COSIANA – new Romanian potato variety

National Institute of
Research and Development
for Potato and Sugar Beet
Brasov - ROMANIA

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Introduction

According FAO (2008) the potato should be a major component in strategies aimed at providing nutritious food for the poor and hungry. It is ideally suited to places where land is limited and labour is abundant, conditions that characterize much of the developing world. The potato produces more nutritious food more quickly, on less land, and in harsher climates than any other major crop - up to 85 percent of the plant is edible human food, compared to around 50% in cereals.

Potato breeding are oriented to obtain varieties with resistance to biotic and abiotic factors and with high yield capacity to satisfy the both quantitative and qualitative needs of consumers.

Productivity, quality and stability are achieved through crop improvement works to promote new varieties with traits performance.

Materials and method

COSIANA it's a new medium late potato variety suitable for cultivation in all traditional areas. The variety is obtained by sexuat hybridation followed by individual clonal selection, according to the classical scheme of potato breeding NIRDPSB Brasov

The main steps of working method were:

- establish of genitors according to the physiological and technological qualities of the tubers
- sexuat hybridization, including seedlings, vegeative populations, descendants, compatative crops (3 years in the network of National Institute for Testing and Registration of Varieties – ISTIS)
- obtaining license and registration in the National List of Cultivated Varieties

The resistance to black wart was determinated at Pojorata Station, Suceava. The starch content and processing quality were determinated in the NIRDPSB Brasov laboratory. Also resistance to late blight and viruses were determinated in the fields and laboratories of NIRDPSB Brasov

Results and discussions

Genitors: Amelia x Impala

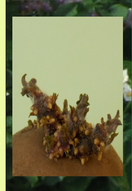
Morphological characters: The plant is tall to very tall, with large number of steams and erect port. The leaf is opening, with medium perimeter, large number of leaflets and green color. The variety has a medium frecquency of the flowers. The flower has red purple color and a large size of the corolla. Corolla has a strong anthocyanin coloration on the inner face and the proportion of blue in anthocyanin coloration on the inside is medium.

The tubers are round-oval with medium shallow eyes, red skin and pale yellow flesh.

Physiological characteristics: Cosiana variety belongs to the group of middle varieties.

Resistance to pests and diseases: Cosiana variety is midlle resistant to late blight on foliage and tubers and also medium resistant to PVY and leaf roll viruse and resistant to potato wart (*Synchitrium endobioticum*).

Culinary quality: It has a intermediate culinary quality (class B/C) and a starch content 15,75%. Cosiana variety is suitable for a range of uses, including chips and pommes frites



Yielding capacity:

Yield is a complex heritable trait, being greatly influenced by environmental conditions and photoperiodicity. Potato variety Cosiana proved a good yield capacity (60 t/ha), being adapted to Romanian climatic and soil conditions as shown in tests carried out in ISTIS network, were it was tested prior approval (Table 1). In ISTIS network Cosiana variety exceeded by 4 to 8% the control varieties, Sante and Redsec varieties in 2013 and Sante and Roclas varieties in 2014-2015. From these percentages may by deducted the yielding capacity in different enviromental conditions and also the ecological plasticity of the variety. Evaluation was done in six centers: Târgu Secuiesc, Sibiu, Satu Mare, Rădăuţi, Luduş (2014-15), Hărman, Bacău (2013).

Table 1

Yielding capacity in I.S.T.I.S. network (2013-2015)

Centru ISTIS	2013			2014			2015		
	Cosiana	Sante	Redsec	Cosiana	Sante	Roclas	Cosiana	Sante	Roclas
Tg. Secuiesc	69537 (140%)	49704 (100%)	55003 (111%)	63461 (120%)	53828 (107%)	50305 (100%)	36263 (80%)	45473 (100%)	32139 (71%)
Sibiu	43756 (95%)	45955 (100%)	56208 (122%)	55601 (109%)	55060 (108%)	51242 (100%)	35887 (100%)	35815 (100%)	31258 (87%)
Satu Mare	26189 (118%)	22262 (100%)	25199 (113%)	20754 (91%)	22703 (100%)	22743 (100%)	22596 (121%)	18685 (100%)	25706 (138%)
Rădăuţi	24053 (89%)	21357 (100%)	29543 (123%)	25759 (128%)	25866 (128%)	20207 (100%)	16783 (97%)	17256 (100%)	21575 (125%)
Luduş	-	-	-	45780 (123%)	43244 (117%)	37104 (100%)	28905 (96%)	30203 (100%)	33901 (112%)
Hărman	23891 (95%)	25225 (100%)	24156 (96%)	48449 (105%)	44045 (95%)	46317 (100%)	41642 (101%)	41375 (100%)	40708 (98%)
Bacău	20633 (77%)	25225 (100%)	27931 (104%)	-	-	-	-	-	-
MEDIA	**31436** (104%)	**30236** (100%)	**34247** (113%)	**39947** (108%)	**38530** (105%)	**36867** (100%)	**30346** (96%)	**31468** (100%)	**30881** (98%)

Culinary quality:

The variety belongs to an intermediate category (class B/C) and has a starch content of 15,75%. Cosiana variety is suitable for a range of uses, including chips and pommes frites (Table 2).

Table 2

Culinary quality of variety Cosiana compared with standard varieties Rustic and Roclas

Character	Cosiana	Rustic	Roclas	Observations
Aspect	2,5	2,5	1,5	1-very showy, ..,4-unshowy
Taste	3,0	3,0	2,0	1-excelent, ..,4-less good
Color	2,5	4,0	4,5	1-white, ..,6-intense,yellow
Disintegration	3,5	1,5	1,0	1-remain whole, ..,4 hard crush
Consistency	2,5	1,5	1,0	1-firm hearty, ..,4-unhearty
Mealiness	3,0	2,0	2,5	1-unmealy, ..,4-very mealy
Moistness	2,0	2,0	2,0	1-moist, ..,4-dry
Granulation	3,0	1,5	2,0	1-fine, ..,4-very coarse
Cooking type	B/C	A/B	A/B	
Rawdiscolouration	2,0	3,0	4,0	1-uncolored, ..,9-blakened
Starch content	15,75	18,85	15,75	

Conclusions

1. The need to create new potato varieties in Romania is imposed by a number of factors, like quarantine pests and diseases *Globodera sp., Clavibacter michiganensis and Rastolnia solanacearum.*

2. The presence of viral infection in Romania is above the pressure existing in European countries with tradition in potato. Varieties developed in these countries have a short life due to the degeneracy viruses.

3. Cosiana variety is a relatively late variety, with a high yield capacity associated with some superior agromonic property.

4. Very good resistance to the important viruses make possible to produce seed without much difficulty.

5. It is recommended to be cultivated in favorable areas and in thermo-hydric stress areas to use irrigation to obtain satisfactory production.

Acknowledgements

Part of this work was founded by Ministry of Agriculture and Rural Development by Project ADER 2.1.1. "Obtaining new potato varieties adapted to climate and economic changes with higher efficiency in water resources management and establish technological packages asking to market and farmers requirements".

PRELIMINARY STUDY REGARDING THE EFFECTS OF SOME COMBINED TREATMENTS OF PVY INFECTED POTATO PLANTLETS CV. ROCLAS

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Introduction

DECREASE the PVY infection level using:

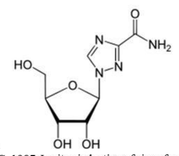
- **antiviral compounds (Ribavirin +Oseltamivir) in tissue culture**
- **electrotherapy**

ESTIMATE the chlorophyll and anthocyanin amount of the acclimatised plants

1. WHY CHEMOTHERAPY?

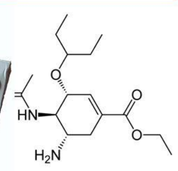
RIBAVIRIN (RBV) (1,ß-D-Ribofuranosyl-1,2,4-triazole-3-carboxamide)

- Broad spectrum **anti-viral activities**,
- RBV5'-phosphate = **inhibitor of inosine monophosphate (IMP) dehydrogenase** [1]



OSELTAMIVIR (OSMV) (Tamiflu) [ethyl (3R,4R,5S)-5-amino-4-acetamido-3-(pentan-3-yloxy)-cyclohex-1-ene-1-carboxylate]

- an **antiviral prodrug**
- **used to slow the spread of flu virus** (influenza A and B) by **stopping** from chemically **cutting with its host cell.**
- produced from shikimic acid, **an inhibitor of neuraminidase** [2]



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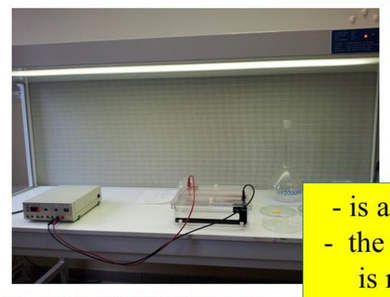
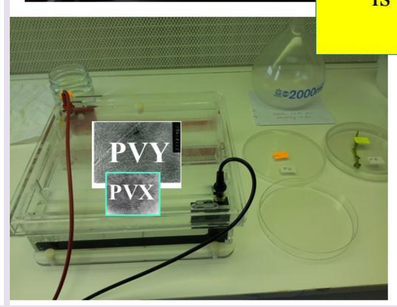
[2] Ward, P., Small, I., Smith, J., Suter, P., Dutkowski, R. 2005. Oseltamivir (Tamiflu) and its potential for use in the event of an influenza pandemic *The Journal of antimicrobial chemotherapy* 55 (Suppl 1): 5–21

2. WHY electrotherapy?



- is a simple method
- the equipment used is not special or expensive



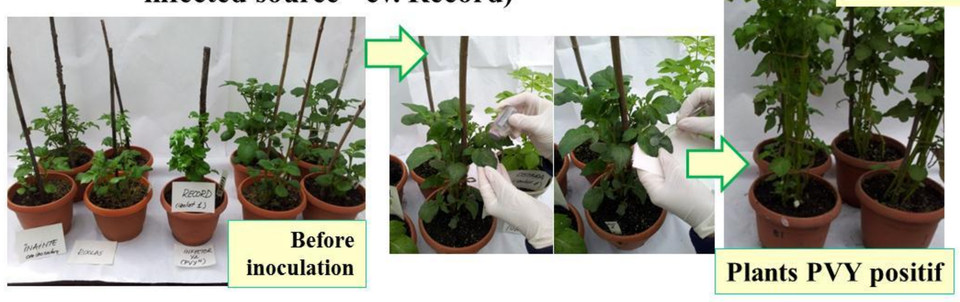
- **electric pulses = stimulants** on plants differentiation *in vitro*
- electric current is applied to plant tissues **for disrupt/degrade viral nucleoprotein and eliminate its virulence activity**

Material and methods

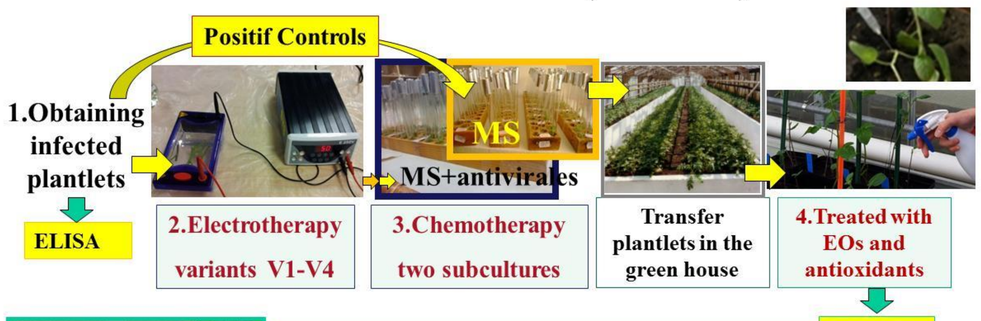
MATERIAL for STARTING

Biologic material

-PVY inoculated plants (using a secondary infected source - cv. Record)



METHOD: STEPS AND TESTS (ASSAYS)



The therapy efficiency index (TEI)*
= % plants regenerated x % virus-free plants / 100

Chlorophyll and **anthocyanin amount** (SPAD units) present in leaves of the regenerated plants acclimatised (SPAD 502 Plus Chlorophyll Meter, Spectrum Technologies, Inc, USA)

Bibliography

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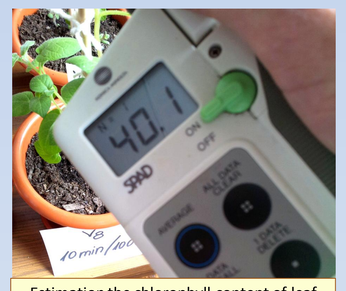
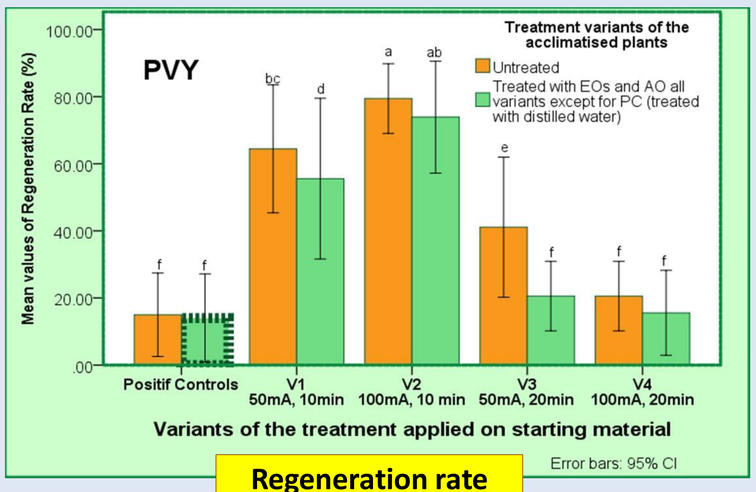
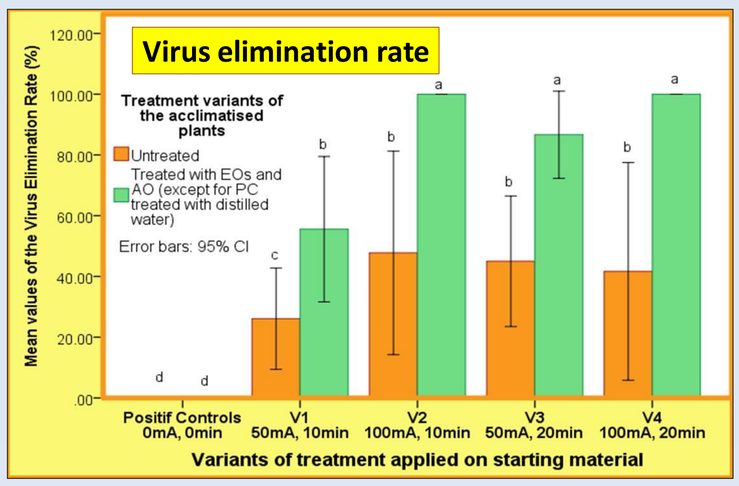


