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The following is a compilation of information concerning the more frequently encountered diseases of potatoes in South Dakota.* Consideration of individual diseases has been intentionally limited to include only that information of particular importance in the production of certified seed tubers.

It is not intended that all questions or problems of growers can be solved by consulting the following pages. Instead, this material is an attempt to present information which can serve as a starting point in understanding the nature, symptoms, and prescribed measures for control of a few important diseases of potatoes.

* The diseases with an asterisk after the common name were found in South Dakota in 1952.

Blackleg*

Cause: Bacterial

Symptoms: Infected seed pieces decay if soil is moist and moisture persists. Bacteria invade portions of shoot adjoining seed piece and entire base of shoot which becomes blackened and mushy. Commonly the whole plant wilts and dies. If soil moisture decreases following infection, outer portions only of base of shoot become shriveled and blackened (typical "blackleg"). Growth of whole plant subsequently retarded, leaflets often become reddish at tips, and branches noticeably upright and rigid. Whole plant eventually becomes pale and yellowish and frequently dies.

Tubers may be infected in field through stem end with internal decay resulting. Frequently disease known as "soft rot" develops in tubers in storage, appearing as watery, slimy rot with offensive odor. This phase of disease often follows sun scald, insect injuries, freezing, and bruising during harvest.

Disease Development: Bacteria capable of overwintering in soil, decaying plant debris, and tubers. High humidity necessary for infection and disease development. Maggot fly often important in transmission. Adult flies lay eggs on decaying tubers in refuse piles, larvae contaminated internally from ingesting such material, contamination persists through life of insect. Eggs, laid around base of potato shoots or in ground cracks before shoots emerge, are contaminated as are larvae which promote possibility of infection by gnawing seed piece. Infection more probable with poor storage of cut seed.

Control: Destroy refuse piles.

Plant seed without curing or keep in cool, well-ventilated storage until planted.

Avoid undue injury during harvest and handling.

Dry quickly as possible after washing (preferably before sacking).

Ring Rot*

Cause: Bacterial

Symptoms: Diffuse, progessive pale yellowing of leaflet margins with possible wilting. Distinctive marginal dieback follows and increases with yellowing. Entire plant commonly becomes stunted and may wilt; stem shows interior browning. Characteristic milky fluid from squeezing lower regions of cut stem. Temperature of 60°F. sufficient to mask symptoms.

Infected tubers may or may not exhibit symptoms before or during storage. Tuber breakdown first apparent by discoloration (light yellow becoming brown to black) in "ring" near surface edge of halved tuber. Further development of disease in tuber characterized by ooze, especially by squeezing. Extensive tuber breakdown may be followed by dehydration and dry powdery appearance, or secondary rot resulting in mushy decay. Internal decay sometimes exhibited only as spots on tuber surface.

Disease Development: Bacteria persist over winter chiefly in tubers, but can survive in dried slime on bags, machinery, or bins; not known to overwinter in soil except in volunteer plants. Infection occurs through wounds, bruises, other injuries.

Contaminated cutting knives and machinery most important annual source of bacteria and quite efficient in transmission.

Control: Thorough disinfection of bags, bins, warehouses with copper sulfate (25#/100 gallons water).

Thorough disinfection of machinery with formaldehyde (1 part formaldehyde/10 parts water) or other disinfectants capable of giving 5000 p.p.m. chlorine (Hilex, Purex, etc. 1 part/4 parts water).

Mercuric chloride (1 part/500 parts water) or boiling water bath for rotary cutting knife or mercuric chloride (1 part/500 parts water) continuously

pouring over stationary two-edged knife.

Allow only foundation or certified seed on premises after cleanup.

Teton and Saranac field tolerant varieties but not immune.

Verticillium Wilt

Cause: Fungus

Symptoms: Lower leaves often yellow first. Length of stem between leaves shortened resulting in tuft of leaves at top of plant. Upper leaflets fold upward and inward on midrib, sometimes followed by sudden wilting. Vascular system (interior of shoot) frequently discolored, some tuber stem-end browning. Often difficult to identify in field.

