

Diseases panorama in major cool season pulse crops and their bio-intensive management strategies

R K Mishra, A K Parihar* and G P Dixit

ICAR-Indian Institute of Pulses Research, Kanpur, Uttar Pradesh 208 024

Chickpea, lentil and field pea are the most important cool-season crops grown worldwide for their higher productivity and nutritional value. These crops are well known for their high protein, mineral and antioxidant properties. Cool season pulse crops are severely affected by several biotic and abiotic stresses at various growth stages, which hamper their production and productivity drastically. Among the biotic stresses, diseases like wilt, root rot, powdery mildew and rust are the most devastating yield-limiting factors, causing huge losses every year if the environmental conditions are favourable. Most of the cool season pulse crops are consumed directly as green vegetables and salads, so the chemical pesticides and fertilizers cause several detrimental effects and residue problems in humans, animals and wild life, and also directly pollute the environment. Hence, bio-intensive-based interventions are more appropriate, cost-effective and environment friendly approach to manage these major diseases of cool season pulse crops for higher productivity and nutritional security for a large population.

Keywords: Cool-season crops, Disease, Management strategies, Pulses

Pulses are most important food commodity that plays very important role in nutritional security of vegetarian and resource for poor population of developing countries and in soil health maintenance, and improvement as well. In India, pulse crops are being cultivated in *rabi* and *kharif* season, however, spring and summer season also has substantial area under cultivation of mungbean and urdbean. In cool season, 5 pulse crops viz. chickpea, lentil, field pea, lathyrus and rajmash are being cultivated in different parts of the country. Among these, chickpea, lentil and field pea are the major cool season pulse crops. Among these field pea has highest productivity (1441 kg/ha) followed by chickpea (1217 kg/ha) and lentil (904 kg/ha). However, the productivity of these crops is quite low as compare to other countries. One cause for this low productivity is the predominance of biotic and a biotic stresses. Among the biotic stresses, different phyto-

pathogens such as fungi, bacteria, phytoplasmas and virus causes several diseases, which severely affect the crops performance under congenial circumstances and cause significant damage in term of quantity and quality of produce.

Chickpea is mainly affected by

Fusarium wilt, Ascochyta blight, dry root rot, Botrytis grey mould and collar rot. While in case of fieldpea, powdery mildew and rust are the major threat to cultivation. In lentil, Fusarium wilt and rust are the most common diseases, which cause significant yield loss under

Table 1. Major disease of chickpea, lentil and fieldpea

Disease	Chickpea	Lentil	Fieldpea
Rust	<i>Uromyces ciceris-arietini</i>	<i>Uromyces viciae-fabae</i>	<i>Uromyces fabae/pisi</i>
Powdery Mildew	<i>Leveillula taurica</i>	<i>Erysiphe trifolii</i>	<i>Erysiphe pisi</i>
Downy Mildew	<i>Peronospora</i> sp.	<i>Peronospora viciae</i>	<i>Peronospora pisi</i>
Seedling rot or wet root rot	<i>Rhizoctonia solani</i>	<i>Rhizoctonia solani</i> and <i>Fusarium solani</i>	<i>Rhizoctonia solani</i>
Aschochyta blight	<i>Ascochyta rabiei</i>	<i>Ascochyta lentis</i>	<i>Ascochyta pinodes</i>
Stem rot	<i>Sclerotinia sclerotiorum</i>	<i>Sclerotinia sclerotiorum</i>	<i>Sclerotinia sclerotiorum</i>
Wilt	<i>Fusarium oxysporum</i> f. sp. <i>Ciceri</i>	<i>Fusarium oxysporum</i> f. sp. <i>Lentis</i>	<i>Fusarium oxysporum</i> f. sp. <i>Pisi</i>
Botrytis grey mould (BGM)	<i>Botrytis cinerea</i>	<i>Botrytis cinerea</i>	--
Dry root rot (DRR)	<i>Rhizoctonia bataticola</i>	--	--



Fusarium wilt infected chickpea (a) and lentil crops (b)

congenial conditions. In this article, attempts have been made to describe disease symptoms, distribution and their management through integrated approaches in major *rabi* season pulses i.e. chickpea, lentil and fieldpea. The details of causal organism for important disease are given in Table 1.

Important disease, symptomatology and their management strategies

Fusarium wilt

Symptomatology: It is a serious disease of chickpea and lentil causes up to 50% yield loss. It is caused by a soil borne fungal pathogen, which penetrates in the host through roots and stops or reduces water uptake to the foliage leading to wilting, discoloration and eventually death of the plant. The disease appears at seedling stage (early wilt) or during the reproductive stage (late wilt) depending on congenial conditions. The adult plants show typical wilt symptoms like drooping of petioles, rachis and leaflets. The roots of the wilt infected plants do not demonstrate any exterior rotting but when roots cut vertically and open, dark brown continuous discoloration of xylem can be observed. The soil and seeds contaminated by wilt pathogen are the primary source of infection for the development of wilt epidemics in pulses.

