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BACTERIAL DISEASES OF SOYBEANS

[Following is a translation of an article by A. P. Klykov, Velikolukskiy Agricultural Institute, published in the Russian-language periodical Zashchita Rasteniy ot Vraditely i Bolezney (Protection of Plants from Pests and Diseases), No 6, 1963, pp. 35-36. Translation performed by Sp/6 Charles T. Ostertag Jr.]

Soybeans are affected by many fungous, bacterial and viral diseases. The bacterial diseases are particularly spread out and harmful. Mainly cotyledonous bacteriosis, brown angular leaf spots (bacterial blight), brown rust bacteriosis, and complete withering of leaves develop.

Cotyledonous bacteriosis (seed bacteriosis, sprout bacteriosis, cotyledon bacteriosis, sprout decay, sprout destruction) is spread over all the regions where this crop is cultivated.

During infection by this disease the seeds lose their germinating power and die in the soil, the cotyledons appearing on the surface of the soil decay, and the development of the plants is slowed down. In some cases it is even necessary to reseed the soybeans. In the Far East the death of 30-60% of the cotyledons from bacteriosis is a quite frequent occurrence. In the Ukraine in some places up to 68% of the seeds are affected, in Georgia cases have been noted of the death of 50% of the cotyledons, in Krasnodarskiy Kray -- 71% and in Severnaya Osetiya -- 95%.

On the sick seeds there appear whitish sunken patches (of various dimensions), sometimes a dark rim runs along their borders and cracks are seen. The affected seeds are dull and whitish. Following swelling they become slimy and do not germinate. Sometimes sprouts appear but turn brown and die. With a very weak infection the cotyledons emerge on the surface but are covered with brown patches of various size and form, and in wet weather droplets of a turbid liquid (exudate) emerge on them. Sometimes the patches even develop on the hypocotyl.

Depending on the weather conditions and the degree of affection, the sprouts either die or form leaves on which signs of the disease are not noticeable, however such plants subsequently lag in growth.

The main causative agents of the disease are Pseudomonas sojae W. (Ps. glycineum) and Ps. solanacearum Sm., but other species of phytopathogenic bacteria are also encountered. Cotyledenous bacteriosis is transmitted with the seeds.

Brown angular leaf spots. On the upper surface of the leaf small circular spots appear with a dark dot in the center. This is bordered by a narrow band as if of oiled tissue and a wide band of blanching tissue. Gradually, the dark spots enlarge, become angular, and fuse into large formless almost black spots. These spots become dry and the tissue may fall out. In damp weather droplets of exudate are noted on the lower surface of the affected leaf. In dry weather they dry up and the tissue is covered with small whitish scales. Under a microscope motile bacteria are apparent in the drops of exudate.

As a rule the disease appears in the period of blossoming of the soybean and develops up until yellowing of the leaves. Besides the leaves, the beans may also be affected. In this case the bacteria penetrates into the seeds and are stored in them until the following year. The causative agent of the disease is the bacterium -- Ps. sojae.

Brown rust bacteriosis is widely distributed in all the regions where soybeans are cultivated. The leaves are covered on top by small rust spots which gradually enlarge and occupy almost the entire surface. On the lower side of the leaves the signs of affection are not noticeable at first but then yellowing develops. The development of the disease usually coincides with the flowering of the soybeans. In some cases it can be detected even in earlier periods of development, but only on weakened plants.

The causative agents of the disease are yellow pigment bacteria. The resistance of varieties to bacteriosis is diverse. Under the conditions of Ryazanskaya Oblast, out of the Far Eastern varieties, Amurskaya 253 and 283 are strongly affected. The fodder varieties with black seeds and Salyut 216 proved to be resistant. Signs of the disease appeared to a weak degree on them.

Wilting is widely distributed in all the old regions of soybean cultivation. It has been noted in the Ukraine, in Krasnodarskiy Kray, and in Voronezhskaya Oblast. According to data from the Kuban test station, in 1939 up to 45% of the plants in detached farms were affected by withering. In Krasnodarskiy Kray in the zone of fluctuating humidity the disease affected from 1 to 15% of the plants in 1948-1951. In the Ryazanskaya and Pskovskaya Oblasts we did not detect withering of soybeans.

The first signs of the disease most often appear in the period of bean formation. The plants begin to wilt lightly, the leaves droop and then

roll up, turn yellow and shrivel. In 2-10 days the plants die. With affection during the period of ripening of the grain the seeds mature more rapidly but become sickly and are not of full-value.

In Krasnodarskiy Kray withering is caused by the bacteria Ps. golanacearum and in the Far East mainly by the fungus Fusarium tracheiphilum Wr. However, a mixed infection of fungus and bacteria can be observed. During bacterial withering, in microscopic sections of the stalks or roots brown sectors of frozen parenchyma almost always can be noted. Its cells are filled with bacteria. In fusarium withering in damp weather a rose or orange coating of mycelium can be detected in the sector at the roots.

