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Management of Phytophthora Diseases of Soybeans

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Phytophthora diseases of soybean, caused by *Phytophthora sojae*, are present wherever soybeans are grown in Nebraska. The pathogen survives primarily as “resting” spores in the soil or in association with infested crop debris. Symptoms associated with *Phytophthora sojae* infections include seed rots, pre- and post-emergence damping off of seedlings and stem rot of plants at various growth stages. Disease development is most rapid at soil temperatures above 60°F with high soil moisture. This disease is most common in low-lying areas of a field, in poorly drained or compacted soils, and in soils with high clay content. It also may occur on well-drained hillsides during growing seasons with excessive moisture availability. Currently 55 races of the pathogen have been identified. In 2000, *Phytophthora sojae* race surveys for soybean were initiated with funding from the Nebraska Soybean Board. As a result of ongoing survey efforts, races 1, 3, 4, 25, and 28 have been recovered from soybean fields in Nebraska. Previous surveys were conducted in eastern Nebraska in 1980 and 1981 and resulted in recovery of races 1, 3, 9, 14, 18, and 23.

Once *P. sojae* is established in a field, it cannot be eradicated. The disease must be “managed” with the use of seed treatment fungicides and resistant varieties. Knowledge of the races present in the state and how varieties with different resistance genes have performed in a grower’s field is critical to variety selection for maximum profitability.

Seed Treatment

Seed treatment fungicides can be used for management of early season seed rot and damping off caused by *Phytophthora sojae*. The compounds labeled for control are metalaxyl and mefenoxam. Mefenoxam is one of the chemical compounds which has been isolated from metalaxyl. A list of products containing these compounds and their recommended rate of application is provided in *Table I*. In general, all varieties of soybean grown in problem fields should be treated since conditions favoring *Phytophthora sojae* also favor *Pythium spp.*, which commonly cause seedling problems in Nebraska.

Financial resources for the Nebraska Soybean Disease Surveys cited in this publication were provided by the Nebraska Soybean Board.

Table I. Seed treatment fungicides¹ labeled for *Phytophthora sojae* control on soybean.²

<i>Product Name</i>	<i>Common Name</i>	<i>Application rate for Phytophthora control</i>	<i>Manufacturer</i>
Allegiance LS	Metalaxyl	1.2-2.4 fl. oz./100 lbs. seed	Gustafson
Allegiance FL	Metalaxyl	0.75-1.5 fl. oz./100 lbs. seed	Gustafson
Allegiance Dry	Metalaxyl	1.5-2.0 oz/100 lbs. seed	Trace Chemicals LLC
Apron FL	Metalaxyl	0.75-1.5 fl. oz./100 lbs seed	Gustafson
Apron Flowable	Mefenoxam	0.82-1.64 fl. oz./100 lbs. seed	Wilber-Ellis
Apron Maxx RTA ³	Mefenoxam and Fludioxonil	5.0 fl. oz./100 lbs. seed	Syngenta
Apron Maxx RTA + Moly ³	Mefenoxam and Fludioxonil	5.0 fl. oz./100 lbs. seed	Syngenta
Apron TL	Metalaxyl	2.0-4.0 fl. oz./100 lbs. seed	Wilber-Ellis
Apron XL LS	Metalaxyl	0.16-0.64 fl. oz./100 lbs. seed	Syngenta
System 3	Pentachloronitrobenzene (PCNB), Metalaxyl, and <i>Bacillus subtilis</i> GBO ₃	4-6 oz/bu	Helena
Warden RTA	Mefenoxam and Fludioxonil	5.0 fl. oz./100 lbs. seed	AgriLiance LLC

¹Product list is intended for information purposes only. No criticism is intended for products not listed nor endorsement for products listed. Always read and follow label directions when applying any pesticide.

²Application rates on the high end of the labeled amount are generally necessary for adequate *Phytophthora sojae* control.

³In fields with a history of high phytophthora pressure, the label recommends using Apron Maxx RTA or Apron Maxx RTA + Moly at the recommended rate of 5.0 fl. oz./100 lbs. seed in combination with Apron XL LS at a rate of 0.16-0.48 fl. oz./100 lbs. seed.

Genetic Resistance

Use of resistant varieties is the most effective means of managing phytophthora diseases in soybean. Genetic resistance in the host is expressed in terms of *Rps* (Resistance to *Phytophthora sojae*) genes. The genes are denoted as *Rps* 1a, 1b, 1c, 1d, 1k, 3, 6, and 7. The pathogen exists in races that interact with these genes. A race is identified by its interaction with the eight known *Rps* genes. In a resistant reaction, the plant survives when infection occurs; susceptible varieties are killed when infection occurs (*Table II*).

Table II. A list of the races of *Phytophthora sojae* identified in Nebraska over the last 20 years and the *Rps* gene reaction to these races.

Race	<i>Rps</i> Resistance Genes							
	1-a	1-b	1-c	1-d	1-k	3	6	7
1	R	R	R	R	R	R	R	s
3	s	R	R	R	R	R	R	s
4	s	R	s	R	R	R	R	s
9	s	R	R	R	R	R	s	s
14	R	R	s	R	R	R	R	s
18	R	R	s	R	R	R	R	R
23	s	s	R	R	R	R	s	s
25	s	s	s	R	s	R	R	s
28	s	s	R	R	s	R	R	s

s = susceptible or plant killed R = resistant or plant not killed

Soybean varieties are marketed on the basis of their genetic make-up in relation to the predominate *Phytophthora sojae* races in a given area. The predominant races in Nebraska are 1 and 3. The most widely available resistance genes in the Midwest are 1-c and 1-k, commonly referred to as c or k in seed company literature. Gene 1-c protects against races 1, 3, 9, 23, and 28, where gene 1-k protects against races 1, 3, 4, 9, 14, 18, and 23. Gene 3 is the only gene that protects against all known races that occur in Nebraska. Currently 40 percent of the maturity group 2 and 63 percent of the group 3 soybean varieties marketed in Nebraska contain some resistance to *Phytophthora sojae*. Resistance within these maturity groups is listed below.

Maturity Group	Percent Nebraska Marketed Varieties With <i>Rps</i> Gene Resistance								
	1-a	1-b	1-c	1-d	1-k	3	6	7	1k/1a
Group 2	5	0	20	0	72	1.5	0	0	1.5
Group 3	9	0	34	0	54	3	0	0	0

Growers should consult local seed company representatives to request varieties with different *Rps* genes than marketed in a specific area.

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C-10, Field Crops**
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