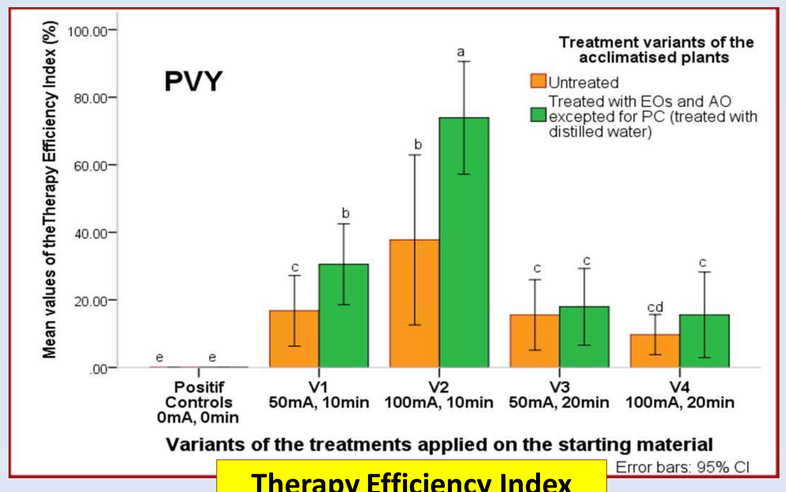
Estimation the chlorophyll content of leaf portable device (SPAD 502 Chlorophyll Meter) and the anthocyanin content at leaf (portable device ACM 200 plus, Antocianin Chlorophyll Meter)

Results



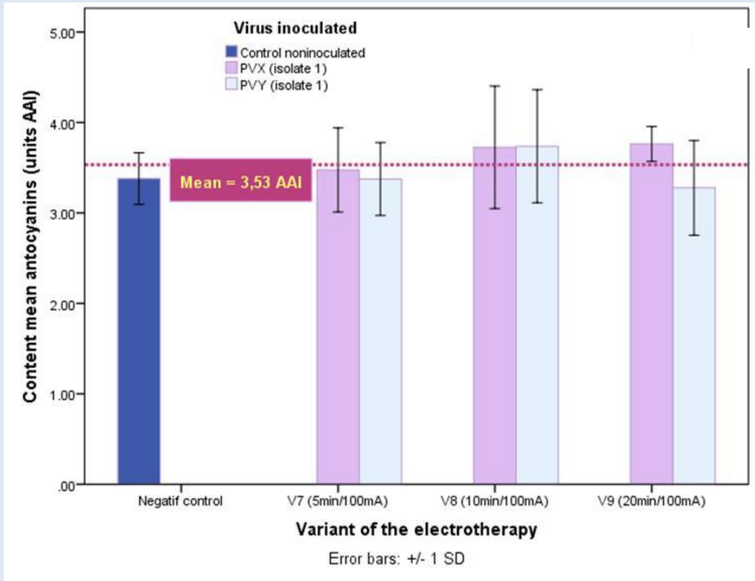
Regeneration rate

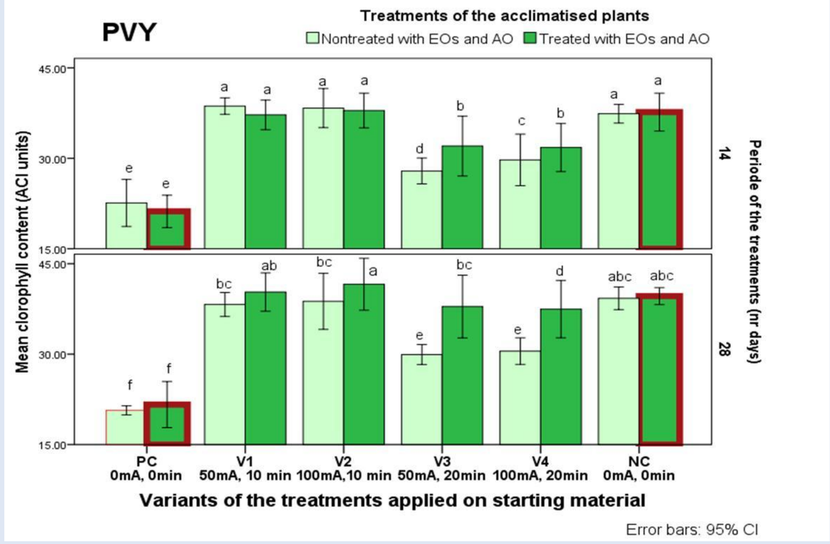




Therapy Efficiency Index

Effects of treatments applied on PVY infected material cv Roclas





Effects of combined therapies on chlorophyll amount of plants obtained from infected material regenerated after 2 consecutive subcultures and acclimatized .The letters indicate significance of differences between variants according to ANOVA and Duncan test (P<0.05).

Plants obtained from PVY infected material treated by chemo- and electrotherapy

Conclusions:

Eelectrotherapy (50mA/100mA, 10min/20min applied on PVY infected plantlets cv Roclas) + chemotherapy (RBV 40mg/l + OSMV 40mg/l) + treatments of acclimated plants have led to:

- 83.7% PVY virus free plants
- higher values of the therapy efficiency index (TEI) compared with the other variants
- higher values for the chlorophyll amount in all the regenerated plants obtained from infected material compared with the variants untreated and the negative control (healthy plantlets untreated)

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The NPK fertilization effects on culinary and technological potato quality

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INTRODUCTION

Culinary quality includes traits related to the overall quality of the boiled tubers: taste, breaking at boiling, consistence, mealiness, moisture, structure of starch granules, pulp color, potato' after-cooking darkening.

The technological quality includes traits related to specific gravity, dry matter, starch and reducing sugars, pretability for industrial processing as pommes-frites, chips, flakes, starch and alcohol. Technological quality is assessed on the basis of quality products from potatoes: efficiency to peeling and mechanical processing, color, texture, oil content for chips and pommes-frittes.

Natural or chemical fertilization and soil type on which potatoes are grown may influence sugar content. A deficiency of phosphorus and potassium in the soil may lead to a decreased synthesis of starch and to an increased sugar content (MUREŞAN, 1999).

When a nitrogen excess is present in the soil, the dry matter content of the potato tubers decreases (WESTERMANN et al., 1994), the specific gravity decreases (ATKINSON et al., 2003) and the reducing sugars content increases.

A good supply with nitrogen is important in achieving economically viable production of potato tubers and achieve potato tubers with size and qualities suitable for processing (ZEBARTH et al., 2012). Potato plants fertilized properly with nitrogen produced tubers with a low concentration of reducing sugars at harvest (KUMAR et al., 2004).

MATERIAL AND METHOD

In experimentation we proposed different levels of fertilization and NPK ratios, for Roclas and Christian varieties, created at N.I.R.D.P.S.B. Brasov. Researches are based on polifactorial experience by type 2A * 2B * 2 C * 4R with following factors and experimental graduations:

- Factor A – variety - a1. Christian
  - a2. Roclas
- Factor B – NPK ratio of fertilization:
  - b1. 1:1:1 from C 15 :15 :15
  - b2. 1:0,9:2 from C 5:10:22 + ammonium nitrate
- Factor C – nitrogen fertilization:
  - c1 = 100 kg N/ha
  - c2 = 200 kg N/ha

Research methods in laboratory included analysis, qualitative and quantitative determinations designed for tubers using purpose.

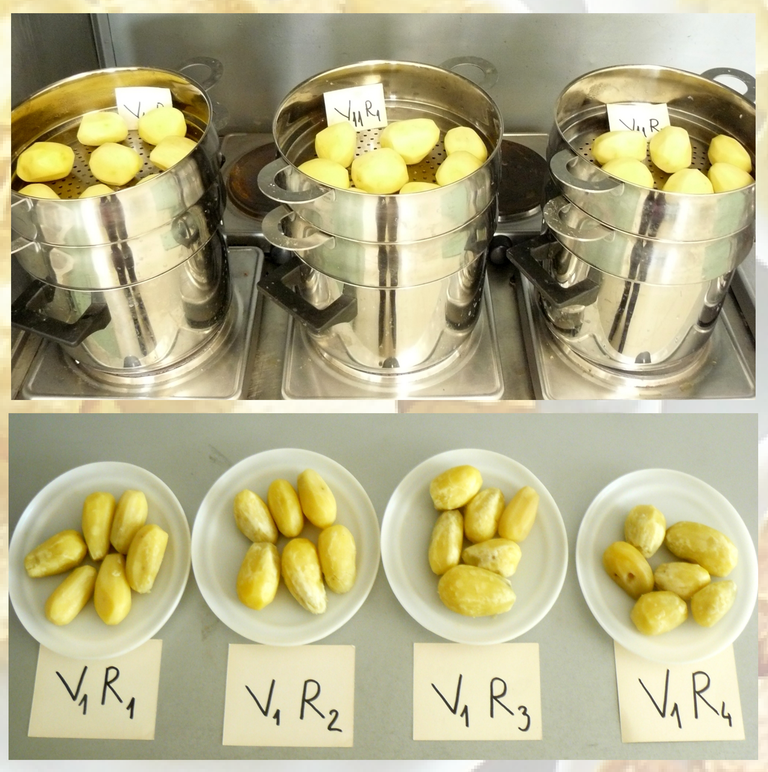
After harvesting and before introducing tubers in storage into cold store, several determinations were made on experimental variations and repetitions, regarding the tuber starch content, the dry matter content of tubers.

To establish the class usage of the tubers, their culinary quality was determined by sensorial analysis.

We also determined the pretability for processing into chips.

The tubers content in reducing sugars was determined by high performance liquid chromatography.

Statistical analyses of obtained data were accomplished using the statistical software package MSTAT-C. SPSS was used for statistical analysis with ANOVA, Duncan test, Pearson correlations and regressions of measurements made in dynamic field and laboratory analyzes.



RESULTS AND DISCUSSIONS

Mean culinary quality traits and the correlations with tubers starch before storage.

2013 and 2014 - two years with very different climate conditions

In 2013, on average, between this two varieties were significant differences regarding the percentage of starch (16.9% for Roclas variety and 16.2% for Christian variety). The other analyses presented were located at the same level.

In 2014, the studied varieties were strongly differentiated in terms of the starch content, dry matter and sugars. The starch content of the Roclas variety (16.2%) exceeded that of Christian variety (13.9%) with 2.3%. Similarly, the dry matter of variety Roclas (24.1%) was significantly higher compared to the variety Christian (22.9%).

A significant difference was recorded also for the reducing sugars' content.

The average values of starch, dry matter and reducing sugars content in the tubers, Braşov, 2013-2014

Varieties	Starch %			Dry matter %			Reducing sugar (glucose +fructose) %		
	2013	2014	Media	2013	2014	Media	2013	2014	Media
Christian	16.2	13.9	15.1± 1.5	25.0	22.9	23.9±1.9	0.12	0.25	0.19±0.15
Roclas	16.8	16.2	16.5±1.0	25.5	24.1	24.8±1.9	0.18	0.49	0.34±0.20
Differences (Roclas-Christian)	+0.7*	+2.3*	+1.5	+0.5	+1.2*	+0.85	+0.06	+0.24*	+0.15
DL 5%	0.7%	0.7%		1.2%	1.1%		0.11%	0.10%	

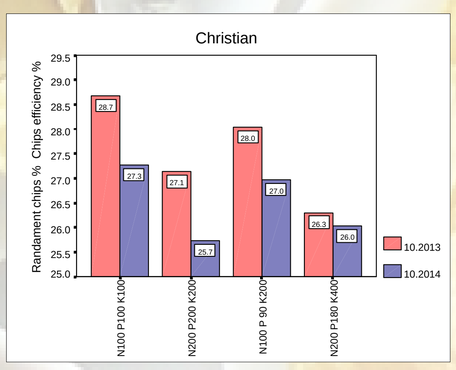
Comparison of correlation coefficients between starch and notes of appreciation for culinary quality traits

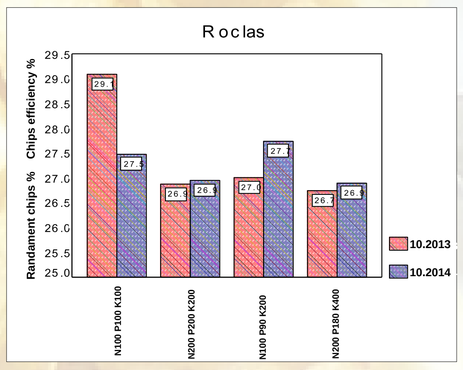
Culinary quality traits	Year	Starch	Breaking at boiling	Consistence	Mealiness	Moisture	Structure of starch
Starch	2013	1					
	2014	1					
Breaking at boiling	2013	0.443*	1				
	2014	0.769**	1				
Consistence	2013	0.234	0.406*	1			
	2014	-0.182	0.028	1			
Mealiness	2013	0.229	0.636**	0.604**	1		
	2014	0.274	0.488**	0.526**	1		
Moisture	2013	0.451**	0.575**	0.460**	0.659**	1	
	2014	0.373*	0.360*	0.030	0.610**	1	
Structure of starch	2013	0.405*	0.678**	0.340	0.594**	0.354*	1
	2014	0.660**	0.729**	0.245	0.691**	0.583**	1

