

AD 678179

TRANSLATION NO. 2145

DATE: 1 March 1968

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ROOT ROT AND OTHER DISEASES OF SUGAR BEETS

U.S. Department of Agriculture
Washington, D.C.

Technical Bulletin No. 1004

Z.A. Pozhar

In 1954 the most widespread and dangerous diseases of sugar beets were root rot in the shoots, cercospora infection, powdery mildew, fusarium infection, mosaic, viral jaundice, starvation diseases, scab and storage rot. Less often zonal and bacterial spots on the leaves, rust, dodder, ["ovivita"] and brown root rot are encountered, and they inflict damage only in areas where they are manifested the most. Very rare are leaf spot caused by Ramulispora, cancer, tuberculosis and scab [scab] of the roots which have caused negligible losses of sugar beet harvest.

Root rot of shoots (*Pyrenium betae* Frank; *P. debaryanum* Hesse; *Fusarium* and others) was observed in all of the USSR oblasts where beets are cultivated. The earliest manifestation of the disease is observed during the period of underground development of shoots. In some areas it was the cause of death of sprouts before they appeared so that the density of shoots was unsatisfactory. Thereafter this root rot was noted to considerable extent in sugar beet shoots (Table 1).

Cases of maximum invasion of shoots were noted at farms where there had been significant precipitation during the spring which caused flooding of the soil and formation of an earth crust. Under such conditions appearance of shoots was delayed, they became weak and were strongly affected with root rot.

Considerable involvement of shoots was also observed in the zone of insufficient humidity: in the southern and south-eastern oblasts of the Ukrainian SSR (Luganskaya, Nikolayevskaya, Odesskaya and other oblasts). More intensified development of the disease was due to drying up of the top layers of soil and marked fluctuations in temperature over a 24-hour period. Under such conditions the shoots were developmentally retarded and were attacked by the pathogens of this disease.

Table 1
Infestation of sugar beet shoots by root rot in 1964

Республика	Процент поврежденных ростков	Колебания процента пораженности
Белорусская ССР	20,7	6,0-60
Литвийская ССР	25,5	1,4-60
Латвийская ССР	37,1	0,7-11
РСФСР	25,4	1,0-10
Украинская ССР	25,7	1,7-80

Legend:

- | | |
|---------------------------------------|------------------|
| a) republic | e) Kirgiz SSR |
| b) percentage of shoots affected | f) Latvian SSR |
| c) fluctuation of percentage affected | g) RSFSR |
| d) Belorussian SSR | h) Ukrainian SSR |

Table 2
Dynamics of infestation of sugar beet shoots by root rot in 1964

Пункт сигнализации	Область, край	Процент пораженных ростков				
		май			июнь	
		первая декада	вторая декада	третья декада	первая декада	вторая декада
Купьянский	Харьковская обл.	—	38	43	58	17
Золотоношский	Черкасская обл.	9	16	11	14	—
Прилуцкий	Черниговская обл.	—	17	21	11	—
Корженевский	Киевская обл.	16	20	16	—	—
Погребинский	Винницкая обл.	4	14	16	14	2
Львовская опытная станция	Курская обл.	—	23	26	24	—
Первомайская опытная станция	Краснодарский край	3	8	20	28	—

Legend:

- | | |
|----------------------------------|---------------------------------------|
| a) reporting point | l) Baryshevskiy |
| b) oblast, kray | m) Pogrebishchenskiy |
| c) percentage of affected shoots | n) L'gov Experimental Station |
| d) May | o) Pervomayskaya Experimental Station |
| e) June | p) Khar'kovskaya Oblast |
| f) first 10 days | q) Cherkasskaya Oblast |
| g) second 10 days | r) Chernigovskaya Oblast |
| h) third 10 days | s) Kiyevskaya Oblast |
| i) Kupyanskiy | c) Vinnitskaya Oblast |
| j) Zolotonoshskiy | u) Kurskaya Oblast |
| k) Prilukskiy | v) Krasnodarskiy Kray |

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The data in Table 2 indicate that root rot showed the most marked development in late May and early June. During this period consolidation of the soil and production of an earth crust were observed in many sugar beet farms, and in some areas there were marked daily fluctuations in air pressure. At the same time the rise in daytime temperature and presence of humidity caused activation of the pathogens. As a result there was a marked increase in infestation of the shoots: in a number of farms of Kharkovskaya Oblast it rose to 52%, in Krasnodarskiy Kray -- to 83%. Analogous findings were made in Kirgiz SSR. Stronger invasion of shoots in Dnepropetrovsk ASSR was observed when sowing was done too early into flooded unripe soil.