Disease Development: Fungus capable of passing winter in tuber and plant debris, good soil inhabitant. Fungus capable of infecting wide range of plants eliminating crop rotation as control.

Disease usually most severe in cooler temperatures.

Control: Soil sterilization and resistant varieties when introduced.

Field control difficult.

Late Blight

Cause: Fungus

Symptoms: May appear on foliage any time weather conditions favorable. Leaves and stems show brownish to purplish-black spots that enlarge rapidly in favorable weather. White "mildew" on under side of leaf spots. Characteristic odor noticeable in field when disease progressing rapidly.

Tubers infected in hill, during harvest, or in storage. Brown to purple discolored areas on tuber surface with discoloration extending one-half inch below surface. Secondary decay usually follows in storage, known as "wet-rot".

Disease Development: Fungus overwinters chiefly in tubers, shoots becoming infected in spring from diseased seed pieces. Fungus fruits just above ground level and reproductive bodies airborne. Humidity necessarily 91% or above and temperature 37-78°F for infection which may take place in 1-2 hours. Cool moist nights essential for epidemics.

Method of tuber infection not clearly understood, but decidedly more severe when vines still green and diseased at harvest.

Control: Two methods of breeding being employed for resistant varieties:

1) resistance from Solanum demissum (wild potato) incorporated into resistant varieties Essex, Snowdrift, Kennebec; 2) resistant varieties Sebago, Menominee, Calrose result of crosses between susceptible varieties. Variations within fungus complicating breeding program, however.

Vine sprays efficient control if foliage properly protected.

Dithane Z-78 replacing Bordeaux mixture as effective spray. Alternating applications of Zerlate and Tribasic Copper sulfate also effective.

Preharvest vine killing recommended in cool northern climates.

Early Blight*

Cause: Fungus

Symptoms: Brown to black spots on leaflets, concentric ridges in spots (resemble target board). Severe infection induces leaf drop.

Infected areas on tubers slightly darker than healthy skin, somewhat sunken, circular or irregular in shape. Inner tuber tissues brown, corky rot not more than one-quarter inch deep.

Disease Development: Fungus may persist in dry leaves for year or more. Spores remain viable at room temperature for up to 17 months. Spores air borne, induce infection in 1-2 hours at 42-93°F. leaf spots visible in 2-3 days, older (lower) leaves attacked first and disease more severe at cooler temperatures.

Control: Dithane Z-78 effective if foliage kept well covered.

High soil fertility seems to reduce severity of disease.

Rhizoctonia*

Cause: Fungus

Symptoms: Sprouts from seedpieces often killed (possibly before emergence) as may be successive sprouts. Later disease characterized by blackened areas on outer portions of underground shoot which interfere with normal development of plant. Stunting, purpling of foliage, tubers at bases of leaves often result.

Tubers exhibit sclerotia ("dirt that won't wash off") on surface; causes no storage breakdown.

Disease Development: Fungus subsists in soil or as sclerotia on tubers. Various types of fungus especially adapted to certain crops, although rotation of one specific crop with others tends to reduce concentration of fungus inciting disease of that particular crop.

Control: Shallow planting of seedpieces. Treating of seedpieces not advisable since fungus prevalent in soil.

Purple Top*

Cause: "Aster-yellows" virus.

Symptoms: Appears not earlier than midseason (usually after tuberization has begun). Young top leaflets roll upward, especially at base; terminal growth of shoot retarded. Leaflets often become purplish, rigid. Aerial tubers frequently formed at bases of leaves.

Disease Development: Not transmitted mechanically (see footnote) or by tubers from diseased plants. Transmitted by leafhoppers (10 days or more after feeding on diseased plant) which may remain infectious from one season to next. Virus carried over winter in northern states in perennial weeds. Appearance and extent of disease dependent upon insects.