Integrated disease management strategies (Cultural, physical, biological, host plant resistance and fungicides):

- Use resistance/tolerant varieties.

- Field sanitation and deep summer ploughing (May-June).
- Intercropping or mixed cropping of chickpea/lentil with linseed.
- Apply decomposed *Sesbania bispinosa*, mustard cake, vermicompost and Farmyard manure at the time of sowing.
- Seed treatment with Dalhanderma (*Trichoderma asperellum* @10 g/kg) or Dalhanderma-1 (*T. afroharzianum* @10 g/kg) at the time of sowing.
- Seed treatment with commercial formulation of *T. viride*, *T. harzianum* and *Pseudomonas fluorescens* (Biocure) @6 g/kg seed + soil application @1 kg/ha at the time of sowing.
- Seed treatment with Carbendazim 50% WP @1 g or Thiram 75% WP @2-2.5 g/kg.

Dry Root Rot (DRR)

Symptomatology: Dry root rot in chickpea is incited by seed and soil borne pathogen. It is most serious in central and southern parts particularly under rainfed situation. Podding and late flowering stages are most vulnerable to this disease; if day temperature goes high (~30°C)



Powdery mildew

Symptomatology: Powdery mildew is a foliar disease of fieldpea causes yield loss up to 80%. It is prevailing in warm and dry days with cool nights. Its symptoms appear on the leaves followed by other greener parts of the plant forming white floury patches on both sides of the leaf as well as on tendrils, pods and stems. These white floury patches subsequently change into greyish brown. As disease progressed, large aerial parts of the host plant may be covered with these white floury patches.



Dry root rot infected chickpea field (A) and single plant (B)

with moisture stress conditions then the disease prevalence is rapidly intensified. The root system remains devoid of lateral roots and tap root become blackish. When uproot the plant usually lower portions of the tap root remains in the soil. Dead roots become hard and fragile, and demonstrate shredding of bark. The dark minute sclerotial bodies can be noticed on the outer surface of roots or inside the base of the stem.

Integrated disease management strategies:

- Use of resistant or tolerant varieties.
- Field sanitation and deep summer ploughing (May-June).
- Moisture stress should be avoided during flowering and podding stages.
- Timely showing of the crop.
- Seed treatment with Dalhanderma (*Trichoderma asperellum* @10 g/kg) or Dalhanderma-1 (*T. afroharzianum* @10 g/kg) at the time of sowing.
- Seed treatment with Carbendazim @2 g/kg of seed + *T. viride* @4 g/kg of seed + soil application of FYM fortified or vermicompost with *T. viride*.



Powdery mildew infected field pea crop

Integrated disease management strategies:

- Field sanitation.
- Foliar spray of fungicides, i.e. sufex @0.2%, Triademorph @ 0.1% or Dinocap @0.1% at 10–15 days intervals at the time of initial appearance of disease symptoms.
- Grow early maturing short-duration varieties.
- Late planting should be avoided.
- Use resistant/tolerant cultivars: IPFD 10-12, IPFD 11-5, IPFD 12-2, IPFD 9-2, IPFD 6-3, IPFD 13-2, IPFD 12-8, IPF 16-13, IPFD 2014-2, Pant Pea 250, HFP 1428, Pant Pea- 347, HFP 715.
- Seed treatment with *Pseudomonas fluorescens* or *Pseudomonas aeruginosa*.

Rust

Symptomatology: Rust is an important air borne disease of field pea, chickpea and lentil. This disease

mainly occurs at the reproductive stage of the crop and form creamy white to light yellow to bright orange coloured pustules on all the aerial parts. Pustules appear on both leaf surfaces and occur more frequently on the lower leaves. During severe infection, pustules can occasionally be seen on stems, petioles, twigs and pods, which results in premature defoliation and possible death of the entire plant. Under congenial conditions, a yield loss has been recorded between 50–100% due to this disease. High humidity and cloudy weather with temperatures of 20–22°C are favourable climatic conditions to the spread of the disease.

Integrated disease management strategies:

- Field sanitation.
- Seed treatment with Diclobutrazole.
- Spraying of biocontrol agents like *Chaetomium globosum* and *Trichoderma koningii* just at the time of first disease symptoms appearance.
- Preventive sprays of fungicides i.e. Mancozeb (0.25%), Propiconazole (0.1%) and Hexaconazole (0.1%) at early disease development stage.
- Cultivation of tolerant/resistant varieties:
Fieldpea: Aman, IPF 4-9, Pant Pea 347, HFP 1428, IPF 16-13, Pant Pea 243, Pant Pea 250, IPFD 12-2, HFP 529 etc.
Lentil: Kota Masoor 4, LL 1373, IPL 220, IPL 316, Pant L 7, KLS 122, KLB 345, IPL 315, IPL 321, IPL 534, IPL 329, IPL 225, Pant Lentil 11 etc.

