato tubers to cure for 8-10 days immediately after harvest preferably at 10-15°C and should be stored in well ventilated cold stores.
- If field remains fallow, plough regularly to minimize weeds, which harbour the pathogens.
- Green manuring is also effective for soil and tuber pathogens.

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TECHNICAL SPECIFICATIONS

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