Intensive invasion of beets in a number of state and collective farms resulted in sparse shoots as well as loss of shoots that had already sprouted. Thus significant losses of shoots due to root rot were observed in Ivano-Frankovskaya, Poltavskaya, Chernigovskaya, Kurskaya, Dnepropetrovskaya and other oblasts, as well as in Kirgiz SSR and Aitayskiy Kray. Loss of infected plants was also noted after thinning of the beets. Thus, in Kurskaya Oblast the losses reached 30% in some areas. The reporting points in Odesskaya, Sumskaya, Kurskaya and other oblasts reported transplantation of large areas of beets (50 hectares or more in a farm) due to severe affection of shoots. The deleterious effect of the disease consisted of the fact that plants that had been affected developed and grew slowly, the root weight was 10-40% less than in healthy plants.

There was relatively mild development of root rot in a number of cases in Ukrainian SSR and RSFSR (Lipetskaya and Orlovskaya Oblasts, Krasnodarskiy Kray, and others). This was due to both improved agricultural techniques at the farms and favorable spring conditions: presence of an adequate amount of stored moisture in the soil, fewer rains after planting and during sprouting as well as lack of sharp temperature fluctuations.

The use of seeds treated with granozan [ethylmercuric chloride seed fungicide equivalent to Ceresan] and TMTD [tetramethyl-thiuram disulfide] caused a considerable drop in infestation of sprouts with root rot. For example at the Put' Il'icha collective farm in Vinnitskaya Oblast seed treatment resulted in a drop from 26 to 11% in the disease.

In the case of a wet spring, triple harrowing as compared to single harrowing resulted in a decline of the disease in Akhtyrskiy Rayon of Syn'skaya Oblast from 28 to 6%, and from 80 to 30% in Ivano-Frankovskaya Oblast (village of Otynya). If thinning was delayed the morbidity often rose from 1 to 20%. The plants were also less affected when the beet crop followed winter crops.

Cercospora (*Cercospora beticola* Sacc.) was noted in almost all areas with a high infestation of beets at the end of vegetation (Table 3).

Table 3
Beet cercospora infection in collective farms in 1964

Республика, край, область	Процент пораженных растений		Степень поражения (баллов)	
	август	сентябрь	август	сентябрь
Башкирская АССР	—	19	—	1,0
Киргизская ССР	46	75	1,7	—
Краснодарский край	—	—	0,5	2,2
Липецкая обл.	—	85	—	3,0
Молдавская ССР	12	60	—	2,3
Орловская обл.	—	20	—	—
Украинская ССР	23	58	0,4	1,0

Legend:

- | | |
|----------------------------------|-----------------------|
| a) republic, kray, oblast | g) Kirgiz SSR |
| b) percentage of plants affected | h) Krasnodarskiy Kray |
| c) degree of invasion (points) | i) Lipetskaya Oblast |
| d) August | j) Moldavian SSR |
| e) September | k) Orlovskaya Oblast |
| f) Bashkir ASSR | l) Ukrainian SSR |

Strong development of the disease was observed in Moldavian SSR and Kirgiz SSR, in Krasnodarskiy Kray, Zhitomirskaya, Cherkasskaya, Vinitskaya and Kiyevskaya oblasti and in some parts of the central rayons of ROSTER. This was due to alternate wet and dry weather favoring optimum production of fungus spores, their spreading and contamination of plants with low resistance to the parasite. In some farms even in late July and early August over half the plants presented cercospora infection to mild and moderate extents, and by the beginning of September there was premature dropping off of sick leaves which resulted in a lower harvest and lower sugar content in the beets.

At the observation plots in Kirgiz SSR 75% of the seed plants and about 30% of the beets in their first year showed mild and moderate forms of the disease in July. In the other beet farm zones a relatively small percentage of the crops was affected (about 10-20%). However, in August there was considerable intensification of development of the disease and in September involvement of almost all plants to a significant extent was observed in a number of areas.

There was much less development of cercospora infection (two to three times less) in the beet fields of Krasnodarskiy Kray, Kirgiz SSR and other areas where seeds from relatively resistant cultivars were used: P028, Pervomayskiy hybrid and others.

Powdery mildew [*Erysiphe communis* (Wallr.) Link.] was observed in most beet growing oblasti and mainly in August. At first the disease

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developed locally then attacked a considerable number of plants (Table 4).

Intensive development of powdery mildew occurred in Kirgiz SSR, in a number of southern, south-eastern and western oblasts of Ukrainian SSR and some central oblasts in the chernozem zone of RSFSR.

