10. MAJOR DISEASES OF LEGUMINOUS CROPS IN JAPAN

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The diseases of leguminous plants are causing severe and widespread damage to this valuable plant every year in Japan. Some of the common diseases of the plants result in death of the young seedlings; some result in injury or death of the growing plants; and some result in spots on pods and seeds. Most of the serious diseases of the plants are caused by viruses, fungi, and bacteria.

List of Common Diseases of Leguminous Plants in Japan

The list of diseases of leguminous plants has been complied from the literature published in Japan.

a. Diseases of soybean

English name	Name of causal agent
Virus diseases	Soybean mosaic virus
	Soybean stunt virus
	Soybean dwarf virus
	Alfalfa mosaic virus
	Bean yellow mosaic virus
Bacterial blight	*Pseudomonas glycinea var. japonica* (Takimoto) Savulesuc
Bacterial pustule	*Xanthomonas phaseoli* var. *sojensis* (Hedges) Starr et Burkholder
Fusarium blight, Fusarium pod-rot	*Fusarium oxysporum* (Schlechtendal) Snyder et Hansen
Downy mildew	*Penonospora manshurica* (Naoum) Sydow
Basal stem rot	*Ophionectria sojae* Hara
Ring leaf spot	*Ascochyta sojaecola* Abramoff
Brown leaf blotch	*Mycosphaerella sojae* Hori
Brown spot, Leaf spot	*Septoria glycines* Hemmi
Sclerotinia rot, Stem rot	*Sclerotinia sclerotiorum* de Bary
Pod and stem blight	*Diaporthe phaseola* Sacc. var. *sojae* (Lehman) Wehmeyer
Sphaceloma scab	*Elsinoe glycines* (Kuribayashi et Kurata) Jenkins
Sleeping blight	*Septogloeum sojae* Yoshii et Nishizawa
Rust	*Phakeopsora pachyrhizi* Sydow
Pod canker	*Macrophoma mame* Hara
Purple speck, Purple blotch or purple stain of seed	*Cercospora kikuchi* (Matsumoto et Tomoyasu) Gardner
Sclerotial blight	*Corticium rolfsii* Curzi
Charcoal rot	*Macrophomina phaseoli* Lehman et Wolf
Anthracnose	*Colletotrichum truncatum* (Shw.) Andrus et Moore
	Colletotrichum trifolii Bain et Essary
	Glomerella glycines Lehman et Wolf
	Gleosporium sp.

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Fusarium blight	*Fusarium oxysporum* f. sp. *tracheiphilum* (Sch.) Snyder et Hansen
	Fusarium moniliforme (Sheld) Snyder et Hansen
Phyllosticta canker	*Phyllosticta sojaecola* Massal
Rhizoctonia aerial blight	*Rhizoctonia solani* Kühn
Gray leaf spot	*Pleosphaerulina americana* (Ellis et Everh.) Hara

b. Diseases of bean

English name	Name of causal agent
Virus diseases	Bean common mosaic virus
	Bean yellow mosaic virus
Bacterial wilt	*Pseudomonas solanacearum* (E. F. Smith) E. F. Smith
Bacterial blight	*Xanthomonas phaseoli* (Smith) Dowson
Halo blight	*Pseudomonas phaseolicola* (Burk.) Dowson
Gray mold	*Botrytis cinerea* Persoon
Angular leaf spot	*Phaeoisariopsis griseola* (Sacc.) Ferdinand.
Ascochyta leaf spot	*Ascochyta phaseolorum* Saccard
Brown leaf spot	*Phyllosticta phaseolina* Saccard
Stem rot, Watery soft rot	*Sclerotinia sclerotiorum* de Bary
Leaf spot	*Macrosporium fasciculatum* Cooke et Ellis
Fusarium root rot	*Fusarium solani* f. sp. *phaseoli* (Burk.) Snyder et Hansen
Rust	*Uromyces appendiculatus* (Persoon) Link
Stem rot	*Corticium rolfsii* Curzi
Charcoal rot, Ashy stem bligh	*Macrophmina phaseoli* (Maub.) Ashby
	Cercospora cruenta Saccard
Anthracnose	*Glomerella lindemuthianum* (Sacc. et Magn.) Shear
Powdery mildew	*Spaerotheca fuliginea* (Schlechtendal) Pollacci
Cottony leak	*Pythium aphanidermatum* (Edson) Fitzpatrick