Ascochyta blight

Symptomatology: This is a serious disease of chickpea and lentil. Its occurrence frequency is highest in chickpea and rarely appeared in lentil and field pea. This disease occurs during cool and moist weather. Initial symptoms include appearance of water soaked lesions on leaves and smaller circular brown spots on leaves, pods and stems. Under congenial conditions, these spots expand quickly and coalesce, blighting the leaves and buds. It spreads mainly by the infected seeds produced from infected crops. The wet and warm weather conditions and dense crop canopy are most favourable to the spread of the disease.

Integrated disease management strategies:

- Crop rotation with non-legume host crops.
- Field sanitation.
- Foliar spraying of Mancozeb @0.25% at 10–15 days' intervals.
- Soil application of *Trichoderma* sp. based formulations @2.0–2.5 kg/acre at the time of sowing or seed treatment @10 g/kg of seed at the time of sowing.
- Use of tolerant/resistant varieties:
Lentil: Pant Lentil – 9, L 4717 etc.
Chickpea: Pusa 1103, RSG 807, DKG 986 etc.
Fieldpea: Pant Pea 347, HFP 1428, Pant Pea 243, Pant Pea 250 etc.

Botrytis grey mould (BGM)

Symptomatology: This disease occurs mainly in cool, cloudy and humid weather during crop season. The disease symptoms first



Rust infected cool season pulse crops, (a) field pea (b) lentil and (c) chickpea



Stem/white rot infected (a) chickpea (b) lentil and (c) fieldpea

appear as water-soaked lesions on the stem, near ground level, that later extend along the stem, and lead to the infection of other stems. Branches break-off at the rotting point and the affected leaves and flowers turn into a rotting mass. The fungus can develop light grey or brown to light brown lesions on leaflets, branches and pod. Flowers and pods may abort in affected crop under condition of severe infection, leading to complete yield loss.

Integrated disease management strategies:

- Field sanitation.
- Dry seed dressing with Vinclozolin (Ronilan), or Carbendazim + Thiram combination.
- Seed treatment with Trichoderma based formulation i.e. Dalhanderma @10 g/kg of seed at the time of sowing.
- Use of tolerant/resistant varieties: Chickpea: CSJ 515, RSG 974, Pant kabuli chana-1, Pant Gram-4, Pant Gram-3, Pant kabuli Gram-2, Pant Gram-6, DKG-986

Stem rot/white rot

Symptomatology: It is a major disease of field pea, chickpea, and lentil. When conditions are favourable like high relative humidity in the canopy at flowering stage, the fungus kills tissue and fills the stem with white cottony like hyphae growth and sclerotia. This is a soil-borne fungus that attacks plant in all stages of crop growth including young seedlings, mature plants and their harvested products.

Integrated disease management measures:

- Proper seed cleaning during threshing and processing period.

- Field sanitation and deep summer ploughing.
- Spray of fungicides (Carbendazim @0.1%) at 10–15 days intervals.
- Use of healthy seeds, clean cultivation and 3-year crop rotation.

Alternaria Blight

Symptomatology: It occurs sporadically under the cloudy and foggy weather condition in the month of November-December. It is a seed borne disease appears at flowering and podding stage of the crop. Initially symptoms, a water-soaked, small, circular, and pale brown lesion appears on leaf margins and tips, particularly on older leaves. Later these lesions turn brown to dark brown and the affected leaflets drop off the plant. During severe infection, dark brown, slightly sunken, elongated scattered lesions also formed on stems, petioles, flowers and pods and affected pods turn dirty black. The pods contain shriveled seeds.

Integrated disease management strategies:

- Use of resistant cultivars.
- Excessive irrigation should be avoided during vegetative and flowering stage.
- Adopt wider spacing to decrease plant density.
- Intercropping with linseed and other non-legumes.
- Seed treatment with Thiram 3 g/kg or Vinclozolin or Dithane M-45 at the time of sowing.
- Foliar application of Mancozeb @2.0 g/litre of water at the time of first disease symptoms appearance.

Downy mildew

Symptomatology: Yellowish to brown scattered patches are appeared on the upper surface of the leaves, leaflets and stipules of young plants. Later on, it progressed in the form of downy growth in patches on the lower surface of entire leaves analogous to the lesions of the upper surface. As the disease advances, the affected tissues turn brownish grey, dry up and too early dropping of leaves. On pods, the disease is first noticed when they are green and flat. The patches are as pale green, more or less elliptical in shape, blotches on the sides, or more irregular, elongated lesions along the pods.

Integrated disease management strategies:

- Sanitation and crop rotation.
- Deep summer ploughing during the month of May–June.
- Spraying of Ridomyl @1.0 ml/litre and Mancozeb @2.5 gm/litre of water at 15 days' intervals.

SUMMARY

To minimize the losses through diseases and enhancing the yield in major cool season crops, bio-intensive approaches are needed for the management of important fungal diseases. Therefore, bio-intensive disease management strategies for important cool season pulses given in this article are need to be adopted judiciously to accelerate productivity. This would certainly be helpful in achieving the target of pulse production in the stipulated time frame.

*Corresponding author's e-mail: ashoka.parihar@gmail.com