Bean Rust
Michigan State University
Cooperative Extension Service
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October 1975
2 pages

COOPERATIVE EXTENSION SERVICE
MSU AG FACTS

No. 56 Extension Bulletin E-893 October 1975

BEAN RUST

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BEAN RUST, a foliage disease caused by the fungus *Uromyces phaseoli typica* Arth, is parasitic only to bean plants. First symptoms of the disease appear as small lesions on the underside of the leaves. These soon enlarge and break out as rust-colored pustules on the leaves (Figure 1-A). Leaves with a large number of pustules soon turn yellow (chlorotic) and eventually fall off.

The rust pustules are filled with spores. These are carried in air currents to adjacent plants and often to plants in neighboring fields. Wind can carry the spores to plants many miles away, often resulting in many centers of infection within a field (Figure 1-B).

Bean rust has only recently been considered of economic importance to Michigan bean growers. In 1973 it was responsible for a greater reduction in yield of Navy beans than any other major bean disease. That year several fields of the varieties Seafarer and Sanilac were heavily defoliated by the rust pathogen. When this happened before normal senescence set in (aging), a new set of leaves frequently developed, replacing those lost from infection.

Eighty-nine bean fields in six major bean-producing counties were monitored for disease during the growing season in 1973. The findings are summarized in Table 1. Rust was reported in 30 percent of the fields the week of August 16. A week later, 72 percent of the fields had rusted plants. Twenty-five percent, or 22, of the fields had a very high incidence of rust accompanied by heavy defoliation and lower crop yields. In contrast to 1973, rust was observed on beans as early as July 30, 1974, and by the end of the season, 53 of 100 fields under observation had rust infection; yet in only two of the fields were the plants heavily defoliated.

Fig. 1A—Urediospores (summer spores) are produced in rust-colored pustules on the leaves.

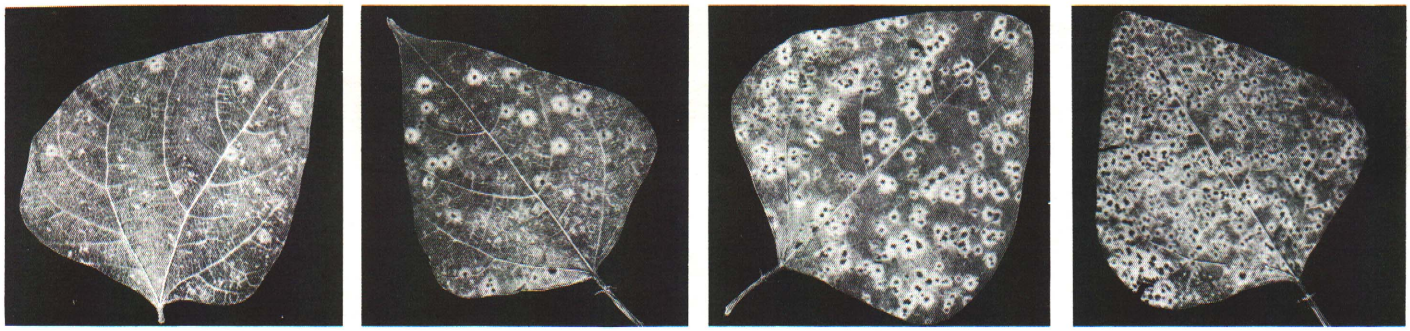
Fig. 1B—Defoliation resulting from rust in a Navy bean field in Saginaw County, 1974.

The results from the 1973 disease monitoring program (Table 1) illustrate the rapidity of rust disease development and spread under favorable conditions. These conditions include a susceptible host, presence of the pathogen, and favorable environment. Many plants were completely defoliated within two weeks after rust was first observed. In comparing the two seasons, it appeared that rust infection was much more critical to plant survival in 1973, a drought year, as compared to 1974, a non-drought year. This could be related to the presence of rust pustules on bean leaves, since the pustules provide an uncontrolled means for water to escape from the leaves. Hence, we would expect infected leaves on plants under a drought stress to wilt and fall off sooner than similarly infected leaves on plants under non-drought stress conditions.

If we assume that the bean fields monitored in 1973 were representative of the bean fields in Michigan, and that yields were reduced by 400 pounds per acre in the heavily infected fields, production losses for Michigan from bean rust would be over 600,000 cwt. in 1973. Actually many fields were observed where the yield reduction from rust appeared to be much greater.

