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The Contribution of Genetic Resistance of Potato Varieties on Virus

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Abstract: ***World production of potato is second to cereals. One of the most efficient key factors of increasing potato production is the quality of seed potato as planting material. In order to control the varieties production, it is necessary the use of a high biological value material, with no viral diseases. The present study revealed that the ELISA method is applicable for the determination of the viral infection degree with effect on the yield of potato seeding material from superior biological categories. Also, the elimination of virus-infected plants using the ELISA method has resulted in a higher yield of potato seeding material from superior biological categories (SE and E basis).***

Keywords: planting material, varieties, biologic potential.

1. Introduction

Of late years, as a consequence of the decay of fossils resources and of the increase of agricultural yield, the role of the biological resources has grown. Therefore, it has become common the use of superior genetic structures which are materialized through high quality seeds, forming a variety or a hybrid (DRAICA, 1995; DRAICA, 2004; TUOMISTO, 2007; AMELINE et al., 2008). The viruses control represents one of the most complicated issues of plants' protection (URLICH, 1963; BOȚOMAN & IANOSI, 2005; KAPSA, 2008). The losses from agriculture caused by plants infection with viruses can be enormous (ANDERSON et al., 1989; IACOB, 2002; IANOSI, 2002). The aim of this study was to evaluate the effect of planting area, variety, planting time, vegetation interruption time, biological category and virus infection on the yield of potato seeding material.

2. Materials and methods

2.1. Materials

Considering the variety as a technological factor for realizing high production yields at performing agriculture level, the creation of new potato varieties solves two major problems: offers the agricultural producers the varieties which are consonant with the ecological conditions and with the zone specific technology; and succeeds in applying the specific technology for the morphological attributes of the created varieties in the existent pedoclimate conditions. The selected planting areas (Figure 1) were from Suceava County, Romania: the Experimental Center in Lucina locality (altitude of 1400 m) and the Station for Agriculture Research and Development in Suceava – SARD (altitude of approx. 400 m). The studied potato varieties (Figure 2), created and certified at the Station for Agriculture Research and Development in Suceava, with the year of their entering in the system of seed material production and reproduction are presented in Table 1.

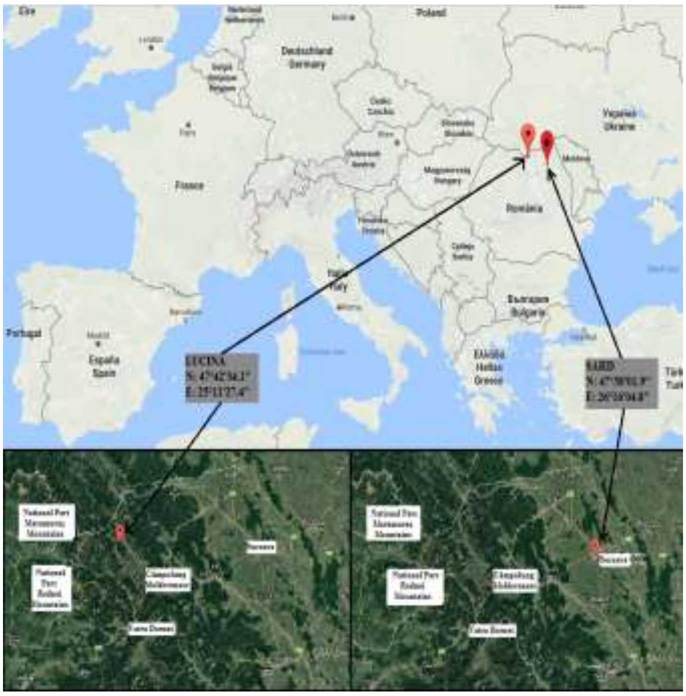


Figure 1. Planting areas under study

Table 1. Studied potato varieties

Variety	Certification year	Vegetation period	Peridema color	Production capacity (q/ha)
Astral "N"	2001	half-early	yellow	357
Rapsodia"N"	2002	half-early	yellow	420

2.2. Methods

The experiments were conducted according to „latin square subdivided plots" method, on type 2×2×2×2, in four replications (SĂULESCU & SĂULESCU, 1967), taking into consideration the following factors: the planting area (A), the variety (B), the planting time (C), the vegetation interruption time (D) and the biological category (E). The factors' classes are presented in Table 2.