N = 32
** Correlation is significant for 0.01
* Correlation is significant for 0.05

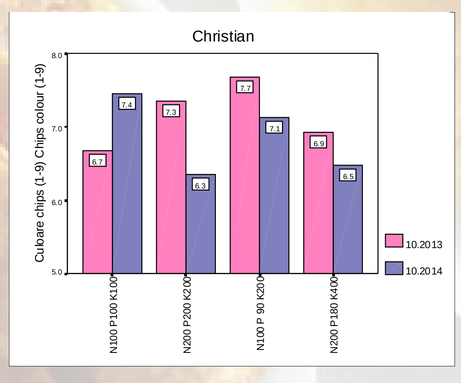
Average suitability for processing into chips and correlations between dry matter, starch, reducing sugar, efficiency to processing into chips and chips color before storing tubers 2013-2014

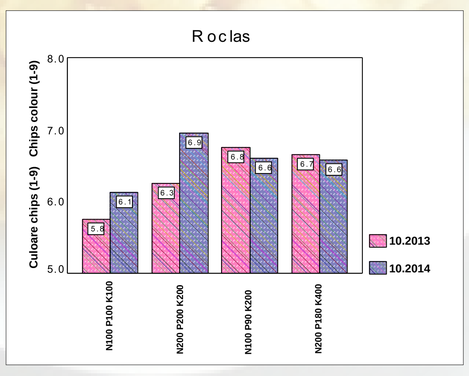
For the two years, on average, the chips' yield did not significantly differentiate; also, the average note for chips color did not differentiate significantly for two varieties researched. In two years between Christian and Roclas variety there are similar differentiation on the level of tuber processing efficiency into chips.
Chips yield decreasing with increasing NPK ratio from 1:1:1 to 1:0.9:2, respectively with increasing nitrogen dose in combination of 100 to 200 kg N/ha. Notes for chips color have a decreasing trend,





Comparison of fertilization variants for chips yield before storage 2013-2014





Comparison of fertilization variants for chips color before storage 2013-2014

The coefficients for the correlations between dry matter, starch, reducing sugar, efficiency to processing into chips and colour of chips before storage

	Variety	Dry matter	Starch	Reducing sugar	Efficiency to processing into chips	Colour of chips
Dry matter	Christian	1				
	Roclas	1				
Starch	Christian	0.772**	1			
	Roclas	0.677**	1			
Reducing sugar	Christian	-0.421*	-0.246	1		
	Roclas	-0.331	-0.167	1		
Efficiency to processing into chips	Christian	0.406*	0.687**	0.232	1	
	Roclas	0.163	0.375*	0.181	1	
Colour of chips	Christian	0.370*	0.420*	0.157	0.444*	1
	Roclas	-0.271	-0.381*	-0.069	0.125	1

N = 32
** Correlation is significant for 0.01
* Correlation is significant for 0.05

CONCLUSIONS

Because the researches were conducted in two years with very different growth conditions in terms of climate, the accumulation of starch and dry matter in tubers was significantly low in 2014 comparing with 2013.

On average, on those two years, the differences due fertilization variants were not provided statistical for dry matter content of tubers. For 2014 fertilization variants with high nitrogen level led to significant decreases in dry matter content to both fertilizing ratios, on both varieties. On both varieties the content of reducing sugar was significantly higher in 2014 comparatively with 2013.

Comparing variants of fertilization, on Roclas variety, tubers from variant with N100 P100 K100 louder crashed on boiling, pulp consistency is more reduced, are more farinaceous and moisture toward the rest of variants for both years, tubers starch contents positively significantly correlate with appreciation notes for milling, moisture and starch structure.

With the increase ratio from NPK 1:1:1 to 1:0.9:2 respective with increasing nitrogen dose combinations from 100 to 200 kg N/ha the decline in yield is found in chips.

Notes for the chips' color have a tendency to decrease, which indicates a darker colour of chips with increasing doses of nitrogen on variants with ratio 1:0.9:2, on both varieties and both experimental years.

The starch content of tubers correlates positively, assured yield statistically in chips of the tubers, r = 0.687 * - Christian and r = 0.375 at Roclas variety. There were no significant correlations between reducing sugar from tubers and chips color for the data obtained in the years 2013-2014 before storage.

BEHAVIOUR OF DIFFERENT POTATO VARIETIES BY SIMULATING *IN VITRO* OF HYDRIC STRESS CONDITIONS

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INTRODUCTION

In vitro selection may shorten considerably time for selection of desirable traits and completes selection the field.

Action for a short period of stress induce reactions in plants of protection, adaptation (response) to respective conditions. There is some evidence that the roots are the primary sensors of water deficit in the soil, causing physiological and biochemical perturbations in stems; growth reduction can generally be interconnected with changes in plant nutrition.

In vitro selection may shorten considerably time for selection of desirable traits and selection completes in the field. For *in vitro* selection PEG, sucrose, mannitol and sorbitol were analyzed in several research papers, as agents of osmotic stress.

In vitro culture techniques minimizes external environmental changes due to nutrient medium defined and controlled conditions applying stress homogeneity.

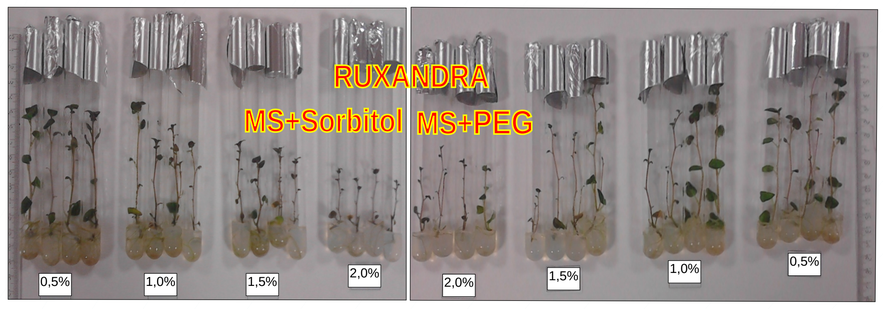
MATERIAL AND METHOD

For rapid identification of genotype with resistance / tolerance to water stress was chosen two simulators of water stress. One of them was polyethylene glycol (PEG 6000) and the second was sorbitol (growth inhibitors). Both of them were separately added in medium using 4 concentrations.

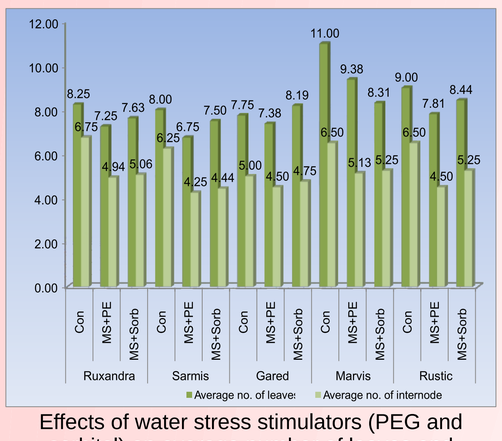
Experience included the following factors:

Experimental factor A: variety, with 5 graduations: **a1** - Ruxandra; **a2** - Sarmis; **a3** - Gared; **a4** - Marvis; **a5** - Rustic.

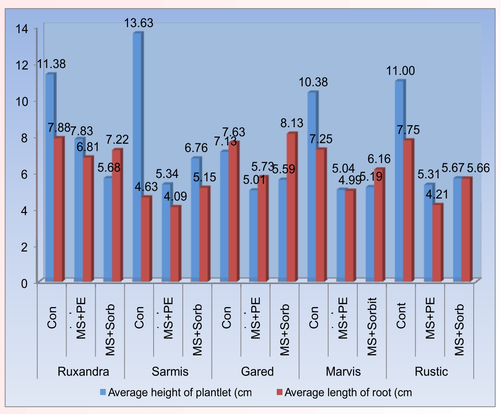
Experimental factor B – nutrient media used (with different simulators of water stress) with 3 graduations: b1 - control medium MS, which contain was no osmotic agent; **b2** - MS medium, to which was added PEG; **b3** - MS medium, to which was added sorbitol.



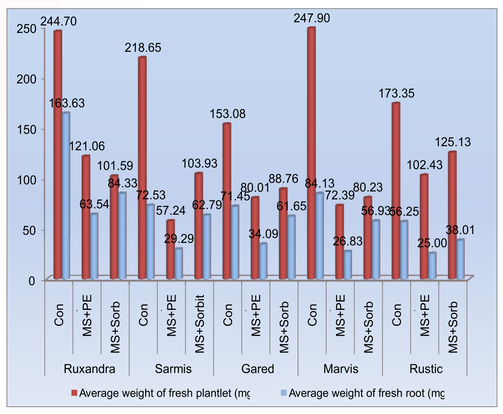
RESULTS



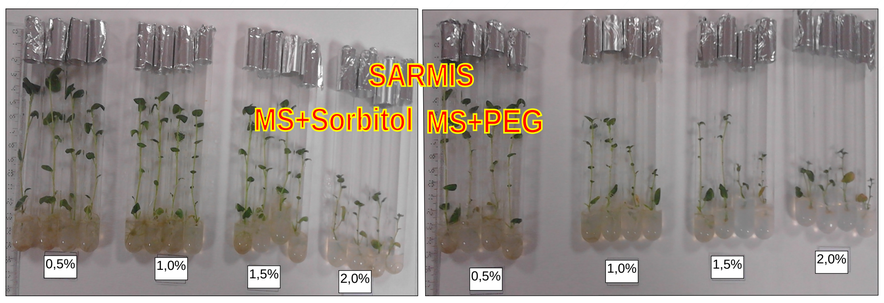
Effects of water stress stimulators (PEG and sorbitol) on average number of leaves and internodes in comparison with control medium

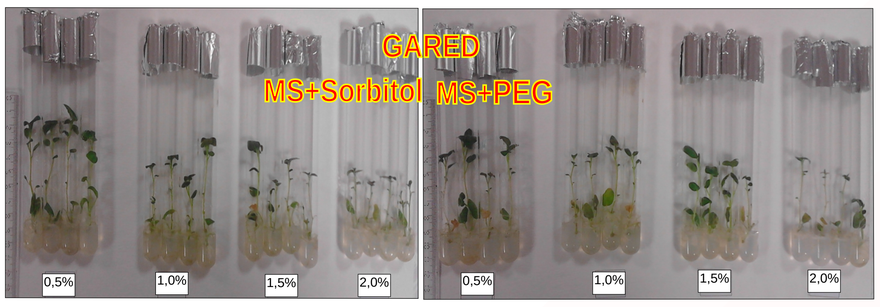


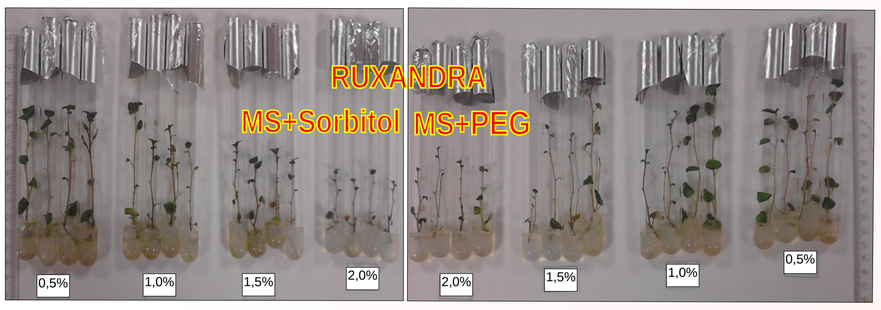
Effects of water stress stimulators (PEG and sorbitol) on average height of plantlet and root length



Effects of water stress stimulators (PEG and sorbitol) on average weight of fresh plantlet and root







The combined influence of variety and inducer medium of *in vitro* water stress over the elements of growth and development

