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THE ROLE OF PRECURSORS IN REDUCING THE HARMFULNESS OF FUSARIUM ROT OF SUGAR BEET ROOTS

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Long-term studies of the zone of sugar beet cultivation in Kazakhstan show that the shorter the interval between beet crops in one place, the greater the risk of contamination with root rot. So on farms where beets were returned to the previous site in 1-2 years, the prevalence of rot was as high as 78.9%. The least manifestation of rot was observed in crop rotations, where the beet was returned to its former place no earlier than 8 years or more, that is, the field was virtually free of soil infection. Here, the affection of root crops was 9.8%, which in turn contributed to an increase in yield (334-425 q / ha).

Keywords. Sugar beet, fusarium rot, predecessor, harmfulness, prevalence, crop rotation, winter wheat, alfalfa.

Long-term cultivation of one plant species on the same field for many years, as a rule, leads to the accumulation of pathogens inherent in a given culture in the soil. This is one of the main reasons for the massive spread of plant diseases caused by soil microorganisms. To improve the soil from harmful organisms, it is necessary to change the soil complex of microorganisms in a directed manner [1-3].

The breeding factor of the microcenosis of the soil is dead plant remains. The differentiating effect of plants and their residues on the formation of microbial coenoses is explained by the difference in root secretions. The latter contributes to the development and accumulation in the soil of certain species of bacteria, fungi and actinomycetes. This indicates that by selecting the predecessors it is possible to regulate the formation of useful microcenoses and to reduce the harmfulness of many plant diseases [4].

The example of Verticillium dahliae shows that all plants, including crops involved in crop rotation, stimulate the germination of microsclerotia in the soil [5]. According to A.A. Benken and A.S. Dotsenko [6], this leads to partial purification of the soil from infection in the cultivation of unaffected plants.

One of the main methods of limiting the development of root rot is the strict observance of crop rotation and the permissible level of saturation with sugar beets [7-11]. Saturation of a crop rotation in excess of 20% leads to the accumulation of pathogens in the soil and a significant increase in plant disease [11, 12].

Among the measures to combat root rot, correct rotation with placement of sugar beet after the most favorable predecessors is of great importance, however, it is necessary to know the optimal periods for the return of beets to the former field. In a beet crop rotation, it is necessary to establish a crop change in which the beets would return to the old place not earlier than in 4-5 years [13].

When changing crops, it must also be borne in mind that some precursors of sugar beet are affected by the same pathogens, for example, causative agents of root rot affect peas. Therefore, in order to prevent the spread of disease pathogens, heavily infected areas need to occupy non-susceptible crops (winter cereals) [14]. In the absence of a host, the causative agent of Fusarium wilt competes with soil saprophytic microorganisms [15].

In Ukraine, the best predecessor, with the lowest damage to plants rotting root crops, as well as high productivity in areas of sufficient moisture, is winter wheat, which goes after perennial grasses [16]. In the zone of insufficient moisture, the minimum damage to sugar beet by diseases is achieved when they are placed in a link with black steam, in the zone of unstable moistening - by the turnover of the occupied steam [17, 18, 19].

From 1997 to 2016, together with employees of sugar factories in Almaty and Zhambyl oblasts, the peculiarities of sugar beet placement in crop rotation were studied to limit the development of root rot in the growing season. A total of 727 sugar beet fields were surveyed over the years, on which the time of the previous sowing was determined, the number of affected root crops was counted and the yield of the crop was determined on the site in the current year (Table 1).

Table 1. Influence of the beet return period on the previous field on the prevalence of root rot (average data for the republic, 1997-2016)

Return of the beet to its original location	Prevalence of rot,%	Productivity, centner / ha
Permanent cultivation of beet from 1961g.	98,6	90,8
After 1- 2 year	78,9	110,4
After 3 - 4 years	23,0	223,5
After 5-6 years	13,2	284,2
After 8 year	9,8	334,0
After 10 year	0,0	424,7

The data of Table1 show that the shorter the time interval between the cultivation of beets in one place, the more it is exposed to root rot. So, on farms where beet was returned to the previous site in 1-2 years, the prevalence of rot was as high as 78.9%. At 3-4 years of return, the incidence of decay is reduced, but remains at a rather high level - 23%. The least manifestation of rot was observed in crop rotations, where the beet is returned to its former place not earlier than 8 years or more, i.e. the fields turned out to be practically free from soil infection of rot of root crops (9.8% and less affected root crops on average), and this, in turn, contributes to an increase in yield (334-425 kg / ha). Based on the presented data, it can be concluded that it is desirable to sow the beet repeatedly on the same site not earlier than in 5-6 years.