Table 2. Technological factors under study

Technological factor	Code		Factor's Classes
Planting area	A	A_a$_1$	ARDS
		A_a$_2$	Lucina
Variety	B	B_b$_1$	Rapsodia
		B_b$_2$	Astral
Planting time	C	C_c$_1$	Early Spring
		C_c$_2$	30 days after Early Spring
Vegetation interruption time	D	D_d$_1$	at warning
		D_d$_2$	30 days after warning
Biological category	E	E_e$_1$	SE basis
		E_e$_2$	E basis
		E_e$_3$	Certified A

4. The complex effect of all studied factors was studied and interpreted in all experimental years, going to clone D (prebasis) taking in the study the seeding material yield for both varieties. Fertilization of the potato plots with N:P:K, 100:100:100 kg s.a/ha, in a balanced rapport, was accomplished. The tubers were planted semi-mechanically at a distance of 21.5 cm between tubers and 70 cm between rows, using the fraction of 30-45 mm. In order to destroy of the potato herbage the first treatment was made mechanically, at warning – after 70 days from the plant sprouting. The second treatment was made with Diquat (Reglone forte) 5 l/ha. After three weeks from the vegetation interruption, the harvesting of the tubers was accomplished. The ELISA (Enzyme-Linked-Immuno-Sorbent-Assay) technique was used for the study of diseases produced by the virus of crop plants and also to detect low concentration of viruses in the studied potato cultures. It permits a simple and accurate detection of viruses in stems and in other vegetative organs of plants. Its principle is based on the interaction antigen – antibody. The applied method was DAS–ELISA (double antibody sandwich - ELISA). The tested viruses were: PLRV (potato leafroll virus), PVA (potato virus A), PVM (potato virus M), PVS (potato virus S), PVX (potato virus X), PVY (monoclonal and polyclonal potato virus Y). There were used the following reagents: IgG (immuno-conjugate), conjugate, positive control, negative control, extraction buffer, coating buffer, conjugate buffer, washing buffer, substrate, microplates, substrate (pNPP tablets). Due to the test's high sensibility, viruses could be detected before symptoms manifestation.

a) Rapsodia Variety b) Astral Variety

Figure 2. Potato varieties under study

3. Results and discussion

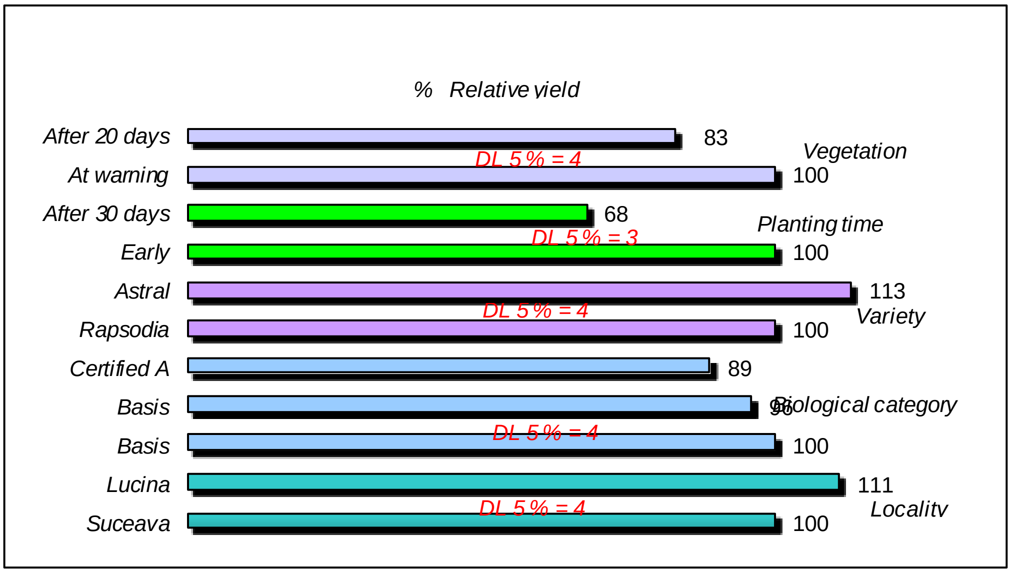
As it can be seen in Table 3, the seeding material yield was mostly dependent on the planting time. Table 3. The potato seeding material yield (q/ha) dependence on the technological factors

Technological factor		PSM (q/ha)	Differences
A	A_a1	140.7	standard.
	A_a2	154.0	13.3***
B	B_b$_1$	138.6	standard
	B_b$_2$	156.1	17.5***
C	C_c$_1$	175.6	standard
	C_c$_2$	119.1	-56.5^{ooo}
D	D_d$_1$	160.7	standard
	D_d$_2$	134.0	-26.7^{ooo}
E	E_e$_1$	155.5	standard
	E_e$_2$	149.0	- 6.5
	E_e$_3$	137.7	-17.8^{ooo}

*PSM - Potato seeding material

DL (limit difference) 5 % = 6.0 q/ha ****significant increases*
1 % = 8.3 q/ha
0.1 % = 11.5 q/ha *^{ooo}significant decrease*

The yield was diminished with 32% (56.5 q/ha) when planting the potatoes 30 days later. A significant decreasing was also observed for the vegetation interruption factor, the yield at 20 days after warning being smaller with 17% (26.7 q/ha) comparing with the culture with vegetation interruption at warning. Considering the biological category factor, the SE class basis culture presented a potato seed yield with 11% (17.8 q/ha) above the yield of the certified A culture. The yield of Rapsodia variety culture surpassed the Astral variety culture's yield with 13% (17.5 q/ha). Also, in comparison with Suceava culture, at Lucina it was registered an increase in potato seeding material yield with 9% (13.3 q/ha), as it can be observed in Figure 3.