Variety	Inducer medium of *in vitro* water stress	The concentration of water stress simulator (%)	The average number of leaves	The average number of internodes	The average height of plantlet (cm)	The average length of root (cm)	The average weight of fresh plantlet (mg)	The average weight of fresh root (mg)
Ruxandra	Control medium (MS)	-	8.25 CDEFG	6.75 A	11.375 B	7.875 BCDE	244.700 A	163.625 A
	MS medium+PEG	0.5	7.50 FGHIJ	5.25 CDEFG	9.075 CD	7.875 BCDE	165.675 F	76.350 EF
		1	7.00 HIJKL	5.00 DEFGH	8.625 CDE	7.125 CDEFGH	153.200 G	83.300 D
		1.5	7.75 EFGHI	5.75 ABCDE	8.25 CDEF	4.250 PQRST	100.125 KL	41.850 NO
		2	6.75 IJKL	3.75 IJ	5.375 KLMNO	8.000 BCD	65.225 OP	52.650 HIJ
	MS medium +sorbitol	0.5	8.00 DEFGH	5.50 BCDEF	7.925 EFG	6.000 HLM	187.775 D	123.625 B
		1	8.75 CDE	5.50 BCDEF	6.800 HIJ	8.125 BC	113.95 I	100.300 C
		1.5	7.50 FGHIJ	5.0 DEFGH	5.000 KLM	8.000 BCD	81.100 M	79.600 DE
		2	6.25 KL	4.25 GHIJ	3.000 TU	6.750 EFGHIJ	23.525 W	33.800 PQ
Sarmis	Control medium (MS)	-	8.00 DEFGH	6.25 ABC	13.625 A	4.625 NOPQRS	218.650 B	72.525 F
	MS medium +PEG	0.5	7.25 GHIJK	5.00 DEFGH	9.125 C	4.500 OPQRST	111.775 I	53.575 HI
		1	7.25 GHIJK	4.50 FGHI	4.850 MNOPQR	5.000 MNOPQR	42.100 ST	47.225 KLM
		1.5	6.50 JKL	4.25 GHIJ	4.625 NOPQR	4.000 S	35.825 UV	12.275 V
		2	6.00 L	3.25 J	2.750 U	2.875 U	39.250 TU	4.100 W
	MS medium +sorbitol	0.5	8.00 DEFGH	4.75 EFGHI	8.750 CDE	5.625 JKLMNO	171.700 E	96.975 C
		1	8.25 CDEFGH	5.25 CDEFG	8.000 DEFG	5.675 JKLMNO	105.500 J	65.400 G
		1.5	7.75 EFGHI	4.50 FGHI	7.000 GHI	6.175 GHIJKLM	105.650 J	65.700 G
		2	6.00 L	3.25 J	3.300 STU	3.125 T	32.875 V	23.100 ST
Gared	Control medium (MS)	-	7.75 EFGHI	5.00 DEFGH	7.125 GHI	7.625 BCDE	153.075 G	71.450 F
	MS medium +PEG	0.5	7.50 FGHIJ	4.75 EFGHI	5.875 JKLM	5.300 KLMNOPQ	106.075 J	41.725 NO
		1	7.00 HIJKL	4.25 GHIJ	4.925 MNOPQR	4.500 OPQRS	50.025 R	37.525 OP
		1.5	7.50 FGHIJ	5.00 DEFGH	4.875 MNOPQR	7.125 CDEFGH	115.95 I	33.000 PQ
		2	7.50 FGHIJ	4.00 HIJ	4.375 OPQRS	6.000 HIJKLM	48.000 R	24.100 S
	MS medium +sorbitol	0.5	7.75 EFGHI	5.00 DEFGH	7.375 FGH	6.000 HIJKLM	124.850 H	50.850 IJK
		1	7.00 HIJKL	4.00 HIJ	5.625 KLMN	8.375 B	73.850 N	81.625 D
		1.5	7.75 EFGHI	4.25 GHIJ	5.375 KLMNO	10.750 A	95.250 L	66.350 G
		2	10.25 AB	5.75 ABCDE	4.000 KLMNOPQRST	7.375 BCDEF	61.100 PQ	47.770 IJK
Marvis	Control medium (MS)	-	11.00 A	6.50 AB	10.375 B	7.250 BCDEFG	247.900 A	84.125 D
	MS+PEG	0.5	9.00 CD	6.00 ABCD	7.375 FGH	7.625 BCDEF	153.875 G	64.100 G
		1	8.75 CDE	4.50 FGHI	4.950 KLM	4.000 RSTU	67.325 O	24.175 S
		1.5	9.25 BC	4.75 EFGHI	4.875 MNOPQR	4.625 NOPQRS	46.775 RS	13.125 V
		2	10.50 A	5.25 CDEFG	2.975 TU	3.700 STU	21.600 W	5.925 W
	MS+sorbitol	0.5	6.50 KL	5.25 CDEFG	7.250 FGH	6.250 FGHIJKL	124.950 H	82.375 D
		1	7.75 EFGHI	4.75 EFGHI	5.725 JKLMN	6.375 FGHIJK	104.350 JK	95.425 C
		1.5	11.25 A	6.50 AB	3.825 RSTU	5.750 JKLMN	57.600 Q	32.950 PQ
		2	7.75 EFGHI	4.50 FGHI	3.950 KLMNOPQRST	6.250 FGHIJKL	34.025 V	16.950 UV
Rustic	Control medium (MS)	-	9.00 CD	6.50 AB	11.000 B	7.750 BCDE	173.350 E	56.250 H
	MS medium +PEG	0.5	8.50 CDEF	5.50 BCDEF	7.175 FGH	5.125 LMNOPQR	183.600 D	45.425 LMN
		1	8.25 CDEFG	4.50 FGHI	6.375 HIJK	4.500 OPQRS	103.775 JK	29.625 QR
		1.5	8.25 CDEFG	4.75 EFGHI	4.950 MNOPQ	4.125 QRST	57.550 K	18.675 TU
		2	6.25 KL	3.25 J	2.750 U	3.075 T	64.800 OP	6.275 W
	MS medium +sorbitol	0.5	8.50 CDEF	5.25 CDEFG	7.125 GHI	6.875 DEFGHI	156.150 G	42.550 MN
		1	8.75 CDE	5.75 ABCDE	6.125 IJKL	5.625 JKLM	195.825 C	48.475 JKL
		1.5	7.75 EFGHI	5.00 DEFGH	5.250 LMNOP	5.375 KLMNOP	102.625 JK	27.200 RS
		2	8.75 CDE	5.00 DEFGH	4.175 PQRS	4.750 NOPQRS	45.900 RS	33.825 PQ
			LSD=1.246	LSD=1.105	LSD=1.116 cm	LSD=1.1186 cm	LSD=5.047 mg	LSD=4.994 mg

CONCLUSIONS

1. Experimental results showed that the sensitivity to drought was not uniform for varieties analyzed.
2. Medium in which was added PEG in different concentrations significantly reduced the average weight of fresh plantlet and fresh root compared with the control medium. This osmotic agent (PEG) is recommended for simulation in vitro of drought and to identify genotypes tolerant to drought.
3. In the process of leaves formation, Marvis variety is highlighted, showing for control medium, the greater average number of leaves (11) as well as nutrient media on which is applied PEG (9.38 leaves) and sorbitol (8.31).
4. Regarding the average number of internodes, this decreases with the addition of PEG and sorbitol in culture medium.
5. The influence of variety and concentrations of osmotic agents marks Marvis variety, which under the influence of concentration 1.5% sorbitol has the highest value of the average number of leaves (11.25).
6. The smallest influence of water stress on plantlets height was observed for variety Ruxandra.
7. Gared and Ruxandra varieties showed good tolerance to water stress on root length, by applying sorbitol in nutritive medium, the root of plantlets reaching an average length of 8.13 and 7.22 cm.
8. By adding PEG (1.5%) Gared variety is characterized by achieving high values of the average weight of fresh plantlet (115.950 mg).
9. For average root weight is distinguished Gared variety that by using sorbitol 1% records a value of 81.625 mg (higher than obtained for control medium: 71.45 mg).
10. For the parameters analyzed, Marvis Gared, Ruxandra varieties, showed the best *in vitro* tolerance to water stress.

Producing potato microtubers under the effect of food colorant

National Institute of Research and Development for Potato and Sugar Beet Brasov - ROMANIA

www.potato.ro

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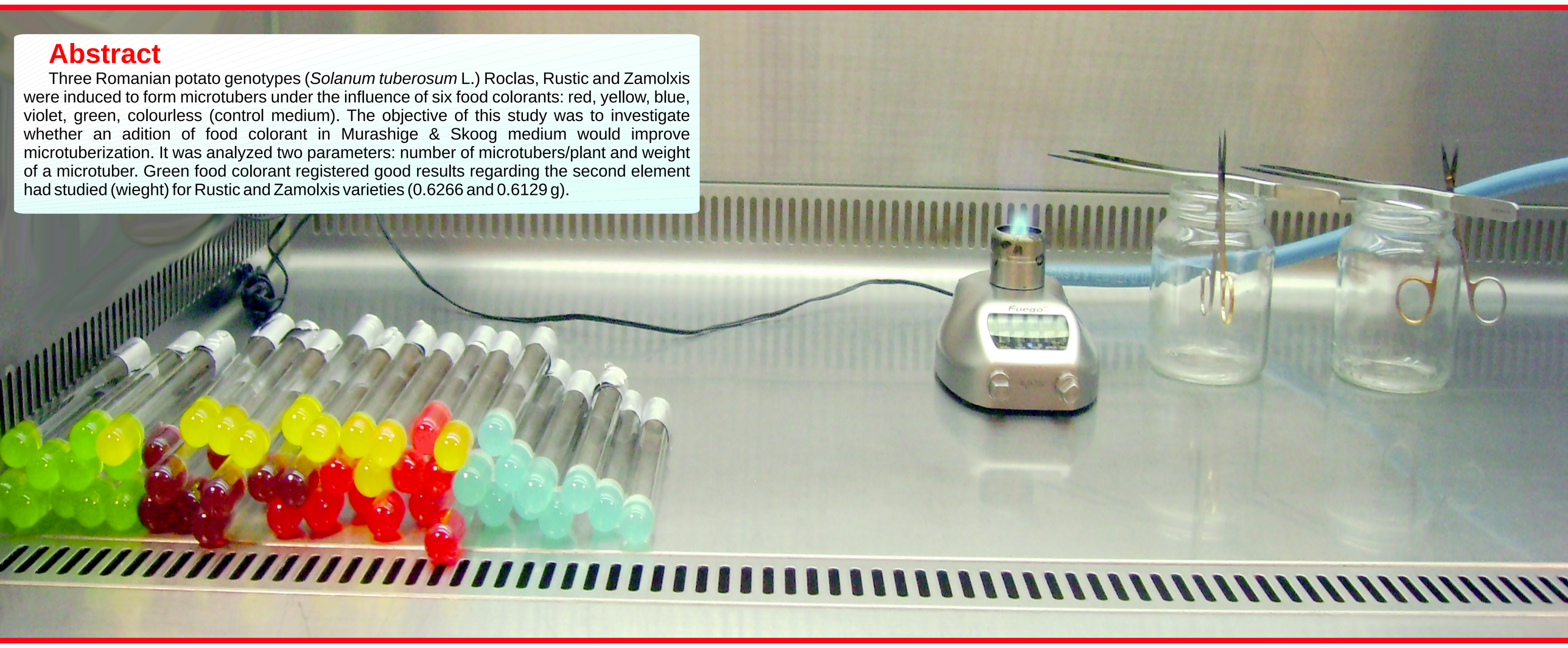
Keywords: plantlets, varieties, microtubers, colorant food

Abstract

Three Romanian potato genotypes (*Solanum tuberosum* L.) Roclas, Rustic and Zamolxis were induced to form microtubers under the influence of six food colorants: red, yellow, blue, violet, green, colourless (control medium). The objective of this study was to investigate whether an adition of food colorant in Murashige & Skoog medium would improve microtuberization. It was analyzed two parameters: number of microtubers/plant and weight of a microtuber. Green food colorant registered good results regarding the second element had studied (wieght) for Rustic and Zamolxis varieties (0.6266 and 0.6129 g).



Materials and method

Microcuttings resulting from uninodal segmentation were inoculated, in recipients containing Murashige & Skoog (1962) medium enriched with naphthyl acetic acid and 20 g / l sugar, and five food colorants; the culture vessels were placed in the growth chamber, ensuring a light and temperature regime required for growth and development of the plantlets (figure 1). After 4 weeks, in recipients with developed plantlets and was applied microtuberization medium and consisted of ½ MS supplemented with sucrose, coumarin, kinetin and different food colorants. (figure 2). The cultures were incubated in the dark at a temperature of 16-18ºC for 12 weeks. After microtubers were harvested.

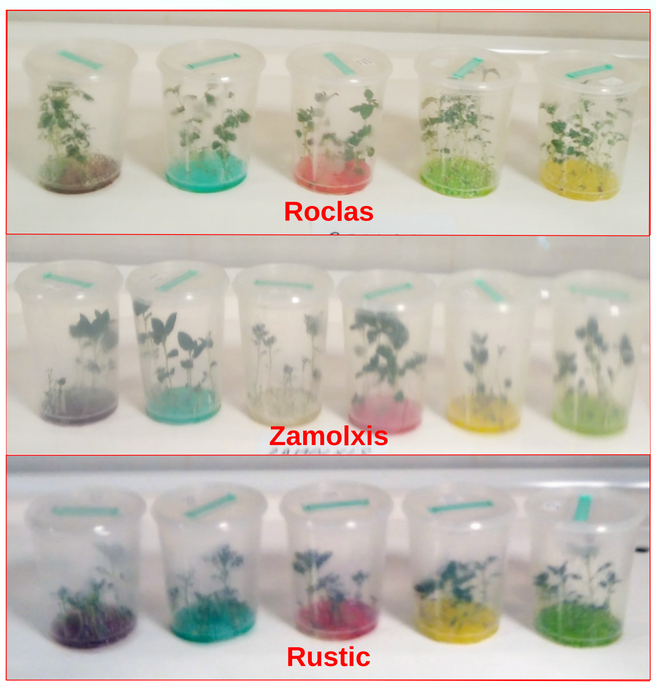


Figure 1. Plantlets developed on medium with different food colorant

Figure 2. Medium of microtuberization with food colorants

Research was made using next factors:

- Experimental factor A- – variety with 3 degrees;
  - a1- Roclas; a2- Zamolxis; a3 – Rustic.
- Experimental factor B – food colorant with 6 degrees
  - b1- red; b2- yellow; b3- blue; b4- violet; b5- green;

Table 1
Food colorants concentrations used in medium of microtuberization

Induced color to medium	Colorant	Colorant to 100 ml medium
BLUE	Liquid food colorant	1ml
YELLOW	Powder food colorant	0.01g
GREEN	Mixture of blue and yellow colorants	1ml+0.01g
VIOLET	Mixture of blue and red colorants	1ml+0.01g
RED	Powder food colorant	0.01g

Results and discussions

For the influence of interaction variety – food colorant over average weight of a microtuber, the highest values were obtain for Rustic and Zamolxis varietis (0.6266 and 0.6129 g), by using green colorant (table 2, figure 3).