c. Diseases of pea

English name	Name of causal agent
Virus diseases	Pea dwarf mosaic virus
	Bean yellow mosaic virus
	White clover mosaic virus
	Alfalfa mosaic virus
	Cucumber mosaic virus
	Water melon mosaic virus
Bacterial stem rot	*Xanthomonas pisi* Goto et Okabe
Bacterial blight	*Pseudomonas pisi* Sackett
Downy mildew	*Peronospora pisi* Sydow
Gray mold, Botrytis pod rot	*Botrytis cinerea* Persoon
Leaf spot, Ascochyta blight	*Ascochyta pisi* Libert
Mycosphaerella blight	*Mycosphaerella pinodes* (Berk. et Blox.) Stone
Choanephora rot	*Choanephora cucurbitarum* (Berk. et Rav.) Thaxter
Sclerotinia rot	*Sclerotinia sclerotiorum* de Bary
Rhizoctonia stem rot	*Rhizoctonia solani* Kühn
Damping off	*Phthium debaryanum* Hesse

Rust	*Uromyces fabae* de Bary
Foot rot	*Ascochyta pinodella* Jones
Seed spot	*Alternaria fasciculata* (Cooke et E[lis) Jones et Grout
Anthracnose	*Colletotrichum pisi* Patouillard
Powdery mildew	*Microsphaera poligoni* (de Candolle) Sawada
Root rot	*Fusarium solani* f. sp. *pisi* (Jones) Snyder et Hansen
	Fusarium solani f. sp. *radicicola* (Wr.) Snyder et Hansen

d. Diseases of cowpea

English name	Name of causal agent
Virus diseases	Asparagus bean mosaic virus
	Cucumber mosaic virus
Common blight	*Xanthomonas phaseoli* (Smith) Dowson
Fuscus blight	*Pseudomonas phaseoli* var. *fuscans* (Burk.) Starr et Burkholder
Sclerotinia rot	*Sclerotinia sclerotiorum* de Bary
Frog-eye spot	*Corynespora vignicola* (Kawamura) Goto
Rust	*Uromyces vignae* Barclay
Southern blight	*Corticium rolfsii* Curzi
Sooty blotch	*Cercospora cruenta* Saccardo
Gray stem rot	*Macrophomina phaseolina* (Maub.) Ashby
Powdery mildew	*Erysiphe pisi* de Candolle
———	*Phyllosticta phaseolina* Saccardo

e. Diseases of peanut

English name	Name of causal agent
Virus dideases	Groundnut rosette virus
	Turnip mosaic virus
	Bean yellow mosaic virus
———	*Pseudomonas solanacearum* (E. F. Smith) E. F. Smith
Early leaf spot	*Mycosphaerella arachidicola* (Hori) Jenkins
Small sclerotinia rot	*Sclerotinia arachidis* Hanzawa
Stem rot	*Diplodia natalensis* Pole-Evans
Late leaf spot	*Mycosphaerella berkeleyii* Jenkins
Violet root rot	*Helicobasidium mompa* Tanaka
Large sclerotinia rot	*Sclerotinia miyabeana* Hanzawa
Southern blight	*Corticium rolfsii* Curzi
Root rot	*Cylindrocladium scoparium* Morgan
Rust	*Puccinia arachidis* Speg.
Gray mold leaf and stem rot	*Botrytis cinerea* pars.

f. Diseases of Adzuki bean

English name	Name of causal agent
Virus diseases	Adzuki mosaic virus
	Cucumber mosaic virus
Bacterial blight	*Xanthomonas phaseoli* (Smith) Dowson

Leaf blotch	*Clathrococcum nipponicum* Hiura
Ascochyta leaf spot	*Ascochyta phaseolorum* Saccardo
	Phyllosticta phaseolina Saccardo
Rust	*Uromyces azukicola* S. Hirata
Southern sclerotium blight	*Corticium rolfsii* Gurzi
Charcoal rot, Ashy stem blight	*Macrophomina phaseoli* Ashby
Leaf spot	*Cercospora cruenta* Saccardo
Anthracnose	*Colletotrichum phaseolorum* Takimoto
Powdery mildew	*Pshaerotheca fuliginea* (Schlech.) Pollacci