Table 4
Data on maximum powder mildew invactor of sugar beets in 1964

Республика, области	% от пораженных растений				
	август		сентябрь		
	вторая декада	третья декада	первая декада	вторая декада	третья декада
Винницкая обл.	—	50	42	—	—
Воронежская обл.	42	—	—	—	98
Днепропетровская обл.	—	—	51	—	100
Донецкая обл.	2	6	8	41	42
Закарпатская ССР	22	100	100	100	100
Киевская обл.	—	—	35	—	80
Львовская обл.	—	78	—	—	—
Молдавская ССР	—	—	—	33	—
Одесская обл.	50	—	—	—	86
Полтавская обл.	18	47	51	—	—
Ровенская обл.	—	—	—	91	—
Хмельнская обл.	10	76	—	—	77
Черкасская обл.	12	—	—	—	67
Черниговская обл.	—	57	93	57	—
Черновицкая обл.	5	25	17	41	—
Киргизская ССР	—	60	—	—	—

Legend:

- | | |
|----------------------------------|--------------------------|
| a) republic, oblast | m) Kurskaya Oblast |
| b) percentage of plants affected | n) Lipetskaya Oblast |
| c) August | o) Moldavian SSR |
| d) September | p) Odesskaya Oblast |
| e) second 10 days | q) Poltavskaya Oblast |
| f) third 10 days | r) Rovenskaya Oblast |
| g) first 10 days | s) Khar'kovskaya Oblast |
| h) Vinnitskaya Oblast | t) Khersonskaya Oblast |
| i) Voronezhskaya Oblast | u) Cherkasskaya Oblast |
| j) Dnepropetrovskaya Oblast | v) Chernigovskaya Oblast |
| k) Kievskaya Oblast | w) Chernovitskaya Oblast |
| l) Kirgiz SSR | |

Considerable affection of beet ovaries was observed in some of the seed growing state farms of Voronezhskaya (up to 24%), Vinnitskaya (15%), Spasskaya (22%) and other oblasts.

Marked increase in number of plants involved occurred in late

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August and the latter half of September. This was due to a dry and warm season. The shortage of moisture caused withering of the plants and decreased its resistance to the disease; these same conditions were the cause of sporulation and spreading of the pathogen. In September, many points (Saksaganskiy, Ul'yanovskiy, Razdel'nyanskiy, Globinskiy and others) reported mass-scale production of cleistocarps.

In the beet growing rayons of Kirgiz SSR treatment of the plants with sulfur preparations resulted in an appreciable restriction of development of the disease.

Peronospora (*Peronospora schachtii* Fuck.) was first manifested in seed plants in many areas. Subsequently from these primary foci the disease spread both to the surrounding healthy seed plants and to first year beet crops. Therefore this infection struck first and more intensively the crops at seed growing farms (Table 5).

Very strong peronospora infection among beet crops was noted in Ternopol'skaya, Zhitomirskaya, Chernigovskaya, Kurskaya, Ryazanskaya, Voronezhskaya and other oblasts as well as Krasnodarskiy Krai. This was due to much precipitation and high moisture level observed at times in these oblasts. In Krasnodarskiy Krai summer crops of nontransplanted beets (up to 33%) which are the main focus of spreading of the disease in this area were found to be affected with particular intensity.

Mosaic was manifested very strongly in seed plants. At beet collective farms seed plants were affected by an average of about 13% (Table 6).

Mosaic struck plants the most intensively at the collective beet farms in Sumskaya, Zhitomirskaya, Poltavskaya, Ternopol'skaya, Voronezhskaya and Kurskaya oblasts, Krasnodarskiy Krai and Kirgiz SSR. In the last area the transplants were 75% involved, and the mother beets -- 24%. At collective farms mosaic was reported by only a few of the observation points in Kievskaya, Sumskaya, Dnepropetrovskaya, Chernigovskaya, Penzenskaya and other oblasts involving 0.4 to 30% of the plants in July-August.

In first year beets mosaic appeared first of all in those areas that were adjacent to seed plant fields. The virus persisted in the roots and was transmitted from sick seed plants to beet plantings. The relatively low development of the disease at most farms was due to the negligible number of carriers -- beet aphids.

Viral jaundice was recorded at some seed-growing farms and rarely collective farms. This disease, like mosaic, appeared on seed plants at the start of vegetation and from them extended to first year beets by sucking insects (Table 7). For all of USSR, the disease was found in 15.5% of the area surveyed the mean involvement constituting: 0.45% of the seed

plants, 0.1% of the mother beets and 0.17% of the commercial beets.