Figure 3. Microtubers obtained on medium microtuberisation medium with green food colorant

Table 2
The combined influence of variety and food colorant on the number and weight of microtubers

Variety	Food colorant	Average number of microtubers/plantlet	Duncan Test	The average weight of a microtubercul (g)	Duncan test
Roclas	Red	1.250	CDE	0.1637	B
	Yellow	1.250	CDE	0.3322	AB
	Blue	2.250	A	0.1183	B
	Violet	2.125	A	0.0992	B
	Green	1.750	B	0.1685	B
	Colourless	1.250	CDE	0.1726	B
Zamolxis	Red	1.500	BC	0.2675	B
	Yellow	1.125	CDE	0.4010	AB
	Blue	1.000	CDE	0.2446	B
	Violet	2.125	DEF	0.0989	B
	Green	1.000	A	0.6129	A
	Colourless	0.875	DEF	0.4018	AB
Rustic	Red	0.875	EF	0.3001	B
	Yellow	0.625	EF	0.1808	B
	Blue	1.375	CD	0.3718	AB
	Violet	0.875	EF	0.3963	AB
	Green	0.875	EF	0.6266	A
	Colourless	0.875	EF	0.3001	B

Media that are in the same column followed by the same letters are not significant, according to Duncan test ($p \leq 0.05$).
LSD=0.3537 microtubers LSD=0.2740 g

Conlusions

1. Weight of microtubers produced under the influence of food colorant, was significantly higher for green colorant compared to the other, when it was applied for Rustic and Zamolxis varieties.

2. In the future will try to perfect this method and identify food colorant to produce microtubers with a high average weight and with a high average number/plantlets.

The behavior of some potato genotypes (*Solanum tuberosum* L.) to water stress induced *in vitro* using sorbitol and polyethylene glycol

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Introduction

Drought is a major environmental factor that determines the growth, productivity and distribution of plants. It is the most serious and worldwide yield reducing stress in agriculture. The increase in drought stress threatens the global agriculture production and food availability. The sustainability of production will depend on the identification and development of new drought tolerant varieties.

Materials and methods

The study was carried out at the National Institute of Research and Development for Potato and Sugar Beet Brasov, Research Laboratory for Plant Tissue Culture. Biological material analyzed in the experiment was represented by a perspective line (LP 11-1525/1), creation of the AMSEM department (NIRDPSB, Brasov) and two isogenic lines belonging to Dutch company Bejo Zaden: LI 101 and LI 102.

During this study were made a series of observations and notations at 2, 4 and 6 weeks on the following parameters: stem length, number of leaves, leaf aspect, rooting, plantlet fresh and dry weight, root length, fresh and dry root weight.

Results and discussions

Throughout observations, water stress caused a decrease in stem length of all lines (Fig.1). However, the lines LI 101-6 and LI 101-7 have achieved good and consistent results for all the time periods both on sorbitol and PEG medium.

Regarding the number of leaves, some lines results on medium added with sorbitol and PEG were similar to those obtained on control or higher. Lines LI 101-6, LI 101-7 and LI 102-4 have achieved good and consistent results both on sorbitol and PEG medium.

Throughout observations, leaf aspect decreased due to drought in all lines. However, the lines LI 101-6 and LI 101-7 have achieved good and consistent results both on sorbitol and PEG medium.

After 2 and 4 weeks drought caused a decrease in level of rooting of all lines. Regarding the roots length, after 6 weeks some lines (LI 101-3, LP 11-1525/1-1, LP 11-1525/1-2 and LP 11-1525/1-3) have achieved better results on the sorbitol medium than control.

Water stress induced *in vitro* caused a decrease in fresh weight of all lines. However, line LI 101-6 has achieved good results both under sorbitol and PEG treatments.

Except lines LI 102-3 and LI 102-2 induced water stress agents are determined a lower amount as regards total dry weight compared to the control. Lines LI 102-4 and LI 101-6 have achieved good results both under sorbitol and PEG treatments.

Figure 2 shows the grouping of studied potato lines depending the date on which observations were performed and all parameters measured. It can be seen that lines were grouped differently at 2, 4 and respectively 6 weeks. Also, as plants grow clustering tendency of lines is becoming more obvious.

In figure 3, a similar distribution of the values is observed at 2, 4 and 6 weeks. The control is separated from the sorbitol and PEG media respectively, the latest forming another group.

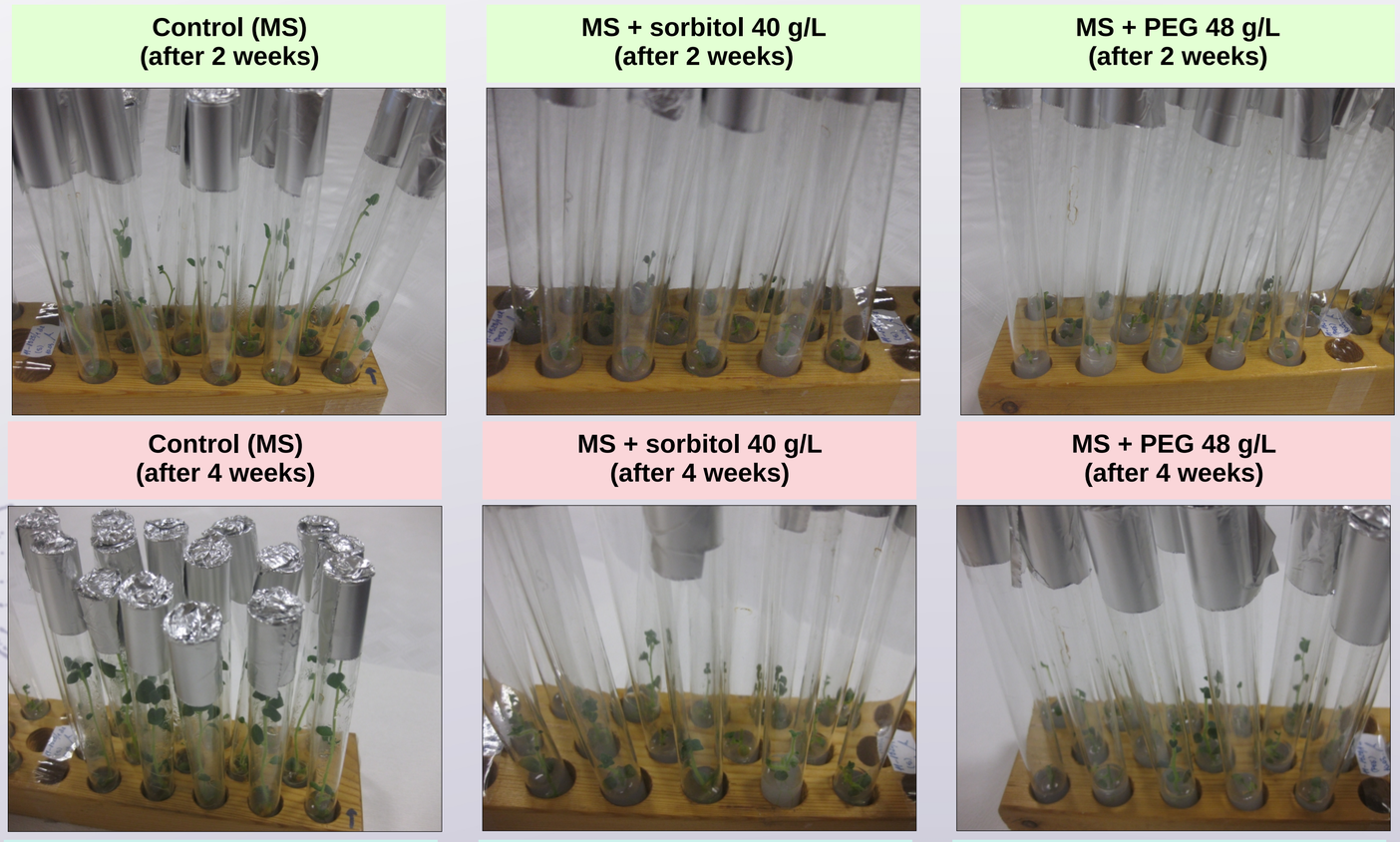


Fig. 1 Potato plantlets evolution (LP 11-1525/1) on different type of medium after 2, 4 and 6 weeks of in vitro culture

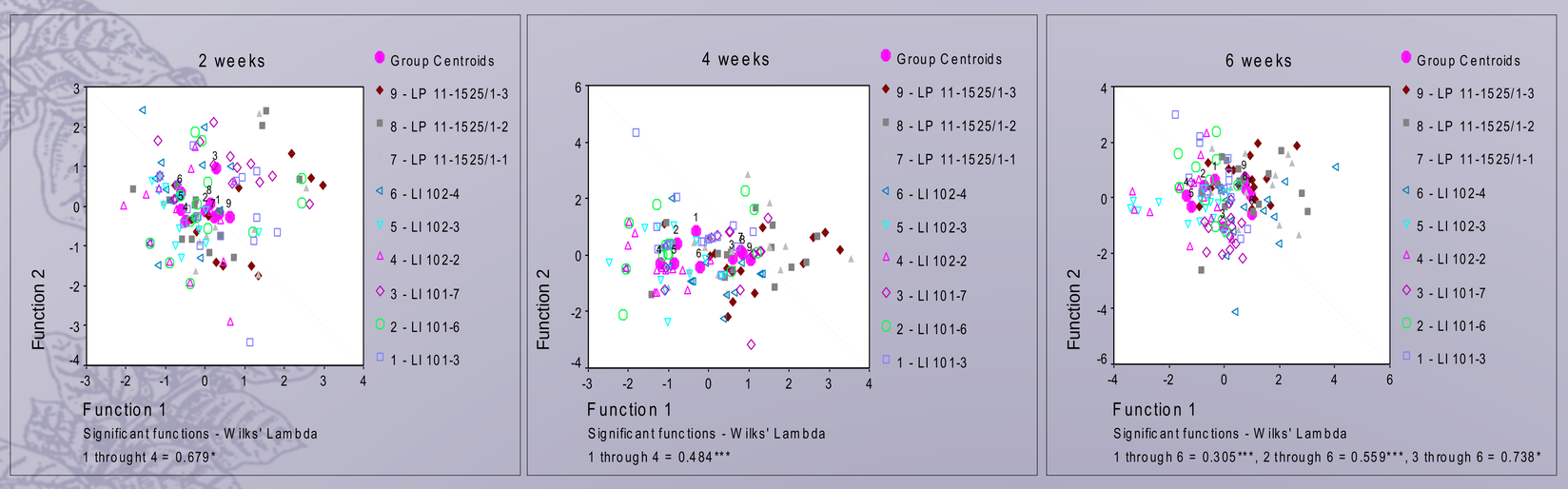


Fig. 2 Potato lines discrimination depending on measured parameters at 2, 4 and 6 weeks

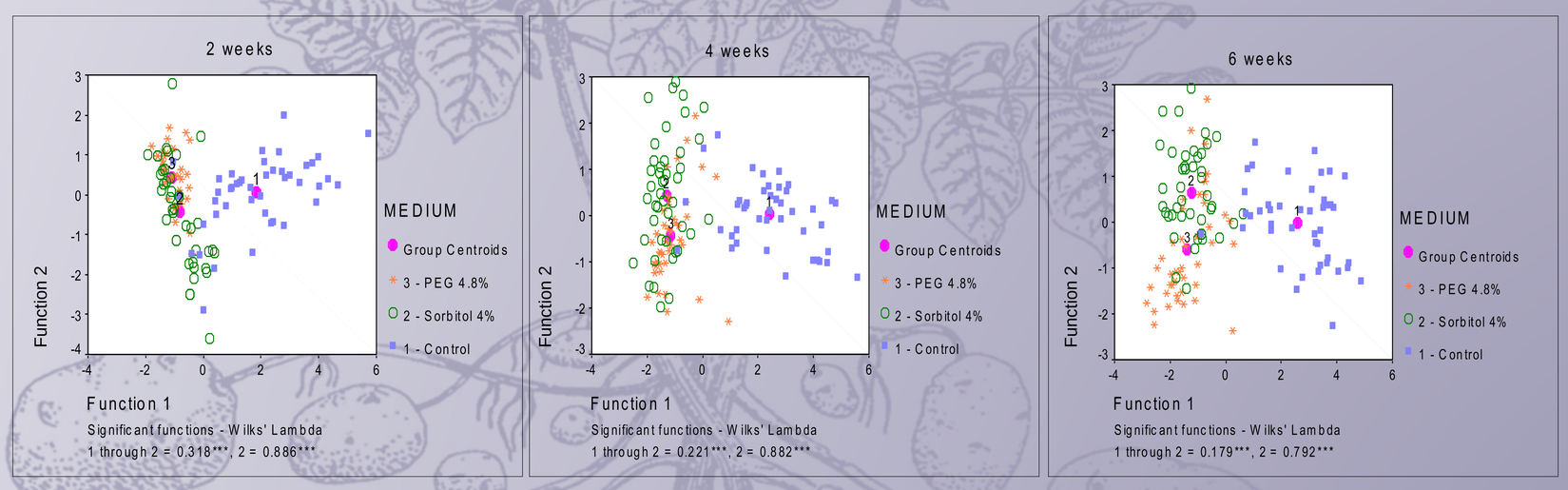
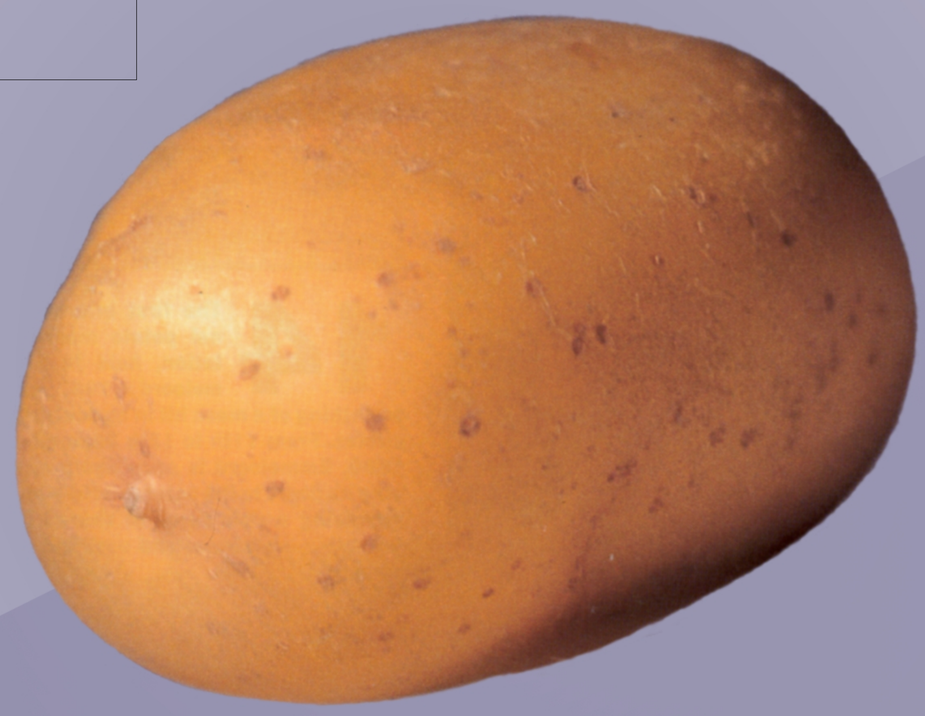


Fig. 3 Potato lines discrimination depending on culture medium at 2, 4 and 6 weeks

Conclusions

- The use of plant tissue cultures allow the evaluation of potato genotypes tolerance to water stress induced *in vitro.*
- Regarding the choice of treatment for inducing drought in laboratory conditions, the average values of the characteristics indicates that PEG had a stronger effect than sorbitol, except for stem length.
- The studied potato genotypes behaved differently depending on the analyzed parameters and the treatment of *in vitro* inducing water stress. It was noted that the line LP 11-1525/1 achieved good results for most of the growth parameters, and lines derived from true potato seed behaved well, in some cases even exceeding line derived from meristems.
- Of the lines derived from true potato seed evidenced LI 101-6 that has performed very well in all analyzed parameters, both on sorbitol and PEG medium. Also, lines LI 101-7 and LI 102-4 have achieved good results on both variants of medium that induce water stress.
- There is the possibility to identify drought tolerance individuals within populations derived from true potato seed.