g. Diseases of broad bean, horse bean

English name	Name of causal agent
Virus diseases	Broad bean necrosis virus
	Pea dwarf mosaic virus
	Bean yellow mosaic virus
Bacterial leaf blight	*Pseudomonas viciae* Uyeda
Downy mildew	*Peronosopa viciae* (Berk.) de Bary
	Phytophthora nicotianae Breda de Haan
Brown spot, leaf spot	*Ascochyta fabae* Spegazzini
Stem rot, sclerotinia rot	*Sclertinia sclerotiorum* de Bary
Rhizoctonia rot	*Rhizoctonia solani* Kühn
Ring spot, zoante leaf spot	*Cercospora zonata* Winter
Rust	*Uromyces fabae* (Per.) de Bary
Chocolate or red spot	*Botrytis fabae* Sardina
Stem rot, sclerotial blight	*Corticium rolfsii* Curzi
Stem wilt, root rot	*Fusarium oxysporum* (Schl.) Snyd. et Hans. f. sp. *fabae* Yu et Fang

Some Aspects of Legume Disease Investigations in Japan

(1) Virus diseases

On the diseases caused by virus, the author will discuss only on the more imprtant and representative ones.

The virus diseases of soybean caused by SMV, SSV, and AMV are found over all soybean areas. But the virus disease caused by SDV seems to be limited in Hokkaido district. The characteristic symptoms of SMV are crinkly, mosaic, feathery mottling, and mild mottling. The virus is transmitted by juice and aphids, or through seeds. The soybean plants infected with SMV produce mottle seeds. The pattern of mottling is a patch, blotch or a band that make a right angle with the hilum macroaxis. It is called as the radical pattern. The early symptom of the virus disease caused by SSV is the top bent with veinclearing of growing leaves. The following symptom is the mild mottling of leaves accompanied with slight crinkilng and reduction in size. The petiole and internode are more heavily shortened than by the SMV. SSV is transmitted by juice and sphids, or through seeds as well as SMV. The soybean plants infected with SSV also produce mottle seeds as well as those infected with SMV. Mottling patern caused by SSV is generally a concentric ring and distinguishable from the radical pattern caused by SMV. The virus disease caused by SDV was first found in Hokkaido district in about 1952. The soybean plants infected with SDV show dwarfing and downward curling,

and or the interveinal yellowing of leaves. This virus is transmitted by aphids and grafting but is not transmitted by juice and seeds. The soybean plants infected with this virus do not produce mottling seeds.

The virus disease of broad bean caused by broad bean mosaic virus is found in a part of Kyushu district. The symptom appears as mosaic and necrotic spots on growing leaves. The plants infected severely sometimes die out. The virus is transmitted through soil, but not by aphids.

AzMV and CAMV are serious to azuki-bean and cowpea plants. The viruses are transmitted through seeds, and the virus are recovered from embryos of the diseased seeds.

(2) Fungus diseases

The diseases caused by *Sclerotinia scleotiorum* are important economically for bean and soybean. The diseases cause the loss of yield. The causal fungus develops under high humidities and fairly cool temperatures. The disease attacks the stems, leaves, and pods. Small soft water spots appear first. The spots enlarge rapidly under cool and moist condition. Within one or two days after infection, the dense masses of white mold grow out over the infected spots. The sclerotia are formed on the spots and they remained for a long period sometimes as long as 10 years. The infection of causal fungus to the host plants takes place on any parts of dead plants by mean of spores.

Next important disease is anthracnose. The disease is severely occurred under moderately cool and humid condition. The infection of causal fungus may occure on any parts of the plants above ground and almost any stages of growth. The very small reddish brown elongated spots appear on leaves and pods first. The spots gradually become more or less circular and are sunken at the center. During moist weather the fungus produces numerous spores, which give the canker a pinkish color.

Sclerotial blight of legume plants caused by *Corticium rolfsii* is also important. The disease is characterized by a rot at the base of plants stems. The sclerotia are round and brown. The disease occures only in southern parts of Japan. The incidence of the disease is limited by temperature. The disease is more important for forage crops such as clover and alfalfa than for bean and soybean.

Purple stain of seed is one of the important diseases of soybean. The disease considerably reduces yield, quality and the market price of products. The incidence of the disease is most vigorous when the mature time of seeds meets wet weather condition. The symptom of purple stain of seed is most evident on seeds. The discoloration varies from pink or light purple to dark purple and ranges small spot to the entire area of seed coat.