Table 5
Percentage infection in beets at collective beet farms

Республика, край, область	Высады			Маточные свеклы			Фабричная свекла		
	площадь (га)	процент пораженных растений		площадь (га)	процент пораженных растений		площадь (га)	процент пораженных растений	
		средний	максимум		средний	максимум		средний	максимум
Тернопольская обл.	111	1,8	60,0	552	1,1	25,0	10	0	0
Хмельницкая обл.	433	1,7	3,2	157	1,0	1,0	—	—	—
Винницкая обл.	2715	0,1	1,1	1897	0,1	1,3	2780	0	0
Житомирская обл.	673	0,1	0,5	418	3,0	28,9	—	—	—
Черкасская обл.	315	0	0	—	—	—	—	—	—
Киевская обл.	—	0	0	269	0,2	0,7	212	0,7	1,2
Полтавская обл.	—	0	0	374	0,2	0,7	47	1,7	2,3
Черниговская обл.	—	7,5	13,7	159	2,6	4,7	—	—	—
Сумская обл.	902	0,1	2,1	650	0	0	257	0,1	0,8
Харьковская обл.	833	0	0	350	0	0	59	0	0
Итого по Украинской ССР	8226	1,1	60,0	4824	0,9	28,9	3395	0,4	2,3
Курская обл.	—	3,2	7,8	—	—	—	—	0,2	0,4
Воронежская обл.	4327	0,7	3,0	2737	0,1	2,2	185	0,1	0,8
Рязанская обл.	1550	1,9	12,0	361	0,2	0,5	—	—	—
Тамбовская обл.	605	0,1	0,2	410	0	0	—	—	—
Пензенская обл.	286	0	0	300	0	0	460	0	0
Краснодарский край	506	3,4	9,7	163	7,2	33,0	539	5,4	13,2
Алтайский край	25	0	0	7	0	0	95	0	0
Итого по РСФСР	7299	1,3	12,0	4611	1,3	33,0	1219	1,1	19,2

Legend:

- a) republic, kray, oblast
- b) transplanted plants
- c) mother plants
- d) commercial beets
- e) area (hectares)
- f) percentage of plants affected
- g) mean
- h) maximum
- z) Ternopol'skaya Oblast
- 5) Khmel'nitskaya Oblast
- k) Vinnitskaya Oblast
- l) Zhitomirskaya Oblast
- m) Cherkasskaya Oblast
- n) Kiyevskaya Oblast
- o) Stavskaya Oblast
- p) Chernigovskaya Oblast
- q) Sumskaya Oblast
- r) Khar'kovskaya Oblast
- s) totals for Ukrainian SSR
- t) Kurskaya Oblast
- u) Voronezhskaya Oblast
- v) Ryazanskaya Oblast
- w) Tambovskaya Oblast
- x) Penzenskaya Oblast
- y) Krasnodarskiy Krai
- z) Altayskiy Krai
- aa) totals for RSFSR

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Table 6
Mosaic invasion of beets at state be... Farms in 1964

Республика, край, область	Высадки		Маточная спекла		Фабричная спекла	
	процент пораженных растений		процент пораженных растений		процент пораженных растений	
	площадь (га)	средний	площадь (га)	средний	площадь (га)	средний
Днепропетровская обл.	9,7	41,0	2,2	12,0	0	0
Хмельницкая обл.	0	0	0	0	—	—
Винницкая обл.	0,1	1,1	0,3	2,9	0,9	1,0
Житомирская обл.	21,4	71,0	11,3	37,3	—	—
Черкасская обл.	0	0	—	—	—	—
Киевская обл.	0	0	0	0	0	0
Полтавская обл.	0	0,5	15,3	57,0	42,2	61,7
Черниговская обл.	0,3	0,8	0,2	0,6	—	—
Сумская обл.	27,6	96,6	0,3	7,0	1,8	9,8
Харьковская обл.	6,7	1,6	2,8	4,0	2,0	2,7
Итого по Украинской ССР	6,0	96,6	3,6	57,0	7,8	61,7
Курская обл.	13,4	16,0	—	—	10,2	16,0
Воронежская обл.	19,7	93,2	8,2	84,5	0,3	1,1
Липецкая обл.	0	0	0	0	—	—
Тамбовская обл.	7,6	9,0	0	0	—	—
Ярославская обл.	0	0	0	0	0	0
Краснодарский край	50,2	100,0	0,1	0,3	20,5	78,0
Алтайский край	0	0	0	0	0	0
Итого по РСФСР	13,0	100,0	1,4	84,5	7,7	78,0

Legend is the same as for Table 5.