Preliminary studies on the correlation between total flavonoid content, total anthocyanin pigment and antioxidant activity

National Institute of Research and Development for Potato and Sugar Beet Brasov - ROMANIA

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Introduction

Potatoes are significant source of natural antioxidants and exhibit antioxidant activity as demonstrated in recent time by many authors. Studies have indicated that these phytochemicals have high free-radical scavenging activity, which helps to reduce the risk of chronic diseases and age-related neuronal degeneration. Genotypes of potato with peel and pulp intensely colored (red, purple, blue) have antioxidant capacity 2-3 times higher than the white / yellow genotypes, and these aliments could help to supplement the required daily doses of antioxidants in the diet.

Objectives. The main objective of this paper was to determine the correlation between flavonoids content, anthocyanins content and antioxidant activity.

Material and Methods

Anthocyanins and flavonoids extraction

Purple potato in amount of 4 g (± 0.02 g) was homogenized in 40 ml of 1% acidified water. The sample was treated with ultrasonic waves (UP400S, Hielscher Inc., USA)and with ultrasonic waves (VCX 750, Sonics & Materials Inc., USA) (Fig. 1).

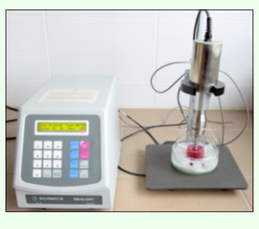


Fig. 1. Experimental setup for direct sonication at frequency 20 kHz

Determination of total monomeric anthocyanin content

The total anthocyanins content were determined by the differential pH method based on the property of anthocyanin pigments to change the color with pH.

Total monomeric anthocyanins (mg cyanidin 3-glucoside equivalent/ 100 g Fresh Weight) were calculated as follows:

$$TAC(mg/L) = (A\ MW\ DF\ V\ 100)/\varepsilon\ L\ Wt$$

$$A = (A_{510nm} - A_{700nm})_{pH=1} - (A_{510nm} - A_{700nm})_{pH=4.5}$$

The semnifications of symbols used in these relations are:
A – Absorbance, ε – Molar extinction coefficient, L – Path length , MW – Molecular weight, DF – Dilution factor, V – Volume, W_t – sample weight

Determination of total flavonoid content

The total flavonoids content (TFC) of different extracts was determined using the aluminium chloride assay.

Concentration values of extracts were obtained from Quercetin standard curve, by interpolating to the X- axis. TFC was calculated by using the following formula:

$$TFC = \frac{R\ DF\ V\ 100}{W}$$

The semnifications of symbols used in this relation are:
R - Result obtained from the standard curve ; D.F - Dilution factor ; V - Volume of stock solution ; W - Weight of plant used in the experiment.

Conclusions

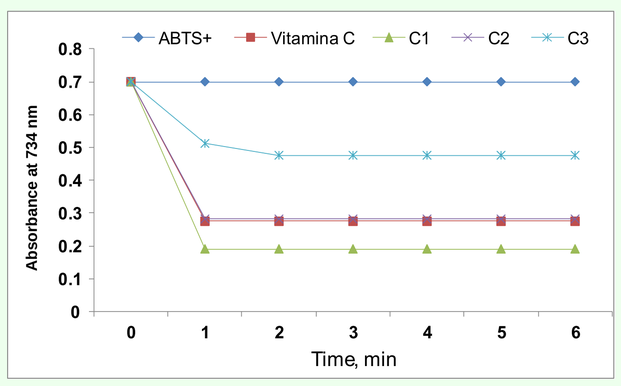
1. The antioxidant activity is strongly correlated with both the anthocyanin content (r = 0.955) and flavonoid content (r = 0.805).
2. It was noted a strong correlation between total flavonoid content and total anthocyanin content (r = 0.767).
3. The antioxidant activity of anthocyanin and flavonoids is comparable with vitamin C of concentration 12 µM.

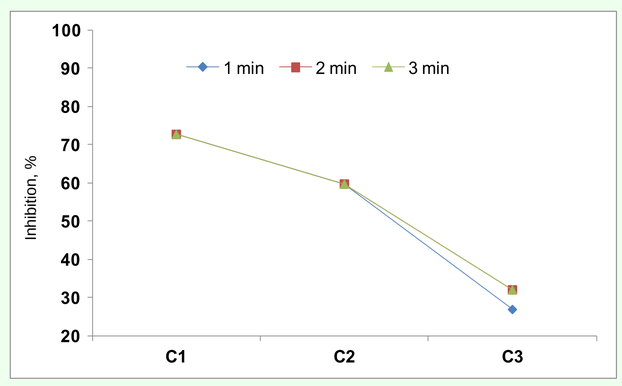
Acknowledgement

*We are grateful to **National Institute of Research and Development for Potato and Sugar Beet** for financial support (project no. PN-II-PT-PCCA-2013-4-1629 and PN-II-PT-PCCA-2013-4-0452) and to **National Institute of Research and Development for Metals and Radioactive Resources** for technical assistance in ultrasonic*

Results and discussions

From below figure it can be seen that the reaction with the radical ABTS is complete after 1 minute for Vitamin C (concentration 12 µM), concentration 1 and 2, and for concentration 3, only after 2 minutes. The reaction time for the concentrate 3 is higher because the concentration of anthocyanin pigments decreases, respectively C1> C2> C3



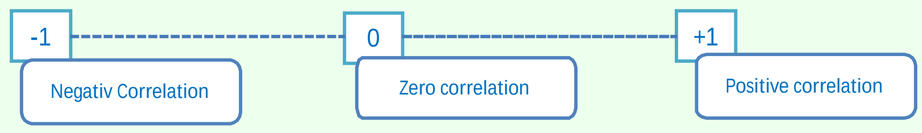


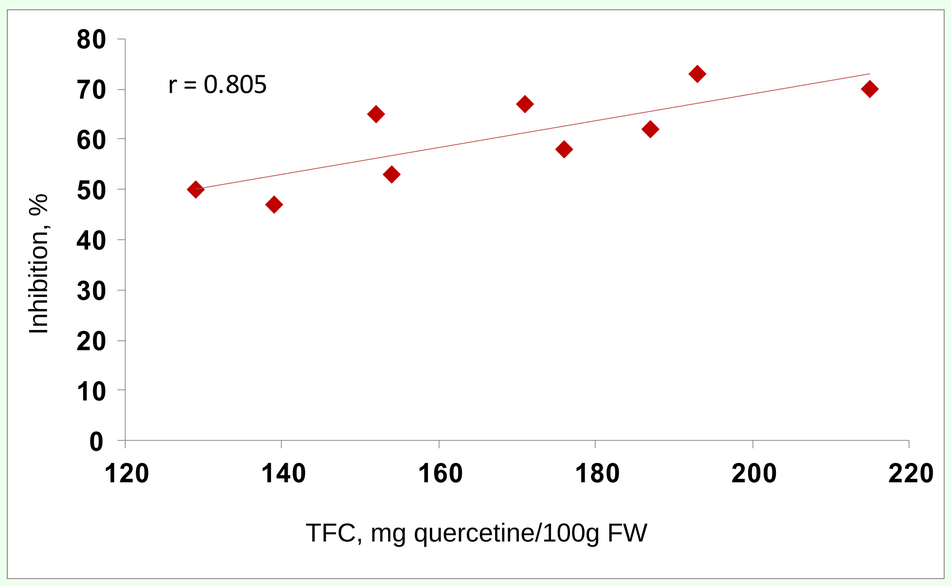
Antioxidant activity can also be expressed by the percentage of inhibition which is calculated, for each reaction time, with the following formula.

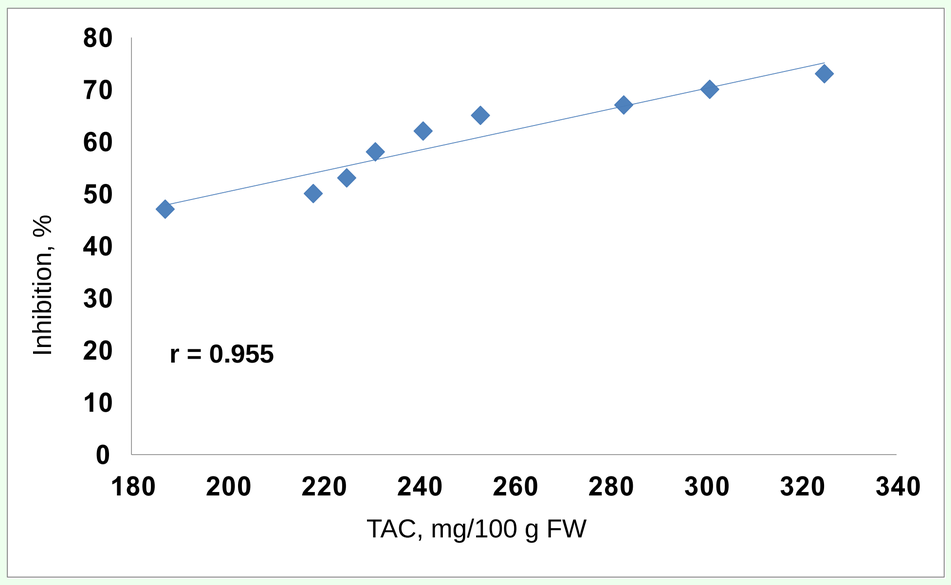
$$Inhibition, \% = \frac{(A_{ABTS} - A_{Probă})}{A_{ABTS}} \times 100$$

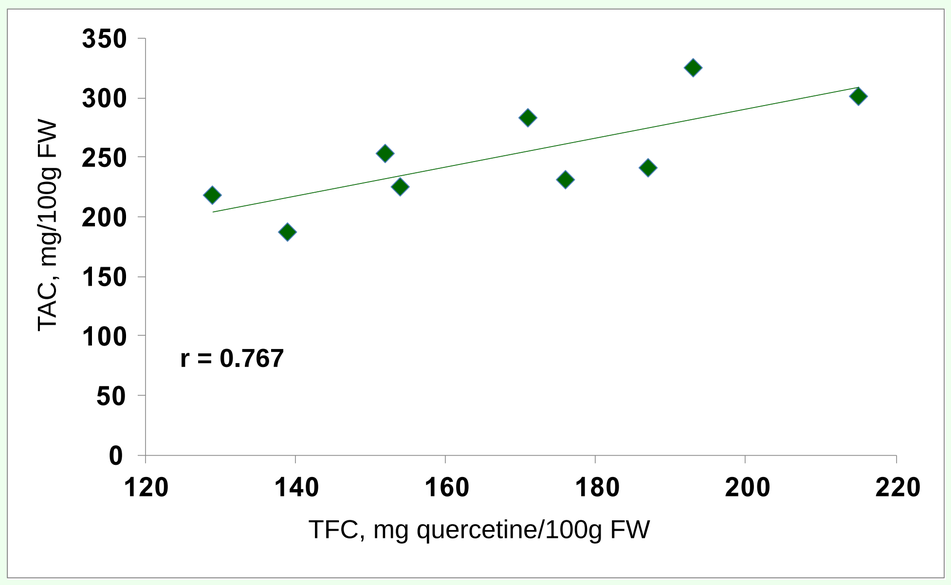
Correlatin between flavonoids content, anthocyanins content and antioxidant activity

In order to determine the correlation between anthocyanin pigments, flavonoids and antioxidant activity was used the simple correlation coefficient (Bravais-Pearson). For the interpretation of this coefficient it can be used the below figure.