The effect of precursors on the damage to sugar beet by root rotations was studied in a stationary experiment, laid in 1981. According to the data obtained, winter wheat and alfalfa to some extent contributed to a decrease in the sugar beet's affection by root rot (table 2). At the same time, we noted that such precursors as corn, potatoes and safflower contribute to increasing the damage of root crops of sugar beet rot.

Table 2. Influence of precursors of sugar beet on damage by rot and productivity of root crops in stationary experiment, 2012-2015

Predecessors	Disease development,%	Yield, c / ha	Sugar content,%	Sugar collection, c/ha
Alfalfa formation turnover	8,0	392	14,8	58,0
Winter wheat	5,2	405	15,0	60,8
Barley	7,5	372	13,5	49,5
Soybean	7,2	365	13,7	50,0
Corn	9,2	331	13,0	43,0
Potatoes	15,7	247	12,2	30,1
Safflower	20,7	220	11,9	26,2
Sugar beet 2 years	9,5	300	12,9	38,7
Sugar beet 3 years	27,7	210	12,0	25,2
Sugar beet 10 years	32,5	165	11,7	19,3
Sugar beet (in monoculture 36 years)	41,7	110	11,0	12,1

The magnitude of the infectious load in the soil has a significant effect on the intensity of decay of root crops of sugar beet in the period of growth and development. This indicator largely determines the onset and intensity of the pathological process. Therefore, determining the magnitude of the infectious load makes it possible to judge the health-improving effect of the agricultural technique used. In this connection, information on the effect of agrotechnical methods applied in a stationary experiment on the quantitative indices of populations of causative agents of root rot is of scientific and practical interest.

In 2013-2015 in a stationary experiment, the number of rudiments of fungi of the genus Fusarium was determined depending on the precursors during the growing season. The purpose of this experiment was to elucidate the dynamics of fungi of the genus Fusarium, depending on the plant species in the crop rotation.

Analysis of soil samples taken in April showed that the initial infection of the soil of the experimental plots involved in these crops changed significantly. The number of rudiments of Fusarium fungi in the replicates of variants varied from 25.6 to 55.1 thousand pieces. on 1 g of dry soil (Table 3).

The results of monthly soil analyzes showed that the quantitative content of Fusarium fungi rudiments changes during the growing season.

A couple in June and July there is a noticeable increase in the rudiments of fungi Fusarium, compared with the initial period. If in April the number of Fusarium propagules was on the average 25.6 thousand units / g soil, then in June - 35.3 thousand, and in July - 45.6 thousand. In late summer and early autumn (August September), there is a slight decrease in their quantity, correspondingly, 41.6 and 39.5 thousand pieces / g of soil. But it should be noted that the accumulated amount of infection by the end of September is much greater than at the beginning of the growing season - 39.5 thousand units / year. (control - 25.6 thousand units / year).

Table 3. Dynamics of the content in the soil of the rudiments of fungi of the genus Fusarium on different precursors of sugar beet in a stationary experiment, 2013

Predecessors	Number of rudiments of Fusarium fungi, pcs / g soil				
	april	june	july	august	september
Steam	26640	35360	43680	41600	39520
Barley	38160	39520	43670	43590	45580
Oats	25680	38880	38520	42000	33280
Lucerne + ryegrass	46200	43050	47550	52500	46640
Barley + alfalfa	55120	50880	49350	53550	52500
Corn	48150	47700	54570	57200	58300

According to barley, the number of Fusarium propagules in April was -38.1 thousand units / year. soil. This indicator did not change until June, and amounted to -39.5 thousand units / year. In July and August there is a slight increase, while the number of Fusarium propagules is 43.6 thousand. By the end of September, there is a further increase of 45.6 thousand units / year. soil.

For oats, as well as for a couple, in spring the level of infectious origin, in comparison with other cultures, is much less - 25.6 thousand. pcs / g. soil. However, with the onset of summer, a gradual increase in the number of fungi Fusarium begins. In this case, during the summer months - June, July, August - the number of propagules is 38.8, respectively; 38.5 and 42.0 thousand units / year. And by the end of September there is a noticeable decrease - by 8.7 thousand compared to the amount noted in August.

According to the lucerne in the mixture of ryegrass, in contrast to the previous versions, in June there is a slight decrease in the number of Fusarium propagules (43.0 thousand versus 46.2 thousand), and since July, as in other cases, there has been an increase of 47.6 thousand. pcs / g. soil. A noticeable increase in the infectious onset occurs in August, then decreases somewhat, and by the end of September the initial value of 46,600 is set. pcs / g. soil.

