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RESEARCH ARTICLE

ASSESSMENT OF THE SELECTIONS MATERIALS OF MANGOLD FOR THEIR STABILITY TOWARDS THE AGENT CAUSING CERCOSPOROSIS - CERCOSPORA BETICOLA SACARDO

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ABSTRACT

During the period of 2013-2015, in the proving grounds of the Agricultural Institute - Shumen was performed an assessment for the agent causing cercosporosis – Cercospora beticola Sacardo from 16 selection materials of mangold. The assessment is made under natural infectious background, with importing of the leaf fertilizer umustim" (1000ml/ha), as well as without it. For the aims of the examination is performed proving test on the block method scheme, in four successions. The recordings are made based on point scales unified by the Agricultural Institute. The infection index of the cercosporosis is determined and the sorts' reaction of the tested materials was compared, in order for the materials to be assessed with the stability methodic, which is standard for the country. It was determined that the infection index of the cercosporosis Cercospora beticola Sacardo for the mangold depends mostly on the stability of the plants and to a lesser extent on the external conditions; the tested selection materials are averagely sensitive and averagely stable; the import of the leaf fertilizer, Humustim", in dose 1000ml/ha, under favourable conditions for the development of the cercosporosis, does not affect the infection index values.

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INTRODUCTION

The cultivation of sorts with a good level of sustainability is a prophylactic measure acceptable not only by economic considerations, but it is the only way to control diseases when the aim is a production of ecologically clean agricultural production. Mangold and beetroot salad are crops recommended for organic farming as mangold is valuable and caloric source of fodder and beet salad is a healthy and highly prized food. Information regarding the different sort reaction of the selection materials to the agent causing cercosporosis can be found in number of publication, in Bulgaria and in foreign countries. In Germany was assessed the stability to the disease of 12 sorts of sugar beet, cultivated in the country. For the plans that are artificially inoculated under greenhouse conditions was found different reaction for the tested sorts (Ulrich – Eberhard, 1996). Information sources for the reactions of stability or sensitivity to the agent of cercospora selection of material from mangold are very scarce, possibly due to still weak interest in this culture. For the differences in the stability of the selection materials regarding the economically most important mangold disease, there is information in publication of our and foreign authors. (Varbanov, 1994, Uchkunova *et al*., 2004, Tanova *et al*., 2008). According to the authors the results obtained show that the mangold attacked in the most severe level by foliar diseases where cercosporosis has the primary importance. In cpmarison the prevalence of the disease in sorts sugar beet and mangold, Tanova *et al*. (2014) came to the assumption that the reduction in the areas of mangold leads the real risk Cercospora to develop stronger foliar of mangold. This requires to correct selection programs for resistance to cercospora and the work to be aimed at creating sorts mangold resistant and tolerant to this economically important crop disease. The aim of the present research is assessment of the reaction of the selection materials of semi-sugar beet (mangold) regarding the most common sugar beet leaf disease in the country – the cercosporosis, with causing agent *Cercospora beticola Sacardo*.

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MATERIALS AND METHODS

Test schemes and recording methodic

The examinations are performed in the Agricultural Institute – Shumen, for the period of 2013 – 2015.

The assessments are made under proving grounds conditions with natural infection background for the cercosporosis and with two backgrounds of fertilization: with leaf fertilizer "Хумустин", in dose 1000 ml/h imported through the phase „ formed leaves". The recordings for the infection index for the disease are performed with the suggested by Varbanov (2004) and Tanova (2003) 6 – points scale (from 0 to 5 points) or 5 – points scale (from 0 to 4 points), depending on the phenophase of the development at the moment of recording. There are 2 recordings made – 14 days after the import of the leaf fertilizer and 10 days after the first recording. The disease infection index is recorded, calculated with the Mc. Kinny's formula (Popkova, 1987):

I = ∑(a .b).100/ NK , where: I - infection index в %; ∑(a .b)- total amount of the product of the number of infected plants (a) and the correspondent value points of infection (b);

N – number of recorded plants; K - the highest value point in the scale.