*DL - limit difference; *83, 100 – the values of relative yield (%) of potato according to vegetation interruption; 68, 100 – the values of relative yield (%) of potato according to planting time; 113, 100 – the values of relative yield (%) of potato according to variety; 89, 96, 100 – the values of relative yield (%) of potato according to biological category; 68, 100 – the values of relative yield (%) of potato according to planting time; 111, 100 – the values of relative yield (%) of potato according to locality.

Figure 3. The influence of the technological factors on the potato seeding material relative yields

Table 4. The effect of planting time and vegetation interruption time on the cultures' yield (q/ha)

Technological factor C	Technological factor D	A	B	PSM (q/ha)
C_c_1	D_d_1	A_a_1	B_b_1	169.5
	D_d_2			142.6
C_c_2	D_d_1			111.2
	D_d_2			105.5
C_c_1	D_d_1	A_a_1	B_b_2	189.8
	D_d_2			160.2
C_c_2	D_d_1			128.7
	D_d_2			118.1
DL 5 %				8.1 q/ha
DL 1 %				11.1 q/ha
DL 0.1 %				15.0 q/ha
C_c_1	D_d_1	A_a_2	B_b_1	197.5
	D_d_2			156.7
C_c_2	D_d_1			130.3
	D_d_2			96.0
C_c_1	D_d_1	A_a_2	B_b_2	220.1
	D_d_2			169.0
C_c_2	D_d_1			138.2
	D_d_2			124.7
DL 5 %				6.4 q/ha
DL 1 %		+		8.7 q/ha
DL 0.1 %				11.8 q/ha

*PSM - Potato seeding material, * DL - limit difference

From Table 4 it can be observed effect of planting time and vegetation interruption time on the cultures' yield (q/ha) and Table 5 show the influence of variety on the cultures' yield (q/ha) at different planting times and different vegetation interruption times.

The relative yield decrease due to the vegetation interruption time was depended to a certain extent by the planting time. The data in the table reveal that the best results were obtained when the planting was realized earlier and the vegetation interruption was made at warning, for both planting areas and varieties. Quantitatively, when the crop establishment is accomplished earlier, the vegetation interruption at warning is more important than the later planting.

Table 5. The influence of variety on the cultures' yield (q/ha) at different planting times and different vegetation interruption times

B	Technological factor	A_a_1 PSM (q/ha)	A_a_1 Differences	**II. A_A_2** PSM (q/ha)	**II. A_A_2** Differences
		C			
B_b_1	C_c_1	156.0	Standard	177.1	Standard
	C_c_2	108.3	-47.7^{ooo}	113.1	-64.0^{ooo}
B_b_2	C_c_1	174.9	Standard	194.4	Standard
	C_c_2	123.3	-51.6^{ooo}	131.4	-63.0^{ooo}
		D			
B_b_1	D_d_1	140,3	Standard	163.9	Standard
	D_d_2	124,0	-16.3^{ooo}	126.3	-37.6^{ooo}
B_b_2	D_d_1	159,2	Standard	179.1	Standard
	D_d_2	139,0	-20.2^{ooo}	146.7	-32.4^{ooo}
	DL 5%		8.1 q/ha		6.4 q/ha
	DL 1%		11.1 q/ha		8.7 q/ha
	DL 0.1%		15.0 q/ha		11.8 q/ha

*PSM - Potato seeding material, *DL - limit difference
^{ooo} significant decrease

The later planting generated the same quantitative decreasing at both varieties, independent of the planting area (Suceava or Lucina).

3. Conclusions

The ELISA technique is indicated on a wide scale for the tests of events on the field, in the study of the diseases produced by the viruses which result from plants of culture. The sensibility of this method in the direct detection of viruses in the plants' extracts, can drive us to the study on the field of these viruses for which we have not found available adequate practical methods.

Among the measures which had a major negative impact on potato seeding material yield, the later planting is the first, followed by later vegetation interruption. The yield diminishing as a consequence of later vegetation interruption was significantly amplified when the planting was conducted later, for both planting areas (Suceava and Lucina) and varieties (Astral and Rapsodia).

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