In Lucerne under the cover of barley, the number of rudiments of fungi Fusarium, unlike all others, was the largest - 55.1 thousand. During the summer, it decreased noticeably, and by the end of the vegetation it returned to its original value (52.5 thousand pieces / year of soil).

In maize early in the summer, there was a slight decrease in the number of Fusarium buds in the soil. However, in the future there is a gradual increase in their numbers until the harvest itself. So, if the number of propagules in July was 54.5 thousand, then in August - 57.2 thousand, and in September - 58.3 thousand units / year. soil.

Thus, it can be noted that all test precursors of sugar beet, except for alfalfa in a mixture of ryegrass and under the cover of barley, did not contribute to reducing the initial value of the infectious load by autumn, but on the contrary, there was a significant increase in the pair by 12.8 thousand, barley - 7,4 thousand, oats -7,6 thousand and corn-10,2 thousand pieces / year. soil. Several other data were obtained for the other two cultures. In lucerne + ryegrass, the level of infectious load by the autumn remains at the level of the beginning of vegetation (46.6 thousand against 46.2 thousand pieces / year of soil), and in alfalfa under the cover of barley - decreases by 2.6 thousand pieces. / g. soil.

In 2014, given the lack of a clear pattern in the dynamics of the number of fungi Fusarium, depending on the precursors of sugar beet, it was considered expedient to determine the contamination of soil by the main pathogens of rot in the beginning and the end of the growing season. According to the results of the research, the size of the Fusarium fungi varied during the growing season of sugar beet (Table 4).

Table 4. Influence of precursors of sugar beet on the content in the soil of the rudiments of fungi Fusarium (in pcs / g soil), 2014

Predecessors	Number of rudiments of Fusarium fungi, pcs / g soil	
	at the beginning of vegetation	at the end of vegetation
West germane Barley	44540	24200
Oats	40290	31080
Lucerne under the cover of barley	43200	22600
Corn	58560	25520
Steam	34800	24640

At the beginning of the growing season (the end of April), relatively high population of soil rot agents is observed in maize. In 1 g of air-dry soil taken from this predecessor, 58.5 thousand Fusarium propagules are contained. According to the precursors of oats, alfalfa under the cover of barley and barley, the population of the soil by the fungi of Fusarium was close and amounted, respectively, to 40.2; 43.3 and 44.5 propagules per 1 g of air - dry soil. A relatively smaller content in the soil of the Fusarium propagule was noted for a couple - 34.8 thousand. pcs / g soil.

By the end of the sugar beet growing season, a significant decrease in the infectious load is observed for all the precursors. Thus, the subsequent in barley, alfalfa under the cover of barley and corn, the number of rudiments of Fusarium is almost two or more than two times less than in the initial period of sugar beet vegetation.

The tendency to decrease the infectious load at the end of the vegetation period is also observed in oats, a couple: accordingly, 9.2 and 10.2 thousand pieces / g of soil is less in the unit of the soil sample being analyzed compared with the initial period.

Thus, the use of alfalfa under the cover of barley and cereal crops, such as winter wheat, barley, oats, as a precursor, contributed to a decrease in the sugar beet's affection by rotting root crops during the growing season. With the use of the above-mentioned precursors, a decrease in the number of one of the main pathogens of root rot, the fungi of the genus Fusarium, was observed.

In 2007-2015, the damage caused by rot and productivity of sugar beet root crops at various beet crop rotations were analyzed (Fig. 1). The highest productivity (505-530 c / ha) and low damage to root rot (8.7-4.0%) are noted in the eight-field crop rotation with a beet saturation of no more than 25% (rotation scheme I and II).

At the same time, a significant increase in plant damage by rot (up to 33%) and yield reduction (430 c / ha) in comparison with the eight-field crop rotation on a seven-field crop rotation (42% sugar beet saturation).

It is known that in recent years for farming enterprises, short-rotational crop rotations are of particular urgency. As the results of our studies show, in the three-field crop rotation with a sugarbeet saturation of 33%, the sugar beet affection rate averaged 60%, and the yield of root crops - 295 c / ha.

A relatively low damage to rot was also observed in beet-fodder seven-field crop rotation (3.5%). However, in this crop rotation, the yield (340 c / ha) and the collection of sugar (55 c / ha) were lower than in the field crop rotation.