Monitoring of aphid flight activity and population structure in potato crop

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INTRODUCTION

**Aphids are among the most important agricultural pests in temperate agriculture systems, attacking all types of plants, woody trees, shrubs, herbs and grasses.
Aphids are also the most efficient vectors of plant pathogenic viruses, therefore they cause serious problems in potato growing. Production of healthy seed potatoes is possible in conditions of reduced number of aphids and their ability to come into contact with the plant and transfer the virus. Thus, the monitoring of virus vectors is essential to determine if a potato area is suitable for seed potato production. A sixteen years survey (2000-2015) was conducted to monitor aphids in potato field in Braşov, to assess the relevance of the aphid species structure and their abundance on potato crop.**

MATERIAL AND METHODS

**Aphid flight activity was studied in different years (2000-2015) in potato crop from Brasov.
The monitoring was started immediately after the emergence of potato and continued until vines started yellowing and was done using the method of yellow water traps. Traps have been raised gradually to be visible for aphids during the growth of potato crop. Samples were taken once per day until drying of the above-ground mass.
Aphids were collected and stored in glass vials containing preserving liquid (2 volumes of ethyl alcohol 90% and 1 volume lactic acid 75%).
Species were identified using a stereoscopic microscope and keys for identification of alatae aphids: Taylor (1981), Muller (1975), Jacky and Bouchery (1980), Blackman and Eastop (1984, 1994), Remaudiere and Seco Fernandez (1990).
Systematics and synonymies were based on Remaudiere and Remaudiere (1997).**

RESULTS

During the sixteen year studies, over 14,293 specimens were collected and a total of 125 different taxa of aphids were identified. Great differences were observed on aphid structure, abundance, distribution and flight activity over the studied years.

Some aphid species were more or less regularly trapped on potato crops during the years. These were: *Aphis fabae* Scopoli, *Aphis craccivora* Koch, *Aphis sambuci* L., *Aphis gossypii* Glover, *Aulacorthum solani* (Kaltenbach), *Brevicoryne brassicae* (L.), *Hyalopterus pruni* (Geoffroy), *Macrosiphum euphorbiae* (Thomas), *Myzus persicae* (Sulzer), *Phorodon humuli* (Schrank), *Rhopalosiphum padi* (L.).

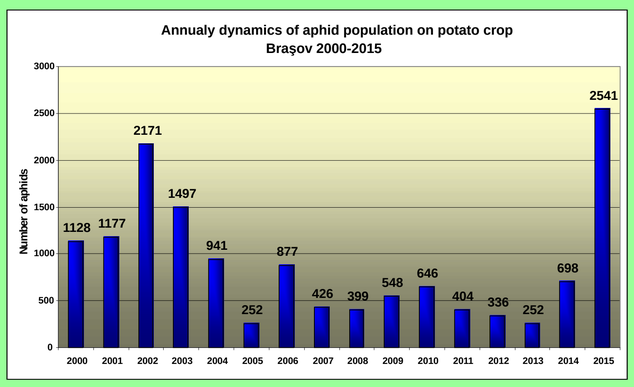
The most abundant aphid populations were on 2002 (2171 speciments) and 2015 (2541 speciments).

The lowest populations were on 2005 and 2013 (252 speciments).

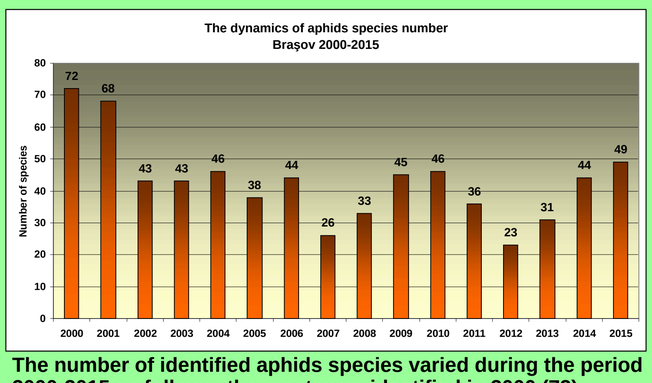
The most abundant were polyphagous species as: *Aphis fabae* Scopoli, *Aphis craccivora* Koch, *Aphis sambuci* L., *Brevicoryne brassicae* (L.).

The populations of the most important vector of potato viruses *Myzus persicae*, were extremely different over the years.

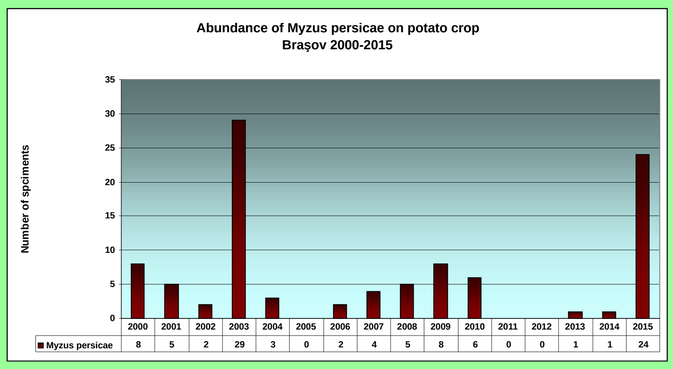
The climatic conditions during winter time and on growing season influenced aphid flight activity, the abundance and number of species. In 2000 and 2015 the aphid population were very high in May and June and represented a real threat for virus diseases of potato crops.



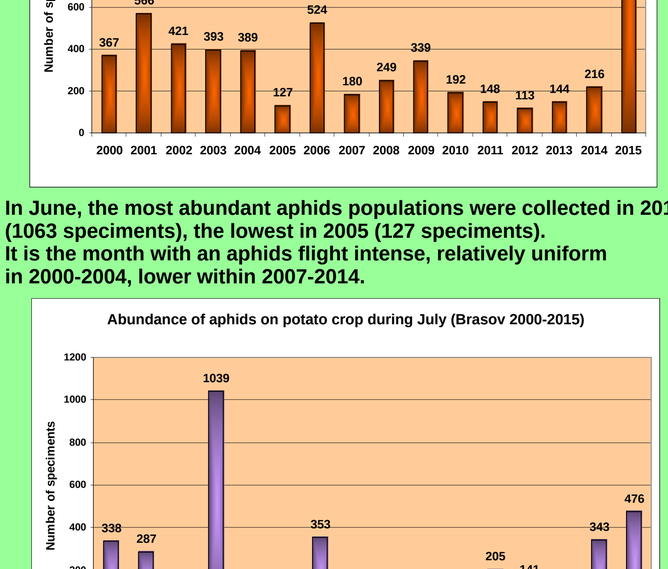
The period 2000-2015 was very different in terms of abundance of aphid populations monitored on potato crop. The most abundant aphid populations were during 2015 (2541 speciments), 2002 (2171 speciments), 2003 (1497 speciments) and the lowest abundance was in 2005 and 2013 (252 speciments). It is noted that between 2000-2004 aphid populations were much higher compared to the period 2007-2014



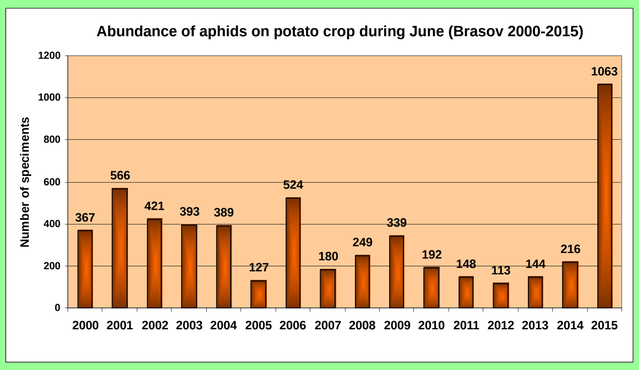
**The number of identified aphids species varied during the period 2000-2015 as follows: the most were identified in 2000 (72) followed by 2015 (49).
The fewest species were on 2012 (23) and 2007 (26).**



**In the period 2000-2015, the abundance of the main virus vector (*Myzus persicae*) was reduced.
The largest populations of this species were in 2003 (29 speciments) and 2015 (24 speciments).
In 2006, 2011 and 2012 has not found any individual**

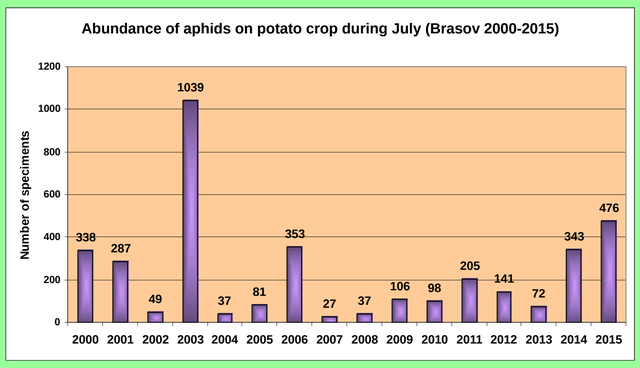


**Monthly abundance of of aphids populations revealed the following: in May, the month of the beginning of growing potatoes were recorded very large populations in 2002 (1701 speciments) and 2015 (995 speciments) followed by 2004 (515 speciments) and 2010 (300 speciments).
In years with an intense aphids flight in May increases the threat of viral infections because the potato plants are very young and not yet resistant.**

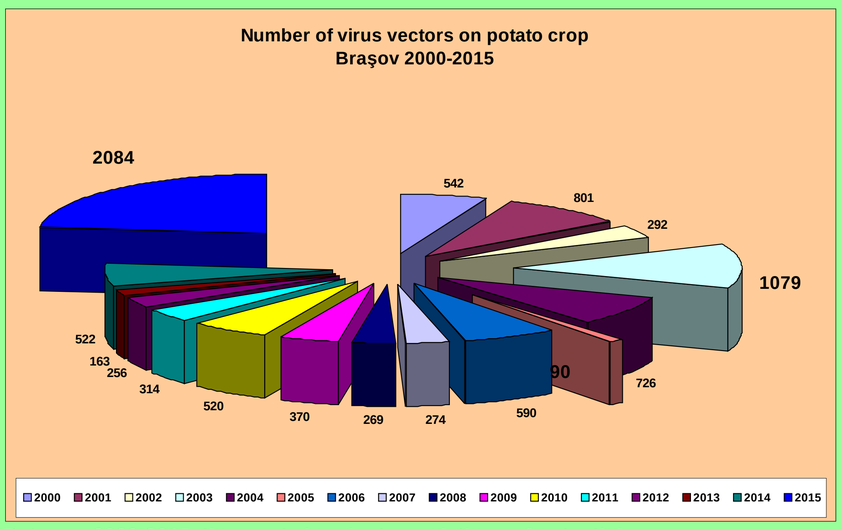


**In June, the most abundant aphids populations were collected in 2015 (1063 speciments), the lowest in 2005 (127 speciments).
It is the month with an aphids flight intense, relatively uniform in 2000-2004, lower within 2007-2014.**

**In July, the most abundant populations were in 2003 (1039 speciments), the lowest in 2007 (27 speciments). Normally, July would be the month with the most intense flight of aphids.
In recent years high temperatures and drought have influenced the culture potato aphid activity.**



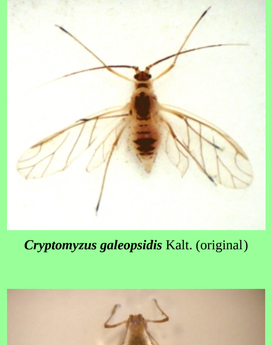
**In August, aphids flight was reduced with exception of the year 2000 (201 speciments).
In 2002, 2004, 2006, 2007 and 2011 in this month aphids were not captured.**



Between 2000-2015, the most abundant populations of potential vectors of potato viruses were in 2015 (2084 speciments) and 2003 (1079 speciments). The abundance was lowest in 2005 (90 speciments).

CONCLUSIONS

- **Flight aphid activity, abundance of species, the number of viruses and vectors dynamics during 2000-2015 was very different probably due to climatic conditions (high temperature, prolonged drought during potato crop vegetation).**
- **Analyzing flight aphid populations during the potato crop vegetation (May-August) result a displacement activity of aphids by May and June (which made the risk of viral diseases to be great) and reducing it in July and August.**
- **In our climatic conditions, July, normally supposed to be the month with the most intense activity of aphid populations.**
- **Between 2000-2015, the abundance of the main virus vector (*Myzus persicae*) was reduced.**
- **Throughout the analyzed period, species with high potential on potato viruses transmission (*Macrosiphum euporbiae* and *Aulacorthum solani*) were rarely identified in catches form yellow pans.**
- **Between 2000-2015 dominant species with a lower viral capacity were: *Aphis fabae, Aphis craccivora, Brevicoryne brassicae, Phorodon humuli*.**



Myzus persicae Sulz. (original)

Aphis fabae (original)

Aphis craccivora (original)

Cryptomyzus galeopsidis Kalt. (original)

Acyrthosiphon pisum (original)

Rhopalosiphum padi L. (original)

Phorodon humuli Schrank (original)

Aulacorthum solani (original)

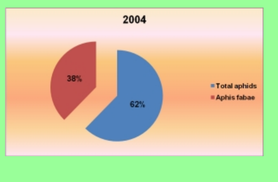
Cavariella aegopodii (original)

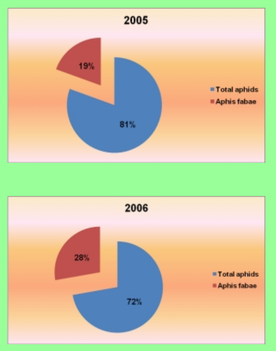
Brachycaudus helichrysi (original)

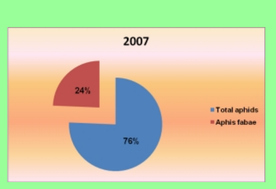
Phyllaphis fagi (original)

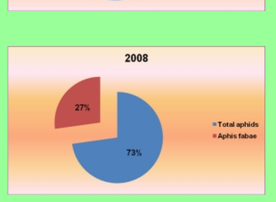
Photo: V.Donescu

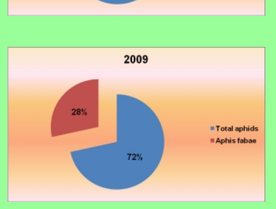
Dominant species 2000 - 2015

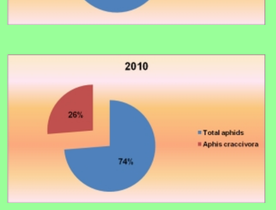


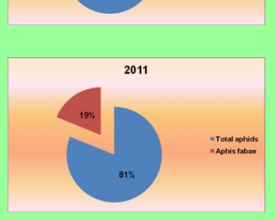


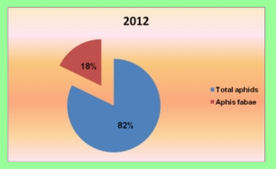


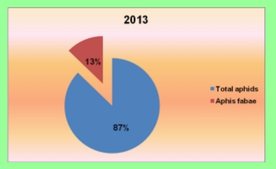


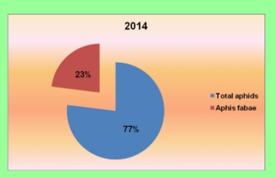


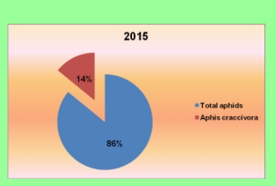












Maintaining biodiversity of medicinal and aromatic plants and producing biological superior category of seed from representative species of hills and mountains areas

National Institute of Research and Development for Potato and Sugar Beet Brasov - ROMANIA

www.potato.ro

Sorina Nitu
National Institute of R-D for Potato and Sugar Beet, Brasov, Romania
Key words: medicinal plants, culture, technologies of cultivation

Introduction

The project suggest the introduction in the culture of important species of medicinal and aromatic plants from spontaneous flora foreign and autochthonous in the view of establishment of cultivation technology and expansion of the cultivated areas with this species

Expected results

The introduction in culture and the elaboration of the technology of cultivation of these medicinal species of plants (Malvasylvestris L. ?i CassiaangustifoliaVahl.), the product of the seed and material for planted from high biological categories, promotion of medicinal plants and the expansion of the cultivated areas with those species, the elaboration of technologies of cultivation at the two species and their patenting

Malva sylvestris L. (mallow forest)

Is a biennial and herbaceous species. The root is jib, fleshy and little branched. The stem is erect, branched, high of 25-100 cm.