The categorization of the testes material is made in accordance with the methodic of the Executive Agency of Variety Testing Field Inspection and Seed Control (Uchkunov, 2008). The examination was performed in parcel attempts, on block method in 4 successions and size of the parcel 10.8 м ^{2,} including: for sugar beet – total 16 selection materials (cross – fertilization of male sterile lines semi-sugar beet) and the mangold, Веси". The results from the proving grounds recordings are processed on the statistical methods for the proving grounds test (Zaprianov, 1983) and are shown in tables.

Climatic conditions

The climatic reference for the regions of the proving grounds trials (Tables 1 and 2) shows that during the period of examination they are very favourable for the occurrence and development of the cercosporosis - Cercospora beticola Sacardo on the beet (Varbanov, 1987).

RESULTS AND DISCUSSION

The results from the recording for the reaction of the sorts and selection material of semi-sugar beet to the recorded disease for the period 2013 – 2015 are shown in table 3. During the first year of the study the selection materials grown with importing of the leaf fertilizer „Humustim" (1000ml/ha) show the clear difference between the infection index values for the cercosporosis.

Legend: MR – averagely stable; **MS** – averagely sensitive**; 0-** proved lower index than the 1st rank; **00-** proved lower index than the 2nd rank;**000-** proved lower index than the 3rd rank;***-** proved higher index than the 1st rank; ****-** proved higher index than the 2nd rank; *****-** proved higher index than the 3rd rank;
In four of the tested lines the infection index for *Cercospora beticola Sacardo* exceeds the index recorded for the standard sort – Vesi. These are the materials- MC201xSKR, MC6634x6VR, SKRRx- 2xMM and MC222xSTR. In two of the selection cross – fertilizations we can observe decrease of this index - 6VR-2xMM and 6VR-2xMM. In the rest one selection materials, cultivated without leaf fertilizer, the infection index for the cercosporosis does not divert in relation to the standard sort. During the second year of the examinations period, the selection materials, cultivated with imported leaf fertilizer keep their reaction towards the agent causing the cercosporosis - *Cercospora beticola Sacardo*.

Table 1. Precipitation in 2013 -2015 (mm)- standard for period of 50 years (IV-IX) - 310mm

Years	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual amount IV-IX
2013	108	46	6	64	145	29	33	40	16	54	27	145	327
2014	49	80	57	37	56	142	54	30	0	-	-	-	319
2015	-	-	-	71	48	28	13	90	26	-	-	-	276
Average	67	57	29	57	83	66	33	53	14	46	36	55	307

Table 2. Temperature in 2013-2015(C°)- standard for period of 50 years (IV-IX) - 19.5^{0}C

Years	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average amountIV- IX
2013	-1.1	-3.9	6.3	13.5	18.3	22.1	28.1	23.9	19.3	15.2	8.2	-0.3	17.6
2014	1.5	2.7	6.7	12.3	18.6	21.6	21.6	24.5	20.4	-	-	-	19.8
2015	1.3	2.6	6.9	14.6	20.8	23.6	27.1	28.4	24.3	-	-	-	23.1
Average	-	-	-	13.5	19.2	22.4	25.6	25.6	21.3	-	-	-	21.2

Table 3. Results of the registration of the attack of varieties and breeding materials of sugar beet by Cercospora beticola- 2013-2015