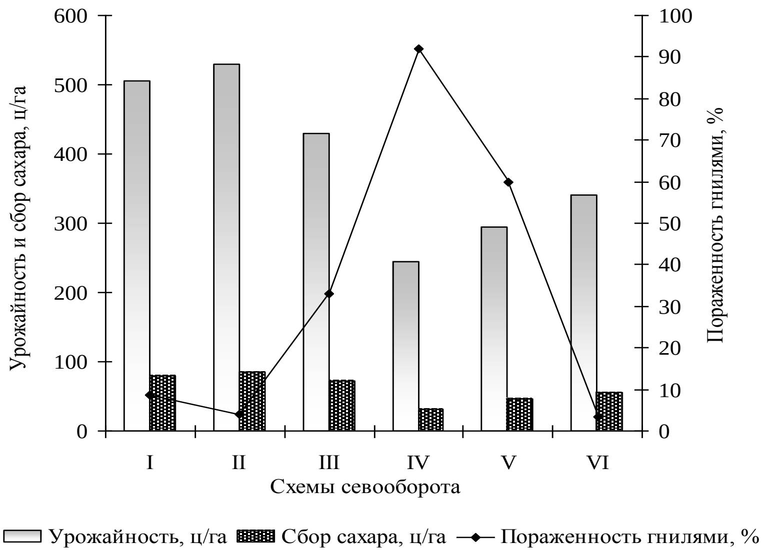

Fig. 1. Productivity and damage by rotting of root crops of sugar beet in sugar beet crop rotation

Note:

1. I 2. 1. cereals + alfalfa 3. 2. Alfalfa 4. 3. Alfalfa 5. 4. Winter wheat 6. 5. sugar beet 7. 6. Winter wheat + siderates 8. 7. corn (or soybean) 9. 8. sugar beet		11. II 12. 1. cereals + alfalfa 13. 2. Alfalfa 14. 3. Alfalfa 15. 4. sugar beet 16. 5. Winter wheat 17. 6. Winter wheat + siderates 18. 7. sugar beet 19. 8. corn (or soybean)
20. III 21. 1. cereals + alfalfa 22. 2. Alfalfa 23. 3. Alfalfa 24. 4. sugar beet 25. 5. Winter wheat 26. 6. Winter wheat + siderates 27. 7. sugar beet 28. 8. corn (or soybean) 29. 9. corn (or soybean)		31. 32. IV 33. monoculture of sugar beet for more than 45 years
34. V 35. 1. oats + steam 36. 2. Winter wheat + 37. pea-oat mixture 38. 3. sugar beet		40. VI 41. 1. alfalfa + ryegrass 42. 2. alfalfa + ryegrass 43. 3. Alfalfa + ryegrass 44. 4. Oats 45. 5. sugar beet 46. 6. Winter wheat 47. 7. sugar beet 48. 8. Corn