Table 1—Rust Development in Michigan Bean Fields in 1973.

County	No. Fields	No. of Fields with Rust			Percent Fields, Heavy Infection
		(Aug. 6)	(Aug. 16)	(Aug. 24)	(Aug. 24)
Tuscola	15	0	8	9	0%
Sanilac	15	0	1	9	20%
Gratiot	15	0	2	4	0%
Bay	14	0	8	14	21%
Huron	15	0	7	15	60%
Saginaw	15	0	8	14	47%



1 2 3 4

Fig. 2—Rust severity ratings (1-4). Photos courtesy Department of Plant Pathology, University of Minnesota.

The Pathogen

The rust pathogen, *Uromyces phaseoli typica* Arth., consists of several races. Race identification of Michigan rust isolates in 1974 indicated the isolates had little variability and were probably all the same race. Pinto 111, a variety grown in Michigan, was especially susceptible to the Michigan isolates.

The bean rust pathogen is autoecius, i.e., completing its life cycle on a single host. Three types of spores are produced during its life cycle. *Urediospores* are produced by the thousands in each of the rust-colored pustules that appear on the leaves during the summer. These spores are responsible for the rapid spread of the disease. When the plant dies or matures, black *teliospores* (resting spores) are produced in the same pustule and survive the winter on plant debris in the field. In the spring the teliospores germinate and produce small spores called *sporidia* or *basidiospores*. These are blown to healthy bean plants and are the primary source of inoculum each year.

Environmental Factors

Urediospores germinate and are able to infect plants under a wide temperature range. Optimum temperatures are from 60° to 68° F.

Ten to fifteen hours of continued wetness are required for infection to take place at 60° to 75° F. These moisture and temperature conditions occur frequently in Michigan during August and September.

Approximately 10 to 15 days are required from the time of initial infection to production of another generation of unrediospores at the infection site. Long periods of continued wetness favor the development of epidemics.

Cultural Control

Allow at least 2 years between bean crops to reduce the possibility of rust carryover from a previous crop.

Avoid planting beans adjacent to fields where rust-infected beans were grown the previous year.

Plow under all bean refuse, preferably in the fall if other conditions permit, to reduce the rust inoculum potential. Some plant refuse will remain exposed if a field cultivator or a chisel plow is used. Inspect bean fields regularly from the beginning of bloom for 3-4 weeks for the presence of rust. Determine the rust severity rating in the field (Figure 2, Table 2).

Apply the rating to Table 3 to determine the need for fungicide application. Protect plants from rust infection by applying an approved fungicide—but only if the conditions for infection and disease development are present.

Table 2. Rust Severity Rating

0 = No disease
1 = 2-10 spots per leaf
2 = 10-40 spots per leaf
3 = 200 spots per leaf
4 = 400 spots per leaf
5 = Most leaves dead, plants heavily defoliated

Be on the lookout for "hot spots" where plants are heavily rusted. If present, consider a spray program.

Fungicides can be effective if applied at 7-day intervals until the plants are in the early pod fill stage or within 3 weeks of maturity. Under extremely favorable conditions for disease development it may be necessary to apply to fungicide at 5-day intervals.

Fungicides are best applied by air at a rate of 5 gallons spray mix per acre. Label directions for the registered fungicide must be followed.

Be on the lookout for disease alerts from your county cooperative extension service. Programs are being developed to predict more accurately when to apply chemicals to control bean rust. Your county extension agricultural agent can supply the latest information on EPA-approved chemicals.

Table 3.—Time of Application of Fungicide for Rust Control on Michigan Dry Beans Based on Plant Maturity and Rust Severity

Weeks to Maturity[1]	Code	Stage of Development	Rust Severity Rating[2] 0	1	2	3	4	5
11-12	1-(S)	Seedling						
8-10	2-(ET)	Early trifoliate						
7	3-(BB)	Before bloom						
6	4-(EB)	Early Bloom		S				
5	5-(FB)	Full bloom		S				
4	6-(SP)	Small pod		S	S			
3	7-(EP)	Early pod fill			S			
1-2	8-(FP)	Full pods (green to yellow)						
0	9-(M)	Pods dry, ready for harvest						

[1]Sanilac—average 42 days to bloom—84 days to maturity.
Seafarer—average 39 days to bloom—78 days to maturity.
[2]S = Apply fungicide

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, East Lansing, Michigan 48824.

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