Sphaseloma scab of soybean caused by *Elisinoe glycines* was discovered by Kuribayashi in Nagano prefecture in 1947. The disease has been occurred very severely in soybean area of Tohoku distritc and Nagano prefecture. But it became less important.

Early leaf spot and late leaf spot of peanut are important and the most destructive diseases during the growing season. The symptom of early leaf spot caused by *Mycospharela arachidicola* is large spots and reddish brown to black on the lower surface and light brown on the upper surface of the leaf. A yellow halo surrounds each spot. The symptom of late leaf spot caused by *Mycospharela berkeleyii* is dark brown or black spot on both surface of the leaf. The spots are usually somewhat smaller than those of early leaf spot.

Root rot disease of peanut has become important in recent years. The disease attacks roots, pegs, and pods. The infected parts are brown to black. Severely infected roots are sometimes fallen out.

Rust of peanut has become important in recent years.

The studies on the rust is progressing at Chiba Agr. Experiment station.

Chocolate or red spot of broad bean caused by *Botrytis fabae* is one of the important disease for broad bean. The disease attacks leaves, stems and sometimes pods. Reddish brown spot appears on leaves at first and lately it develops enlarged. The disease occures under humid condition.

(3) Bacterial diseases

Bacterial diseases of legume plants are found to some extent over most of legume plant areas. But they are not so serious as the diseases caused by fungi and viruses.

Control Measures for Legume Diseases

1) Virus diseases

The most effective control measures for virus diseases are (1) planting disease-resistant varieties, (2) using virus free seed, (3) rotating crops, (4) eliminating of diseased plants out of field.

2) Fungus diseases

The most effective control measures for fungus diseases are (1) planting disease-resistant varieties, (2) using of disease free seed, (3) rotating crops, (4) eliminating of diseased plants out of field (5) spraying of fungicides.

Discussion

H. K. Jain, India: What are the host specificities of *Fusarium oxysporum* and *Fusarium solani?* Do they attack more than one legume species and have several races? Are there any varieties which are resistant?

Answer: The host specialities of *Fusarium oxysporum* and *F. solani* are based on their biological or physiological specializations. The specialized type is called physiological race, Many races are found in *Fusarium oxysporum* and *F. solani.*

One race which attacks soybean plant is not able to do other leguminous plants. Yes, there are some resistant varieties.

P. P. Kurien, India: You mentioned about the serious incidence of fungal infections in different legumes. Does it cause any serious problem of Aflatoxin and other similar fungal toxins in the grains, especially in soybeans and peanut? What is the extent of toxin contamination in indigenous crops.

Answer: I think, aflatoxin may be effective in infecting causal fungus to the host plants, but I do not know well about them.

Sadikin Somaatmadja, Indonesia: Do you have any bacterial disease (*Xanthomonas solanacearum*) in peanut in Japan?

We have received some peanut varieties from Japan, among which about 90 to 100% of the Virginia type were attacked by *Xanthomonas solanacearum.*

Answer: Yes, we have, but it is not so serious as the diseases caused by fungi.

Baluch, M. K., Pakistan: 1) Could you give us the details of the techniques and the equipment used for the identification of various viruses in Japan.

2) Also kindly elucidate the process and program of producing the virus free seed in Japan, as you have recommended the use of virus free seed to avoid the damage through viruses.

Answer: 1) The following techniques are used for the identification of various viruses in Japan:

(a) Observation of the symptoms in the differential host plants,
(b) test of physico-chemical properties of the virus,
(c) observation of morphorgy and size of virus particles,
(d) by using electron microscope,
(e) serological test of the virus.

2) The virus free seeds are able to get from virus free plants.

Sadikin Somaatmadja, Indonesia: Is bacterial disease (*Xanthomonas solanacearum*) not important in peanut in Japan? Introduced peanut varieties to Indonesia proved to be very sensitive to this kind of disease.

Answer: Yes, there is the bacterial disease of peanut caused by *Pseudomonas solanacearum* in Japan, but it is not so serious as fungus diseases. It may depend on the cool weather in Japan.

Sadikin Somaatmadja, Indonesia (Comment): The excess of water in the soil during the ripening may also cause mottling seeds of soybean. This usually occurs in the yellow varieties with colored hilum (black or brown).