The combat with these diseases, the infectious onset of which is found within the seeds, is particularly difficult. The seeds of soybeans undergo high temperatures and wetting poorly, and this excludes the possibility of thermal processing and humid treatment.

Out of the dry disinfectants the most effective are granozan (NIUIF-2) [NIUIF - Samoylov Scientific Research Institute of Fertilizers and Insecto-fungicides; an ethylmercuric chloride seed fungicide equivalent to Ceresan] mercuran, and tetramethylthiuram-disulphide (TMTD). In doses of 2 kg to 1 ton of seeds they provide good protection to the germs and do not negatively influence the seeds and sprouts. During industrial tests under the conditions of Krasnodarskiy Kray and Ryazanskaya Oblast these disinfectants decreased the amount of diseased sprouts by 5-11 times, increased germination by 3-12%, and increased the harvest by 5-59% (depending on the disinfectant, the variety of soybean, weather conditions, agrotechnique, and the degree of infectivity of the seed material). Mercuran, in addition to this, protected the seeds and shoots from harm by click beetles and other soil dwelling insects.

The stated preparations hardly suppress the formation of nodules and in some cases even promote an increase in their number. Thus, according to data by I. S. Androsov (1955), under conditions of the Far East where there are many rhizobia in the soil, the treating of seeds with nitrogen in conjunction with disinfection by granozan increased the amount of nodules on the roots of soybeans by one and a half times (compared with treatment by nitrogen alone).

In our experiments (1958) in Ryazanskaya Oblast on the treating of seeds with nitragin (or applying it in small rows) and disinfection with granozan, mercuran, and TMTD (dosage 2 kg/t, variety Salyut 216), the number of nodules on the roots of soybeans in soil where there were no rhizobia decreased only from the use of mercuran. The seeds are disinfected 3-4 weeks prior to sowing and treated with nitragin on the day of sowing. With an increased moisture content of the seeds (higher than 14%) they are disinfected just 1-3 days prior to sowing.

In addition to the specified preparations, hexachlorbenzene can be used for dry disinfection. It is applied 2 kg/1 ton of seeds.

This treatment, though it sharply reduces the number of affected sprouts, does not completely rid the plants of cotyledonous bacteriosis. Since in diseased seeds there is a tremendous amount of bacteria, and in seeds which are externally healthy there are few or none at all, the question arises about the possibility of selecting seeds, based on external signs, for sowing in seed plots. As practice showed, in the first year of selection the number of diseased sprouts dropped sharply, and in the second year the plants were almost completely free from not only cotyledonous but other types of bacteriosis.

The manual sorting of seeds is a quite rapid process. One man in one working day is able to sort out 30-40 kg of grain. This means that each farm can sow healthy seeds in the seed plots.

Out of the prospective and standard varieties studied by us which are cultivated in Kuban they can be broken down into varieties that are weakly, moderately, and strongly affected by bacterial diseases. The average affection rate of varieties by cotyledonous bacteriosis was: Novo-Kubanskaya 52 -- 49%, Kubanskaya 276 -- 27%, VNIIMK - 24%, Kubanskaya 4958 -- 6%. Resistant varieties can be selected for each zone.

Observations from 1955-1962 in the Ryazanskaya and Pskovskaya Oblasts showed that out of 17 varieties of soybeans (mainly Far Eastern selections), the Zarya and Kazanskaya are strongly affected by angular leaf spots. Affected moderately are the Amurskaya 116, 253, 283, 262, 266, and the Salyut 216, and weakly -- the Pobeda, Khabarovskaya 25 and Rekord severnyy. Cotyledonous bacteriosis strongly affects Amurskaya 253 and 283 and weakly -- Buraya kormovaya, Salyut 216, and Amurskaya 262.

In the southern regions the period of sowing is very important in the struggle with bacterioses of soybeans. During late terms the soybean's period of vegetation is sharply reduced, but the beans ripen almost simultaneously with beans in early seedings. Therefore the plants suffer much less from bacterial diseases. Particularly effective are late periods in conjunction with disinfection and the selection of healthy seeds for early-ripening and average-ripening varieties in seed plots. For Kuban and Moldaviya the periods for sowing soybeans can be considered as 25 May - 10 June. For areas other than the black earth zones the optimum periods are 10-25 May. Later seeding periods here have never given good results.

In the struggle with bacterioses, in particular with cotyledonous bacteriosis, considerable importance is attached to the agricultural methods which promote a harmonious emergence of sprouts.

Figure (Page 35) Brown angular leaf spots.

Figure (Page 36) Brown leaf blight