Control: Leafhopper and perennial weed host (especially milkweed) eradication.

Footnote: Mechanical transmission of virus indicates transmission to healthy plant by: 1) rubbing leaves of healthy plant after first rubbing leaves of diseased plant; 2) rubbing juice of infected leaves on leaves of healthy plant.

Spindle Tuber*

Cause: Spindle tuber virus.

Symptoms: No mottling of foliage, often darker green than normal; leaflets, especially margins, sometimes slightly puckered. Plant somewhat dwarfed, petioles characteristically upright giving appearance of stiffness.

Tubers longer than usual--"spindle shaped", with excessive number of eyes (especially near bud end).

Symptoms best expressed in warm soil with plentiful moisture.

Disease Development: Virus carried over winter primarily in tubers, transmitted by aphids, grasshoppers, and flea beetles as well as by cutting knife and picker planters.

Field spread (in Nebraska) greater than with mosaics or leafroll.

Control: Use of seed low in virus content.

Eradication of aphids, grasshoppers, and flea beetles.

Mosaics*

Cause: Latent (X, or healthy potato virus); mild (A, or crinkle virus); Rugose (Y, or veinbanding virus).

Symptoms: Latent: Top killing in many European varieties. North American varieties vary in symptom expression from no external symptoms to mottle, stunting, necrotic (dead) spots on leaves and/or in tubers. Nearly all older standard varieties in U.S. generally infected and essentially symptomless. Expression of external symptoms favored by cool temperatures, short daily exposures of 73°F or above sufficient to mask.

Mild: Some European varieties exhibit no external symptoms, others become completely necrotic when infected. North American varieties vary in reaction from various degrees of mottle to top killing. Undersize only symptoms on tubers. Cool temperatures promote severe mottling and stunting, masking at warm temperatures.

Rugose: Leaflet puckering and curling most conspicious early symptoms with mottle less prominent. Subsequent spotting on leaflets starting on lower leaves increases until leaf killed, often clinging to stem. Tubers unaffected other than reduction in size. External symptom expression favored by warm temperatures and supressed by cool.

Disease Development: No insect known to transmit latent, but aphids transmit mild, rugose. All three transmitted mechanically. Seed tubers chief means of perpetuation of all three diseases.

Control: Use of seed tubers low in virus content primary measure. Immunity from X of seedling 41956 being incorporated into breeding programs. Rural New Yorker and Irish Cobbler resistant to mild.

Leaf Roll*

Cause: Potato leaf roll virus.

Symptoms: Primary symptoms (current season infection) usually appear after mid-season on upper leaves. Secondary symptoms (previous season infection) appear soon after emergence and continue development until whole plant eventually involved.

Affected leaflets roll upward from margins toward midrib; become rigid, leathery, with whole plant often appearing more erect than normal with foliage lighter green than normal, possibly tinted reddish, but no mottling. Number and size of tubers decreased.

Disease Development: Principal method of perpetuation by infected tubers. Several aphids capable of field transmission. Disease increase rate and extent dependent upon aphid population.

Control: Use of seed low in virus content.

Thorough control of aphids.

Chippewa and Katahdin show no phloem necrosis of tubers

Breeding for resistance in progress.

Sources of Potato Seed

1. Purchase from foundation farm or certified grower
    - A. Expensive, not always reliable
    - B. Saves time and trouble of producing own seed
2. Replanting certified or unclassified seed
    - A. Frequently unsuitable for certification without roguing
    - B. Inexpensive
3. Individual Tuber Unit Plots
    - A. Extra time planting and roguing
    - B. Provides seed of which grower feels certain

Determining Disease Content of Seed

1. Greenhouse indexing
    - A. Extensive greenhouse facilities necessary
        1. Indoor
        2. Restricted size of sample
2. Southern test plots
    - A. More reliable information
        1. Outdoor
        2. Larger sample
    - B. Advertising