Note: The data on areas surveyed are the same as in Table 5.

Table 7
Viral jaundice invasion of beets at seed growing farms in 1964

Республика	Высадки			Маточная спекла			Фабричная спекла		
	площадь (га)	процент пораженных растений		площадь (га)	процент пораженных растений		площадь (га)	процент пораженных растений	
		средний	максимальный		средний	максимальный		средний	максимальный
СССР	1626,4	7,68	44,0	705,0	3,67	15,0	2956,7	1,91	8,1
РСФСР	774,5	0,96	1,4	303,0	0,21	0,5	120,0	0,15	0,25
Итого	2400,9	4,32	44,0	1008,0	1,94	15,0	3076,7	1,03	8,4

Legend:

- a) republic
- b) transplanted plants
- c) mother plants
- d) commercial beets
- e) area (hectares)
- f) % plants affected
- g) mean
- h) maximum
- i) Ukrainian SSR
- j) RSFSR
- k) totals

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Large spots developed mainly on the lower leaves with massive production of fungus pycnidia. At the site of infection the tissue often broke so that the leaves had holes. The disease accelerated dying off of the inferior leaves of beet inflorescences. In addition its destructiveness was intensified due to accumulation of residues invaded by the fungus which induced sprout root rot in beet farms, stem and seed tuber spots as well as root rot (core rot).

Ramularia (*Ramularia betae* Rostrup) was found in Latvian SSR in mid August (Bausskiy observation point). By the start of September there was mild focal involvement of 15% of the plants.

Wings (*Cuscuta* sp) was encountered focally in July-August in beet fields of Kirgiz SSR to a significant extent, and also rarely at collective farms of Kiyevskaya and other oblasts.

Some degree or other of root rot was observed everywhere, especially when the soil was not moist enough. In particular core rot resulting from boron deficiency was observed to significant degrees in some parts of Latvian SSR (up to 28 and even 80%), L'vovskaya (up to 10%), Dnepropetrovskaya and Chernigovskaya oblasts (6-7%). As a result of dying off of the central leaves of the beet inflorescence the lateral protrusions of the neck of the root rotted.

Brown root rot was observed in areas of swampy soil in Kirgiz SSR, Latvian SSR, Ukrainian SSR and Belorussian SSR. Thus at the collective farm imeni Michurin, Chuyskiy Rayon, in Kirgiz SSR up to 40% of the plants presented brown rot by the end of August, and up to 10% at the collective farms imeni Dmitrov and "Road to Communism" in Belorussian SSR. Intensive beet rot was also observed in foci of invasion of the root systems by root aphids. Beet plants with rotted roots withered.

Yellow root caps were observed in considerable number in the irrigated zone of beet growing (Kirgiz SSR). When beets were exposed to the rain there was a higher incidence of root rot in the region of open cavities [follows].

In 1965 extensive root rot can be expected in beets in the rayons with heavily flooded soil encountered most often in Chernigovskaya, Rostavskaya, Kirovogradskaya, Vinnitskaya, Kurskaya, Voronezhskaya oblasts and Altayskiy Kray.

Cercospora infection will apparently develop wherever there were foci of the disease and where a significant number of infectious sources accumulated, namely in Moldavia and Kirgizia, in the beet growing oblasts of the Ukraine and Krasnodarskiy Kray. For the same reasons there will be considerable manifestation of powdery mildew in some parts of Moldavia, Kirgizia, in the Ukrainian steppe zone, and in the central oblasts of the

Chernozem zone of RS.

Ascochyta infection will be manifested more in the irrigated zone of seed growing and first of all in the seed plants (western oblasts of the Ukraine, Krasnodarskiy Krai, Baltic republics, central oblasts of the RSFSR chernozem band and perhaps in Bashkir ASSR and Chuvashskaya oblast).

Mosaic and jaundice involvement of the leaves will apparently increase in the southern and central oblasts of European USSR as well as Chuvashskaya plain in Kirgiz SSR, but primarily at those farms where the mother plants were invaded by these viruses.

Stem rot should be expected in Chuvashskaya plain as well as in the areas where there is stagnant water, and core rot in areas with light forest soil, low boron content (western oblasts of the Ukraine, Baltic republics). Fusarium and bacterial rot will develop focally in areas of accumulation of root rot as well as in drought areas. No significant broadening of the spectra of rust, zonal leaf spot and anularia infection is expected.

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