Variants	Infection index-% Processed with, Хумустин"- 1 l/ha,					Infection index-% Without, Хумустин"				
	2013	2014	2015	Average value for the period	Stability	2013	2014	2015	Average value for the period	Stability
Vesi- standard	15.4	15.8	13.4	14.7	MR	17.8	16.6	15.4	16.6	MS
SKR- 2xMM	21.2	21.0	23.5^{***}	21.0^{*}	MS	14.7	15.9	13.8	14.8	MR
MC6634x SKR	10.4	9.7	11.1^{0}	10.4	MR	8.7^{000}	10.0^{0}	8.4^{0}	9.0^{0}	MR
MC201xSKR	25.8^{**}	26.4^{***}	24.2^{***}	25.5^{**}	MS	20.5	22.6	14.5	19.2	MS
6VR-2xMM	8.6^{00}	6.3^{000}	5.8^{000}	6.9^{0}	MR	7.5^{000}	8.9^{0}	6.8^{00}	7.7^{00}	MR
MC6634x6VR	22.7^{*}	24.1^{*}	21.2^{***}	22.6^{**}	MS	20.7	23.6^{*}	17.5	20.6	MS
MC201x 6VR	18.5	16.5	15.2^{*}	16.7	MS	17.2	10.6	12.2	13.3	MS
SKRRx- 2xMM	22.6^{*}	27.2^{***}	24.2^{***}	24.6^{***}	MS	23.7	28.8^{***}	22.3^{*}	24.9^{***}	MS
MS6634xSKRR	20.6	22.9^{*}	29.2^{***}	24.2^{***}	MS	22.7	25.8^{**}	20.5	23^{**}	MS
MC201x SKRR	12.5	10.7	9.8^{000}	11.0	MR	10.5	14.8	8.7^{0}	11.3	MR
MS222x SKRR	9.5	7.9^{0}	6.3^{000}	7.9^{0}	MR	9.3^{00}	7.0^{00}	7.9^{0}	8.0^{0}	MR
STR-2x MM	7.6^{0}	5.5^{00}	5.8^{000}	6.3^{0}	MR	8.0^{000}	5.7^{000}	6.0^{00}	6.6^{00}	MR
MC6634x STR	8.2	19.3	14.6	14.0	MS	15.5	16.9	20.3	17.5	MS
MC201x STR	14.9	12.9	11.5^{0}	13.1	MR	12.4	10.0^{0}	10.7	11.0	MR
MC222x STR	23.0^{*}	21.7	20.2^{00}	21.6^{*}	MS	24.2^{*}	23.8^{*}	10.8	19.6	MS
GD 5%	6.4	6,7	1.7	5.5		6.4	6,7	6.7	5.5	
GD 1%	8.5	8,9	3.4	8.2		8.5	8,9	9.4	8.2	

During the last vegetation from the examination period all selection materials with imported leaf fertilizer, except the cross – fertilization MC6634x STR and MC6634x STR show diversion in the infection index values. The derivations for six of the materials are positive - SKR- 2xMM, MC201xSKR, MC6634x6VR, MC201x 6VR, SKRRx- 2xMM and MS6634xSKRR. For eight of the selection materials are recorded the lowest values of the infection index for the cercosporosis. These are the lines MC6634x SKR, 6VR-2xMM, MC201x SKRR, MC201x SKRR, MS222x SKRR, STR-2x MM, MC201x STR and MC222x STR. In the first year of examination without imported leaf fertilizer, five selection materials showed diversion in the reported values of the infection index, for one of them this diversion is positive in relation to the standard - MC222x STR and four materials are with negative diversion - MC6634x SKR, 6VR-2xMM, MS222x SKRR and STR-2x MM . During the second year the reaction of the selection materials, cultivated without imported leaf fertilizer, with a few exceptions, is identical. During the third years the same selection materials keep the values of the infection index for the cercosporosis registered for the previous vegetations. The generalized results show that for six selection materials the import of leaf fertilizer leads to increase of the infection index for the cercosporosis. These are the lines: SKR-2xMM, MC201xSKR, MC6634x6VR, SKRRx- 2xMM, MS6634xSKRR and MC222xSTR. For three of selection materials is reported lower infection index, and for the rest tested materials the import of the leaf fertilizer has not affected the infection index for the cercosporosis. In lack of a leaf fertilizer the tested materials keep the tendency for the reported values of the infection index. Regardless from the import of the leaf fertilizer – „ Хумустин", in dose 1000ml/ ha, the tested selection cross – fertilization have clearly shown differences regarding the occurrence of cercosporosis. Seven of the tested selection materials: Vesi- standard, MC6634x SKR, 6VR-2xMM, MC201x SKRR, STR-2x MM, MC201x STR, MC222x STR are assessed as averagely sustainable, and the lines: SKR- 2xMM, MC201xSKR, MC6634x6VR, MC201x 6VR, SKRRx- 2xMM, MC6634x STR, MS6634xSKRR,MC222x STR, SKRRx- 2xMM и MC6634x6VR are assessed as averagely sensitive.

Conclusion

The results from the performed examinations and recording give reasons for the following conclusions: The tested selection materials are averagely stable and averagely sensitive. The import of the leave fertilizer, Humustim", in dose 1000ml/ha, under favourable conditions for the development of the cercosporosis does not affect the infection index values.

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