References

1 Vilchesh S. Parasitism and pathogenesis of fungi that cause root diseases: Trans. from English. // Problems and achievements of phytopathology. - Moscow: Izdat. s.-. literature, magazines and posters. - 1962. - P.427-443 (in Russ.)
2 Kalmykova N.A., Gogol L.A., Rodionova L.I. Formation of Microbial Soil Communities in Intensive Sugar Beet Rotations // Mikrobiol. Journal. - 1994. - 56, №2. - P.100 (in Russ.)
3 Shinkov I.F. Sugar beet crop rotation: Agro recommendations for cultivation of sugar beet in Kyrgyzstan. - Frunze, 1969. -10-20 (in Russ.)
4 Babayan A. To the system of agrotechnical and preventive measures in the fight against the verticilliose wilt of cotton // Cotton. - 1969. - № 7. - P. 41-46
5 Gubanov G.Ya., Sabirov B.G. Fusarium wilt of cotton // Tashkent: Fan, 1977. -96 p.
6 Benken A.A., Dotsenko A.S. Conditions of germination of microsclerotia in soil // Mycology and phytopathology. - 1970. - P. 351-353 (in Russ.)
7 Kornienko A.S. Modern problems of protection of sugar beet from diseases with the industrial technology of its cultivation // Integr. syst. protection of sugar beet from harm., disease., and weeds. - K.: VNIS. - 1986. - P. 62-70 (in Russ.)
8 Pozhar Z.A. Increase of sugar content and technological qualities of sugar beet under the influence of methods of combating diseases // Basis povysh. saccharine and technology. qualities of sugar beet. - K.: VNIS. - 1986. - P.48-55
9 Khovanskaya, KN Agrotechnics in the struggle against the corn root and the rotting of sugar beet // Science and before. experience in proizv. - K.: VNIS. - 1965. - P. 251-255. (in Russ.)
10 Yarmukhamedov R.Kh., Chebolda E.V. Change of productive and technological indicators of sugar beet depending on permanent cultivation and predecessors // Abstracts of scientific papers. conference. young scientists KirgNiz. - Frunze. - 1973. - P. 35 (in Russ.)
11 Maui A.A. Diseases of root crops of sugar beet. Almaty. 2009 P.231 (in Russ.)
12 Мауи А.А., Толебай Ж. Симптомы и биологические особенности возбудителя ризомании сахарной свеклы. ВестникКазахскогогосударственногоженскогопедагогическогоуниверситета, 2016, №6, с.30-36
13 Afanasiev M.M., Baldridge D.E. Selection for the resistance and chemical control of Rhizoctonia root rot disease of sugar beets // J. Amer. Soc. Sugar Beet Tech. -1968. - 15, №2. - P. 428-443
14 Agrotechnical methods of protection of sugar beet from pests, diseases and weeds: Recommendations / Fire Z.A, Kolomiets A.P., Tishenko E.I. and others - M .: Agropromizdat, 1988. – 21p (in Russ.)
15 Orekhova V.A. Control of the root cane of sugar beet in the Altai Territory. In: Effect. measures to protect sugar beet from disease. with the Indian. technol. its rises. - K.: VNIS. - 1986. - P.45-48
16 Bilay V.I. Fusariums. - K.: Naukova dumka, 1977. – 442 p. (in Russ.)
17 Barshtein L.A., Baranovsky V.D. Концентрація цукрових буряків у сівозміні // Tsukrovi Buryaks. - 1998. - №3. - P. 11-12 (in Ukr.)
18 Ermekova B.D. Micromycetes of cultivated soils in Kazakhstan (winter wheat and sugar beet): Abstract. dis. ... Doctor of Biol. Sciences .: 03.00.05. and 03.00.24 / Ін-т. botany and phytointer. AN Rep. Kazakhstan. - Almaty, 1997. - 46s. (in Russ.)
19 Zemlyanoi A.I., Pyatkovskii N.K. The susceptibility of sugar beet to root and cercosporosis depending on the location of its crops in the crop rotation // Effect. measures to combat disease. and it hurts. with int. tech. increase. sugar beet- K.: VNIS. - 1990. - P.27-30 (in Russ.).

РОЛЬ ПРЕДШЕСТВЕННИКОВ В СНИЖЕНИИ ВРЕДОНОСНОСТИ ФУЗАРИОЗНОЙ ГНИЛИ

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Многолетние исследования зоны свеклосеяния Казахстана показывают, что чем меньше интервал во времени между посевами свеклы на одном месте, тем больше риск заражения гнилями корнеплодов. Так в хозяйствах, где свеклу возвращали на прежний участок через 1-2 года, распространенность гнили достигала 78,9%. Наименьшее проявление гнили отмечено в севооборотах, где свекла возвращалась на прежнее место не ранее, чем через 8 лет и более, то есть поля оказывались практически свободными от почвенной инфекции. Здесь поражаемость корнеплодов гнилью составила 9,8%, а это, в свою очередь, способствовало увеличению урожайности (334-425 ц/га).

Ключевые слова: сахарная свекла, фузариозная гниль, предшественник, вредоносность, распространенность, севооборот, озимая пшеница, люцерна.

ФУЗАРИОЗДЫ ШІРУДЕГІ АЛДЫҢҒЫ ЗАРДАПТАҒАН ЗИЯНКЕС САҢЫРАУҚҰЛАҚ ТҮРЛЕРІНІҢ РӨЛІ

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Көпжылдық зерттеулер қызылшаны егу уақытының арасында ұзақ мерзім сақталып отырса қызылшаның тамыржемісінің зардапталу қаупі төмен болады. Себебі ауру қоздырғыш түрлердің споралары, конидиялары азайып топырақ тазаланады. Шаруашылықтарда қызылшаны бұрынғы егілген орнына 1-2 жылда қайта егу жағдайында шіру процессі 78,9 пайызға жеткен. Шірудің аз мөлшерде болуы бұрынғы егілген орынға қайта 8 одан да көп жылдан кейін қайта өсіру кезінде байқалады. Яғни егістік қайта тазарған болды да, бұл жердегі шірудің сандық мөлшері 9,8 % -ыз болды. Нәтижесінде қызылшаның өнімі жоғарлады (334-425 ц/га).

Түйін сөздер: қант қызылшасы, алдыңғы зардапталған саңырауқұлақ түрлері, фузариозды шіру, зиян келтіру, таралуы, ауыспалы егіс, күздік бидай, жоңышқа.