Leaves are with long pigtails, round up to the form of kidney, 3-7 lobed, serrated edges.

The flowers have the peduncle of 1-3 cm and are arranged by 2-6 in the armpits of the leaves. the corolla has a radial symmetry, with 5 free petals of 2-3 cm, of red-purple color, with different nuances.

The fruit is in the shape of a disc,

Cassia angustifolia Vahl. (Senna or Siminichia)

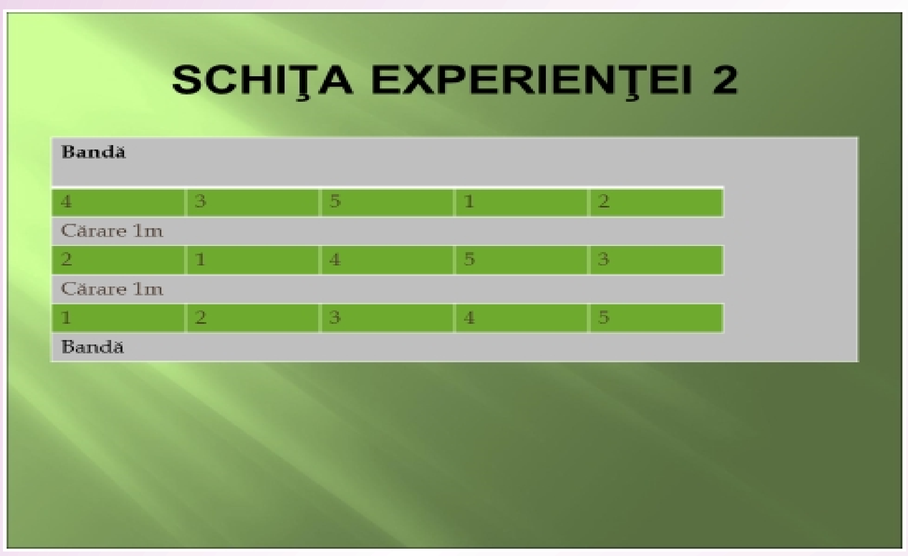
Is an herbaceous plant, of the Fabacheae family.

The leaves in the even number composed with 5-9 pairs of little bright leaves, longish, with the edge of the whole and almost without tail.

Yellow flowers, with a single plane of symmetry, on type five, in the form of clusters axillary.

Every flower presents 5 sepals, 5 unequal petals, 10 unequal stamens, with free filaments.

The gynoecium with a single chapel. The fruit is a pod flattened with brown color, long of 5,5 cm. Multiply by seeds. Cassia prefers sandy soils, easy,



International Conference
"Climatic changes, a permanent challenge for agricultural research on potato, sugar beet, cereals and medicinal plants“ – Brașov 25-27 May 2016, ROMANIA

Hyperspectral analysis used for monitoring crop vegetation status

Authors:
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Transilvania University of Brașov, ROMANIA
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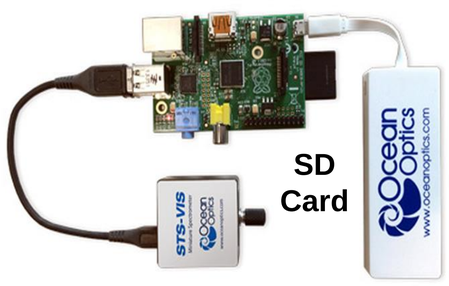
Abstract. The paper presents the ways in which the crops vegetation status can be determined and monitored using spectral information. For the hyperspectral analysis, authors used an experimental model that contains VIS (350-800 nm) and NIR (650-1100 nm) Ocean Optics mini spectrometers, with 1.5 nm optical resolution. A Raspberry Pi microcontroller development system controls the entire acquisition process. The acquired data allow the calculation of different vegetation indices. Correlating indices with GPS coordinates, maps of favorability and risk for crops can be generated. Results are validated in laboratory. Information are stored in a database which is an extremely useful tool for real time intervention on the crops vegetation status in precision agriculture.

Keywords: Precision agriculture, crop vegetation status, hyperspectral, vegetation indices

Raspberry Pi



STS Spectrometer

Li-Ion Batery

SPECIFICATIONS

Engineering Specifications	STS Developers Kit
PHYSICAL	
Dimensions (spectrometer):	40 mm x 42 mmx 24 mm
Weight (spectrometer):	~ 60 g
Weight (complete kit and cables):	190 g
KIT COMPONENTS	
Wi-Fi range:	Up to 150 m (2.4 gHz frequencies)
Wi-Fi dongle:	USB plug-in
Power draw:	~1A with Wi-Fi
Battery:	Lithium ion, 3000 mAh (~3.0 hours wireless endurance)
Raspberry Pi interface:	Wi-Fi, USB, Ethernet, Bluetooth
SD card:	8 GB
SPECTROMETER	
Wavelength range:	190-650 nm (UV), 350-800 nm (Vis) and 650-1100 nm (NIR)
Optical resolution:	1.5 nm FWHM w/25 µm slit
Signal to Noise:	>1500:1
Dynamic range:	5 x 10^9 (system, with 10 s maximum integration); 4600:1 single acquisition
Integration time:	10 µs to 10 s
Connector:	SMA 905

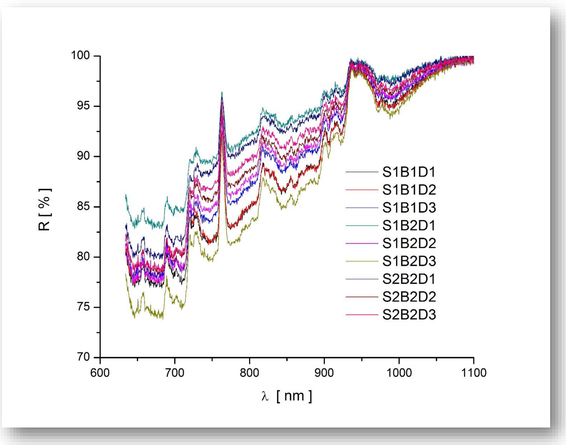
http://oceanoptics.com/product/sts-developers-kit/

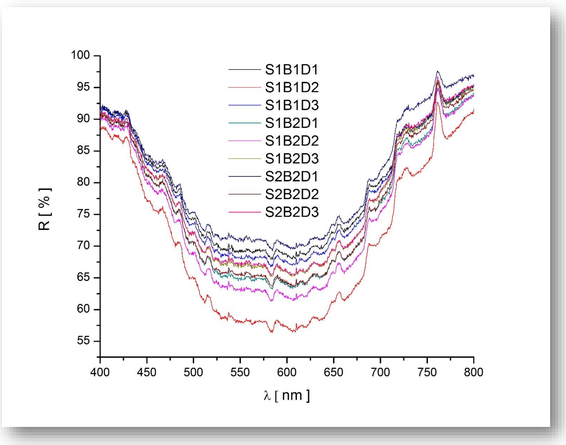
Multispectral Terrestrial Mobile Mechatronic System (MTMMS)

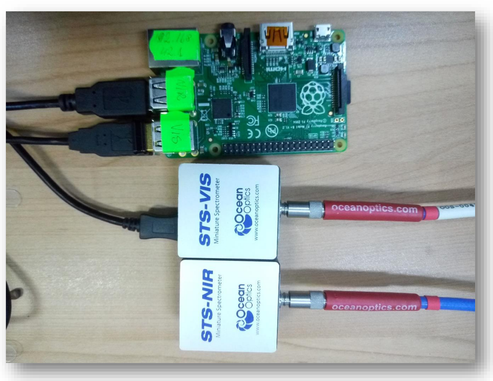
Acquisition, Processing, Storage and Transmission System for Multispectral Information (APSTSMI)

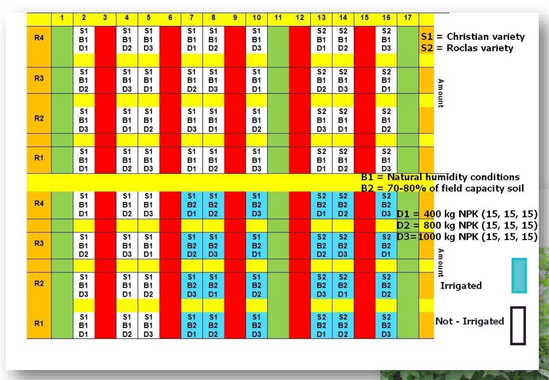
Multispectral Autonomous Aerial Mobile Mechatronic System (MAAMMS)

Innovative Technology for Multispectral Monitoring of the Vegetation Status of Crops (ITMMVSC)









GPS

Vegetation indices + GPS coordinates

Maps of favorability and risk for crops

Database

❑ **Project director**

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http://www.unitbv.ro/fdpm/CercetareStiintifica/C04Sistememecatroniceavansate/ProiectParteneriate-MoniCult/MoniCult-en.aspx

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Data acquisition application for precision agriculture domain

National Institute of Research and Development for Potato and Sugar Beet Brasov - ROMANIA
www.potato.ro

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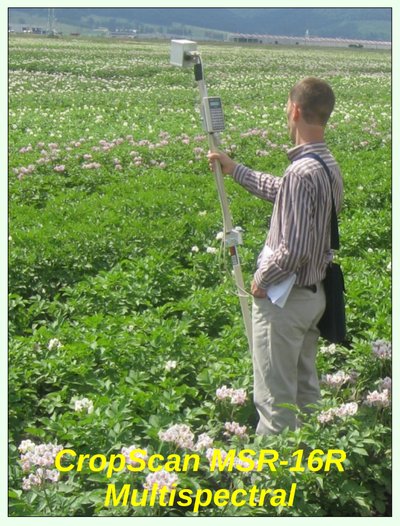
Introduction

Precision agriculture: agricultural land management taking into account soil natural and spatial variation
The goal: optimizing the use of soil resources, water and chemical fertilizers through fertilization uneven.

Current data acquisition procedure
- noting the measured data on paper;
- saving measured data to the memory card
- aligning data from the memory card with those on paper
- copying data from the paper to electronic format;-
- transfer from electronically format into a database.
- high risk of introducing errors in measurement!

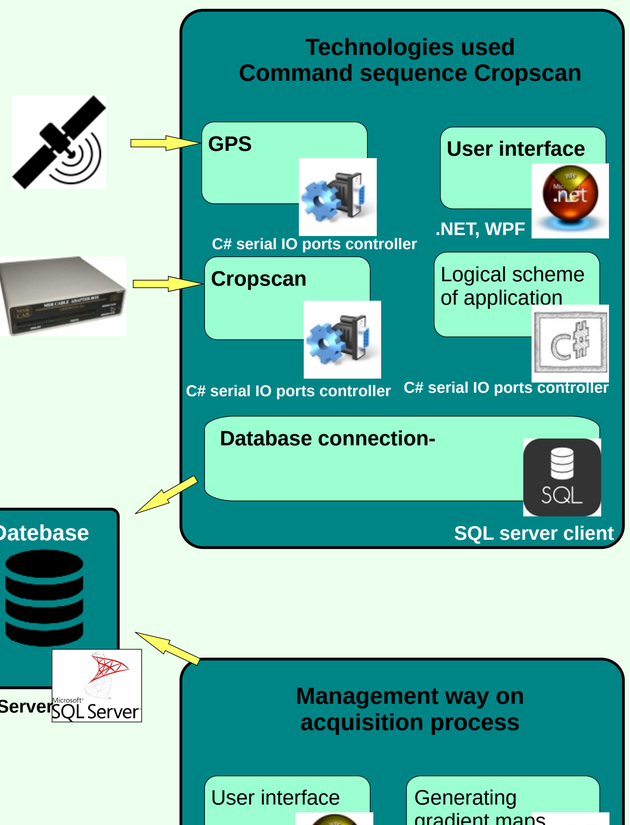
Soil electrical conductivity monitoring with VERIS (Mobile Sensor Platform)

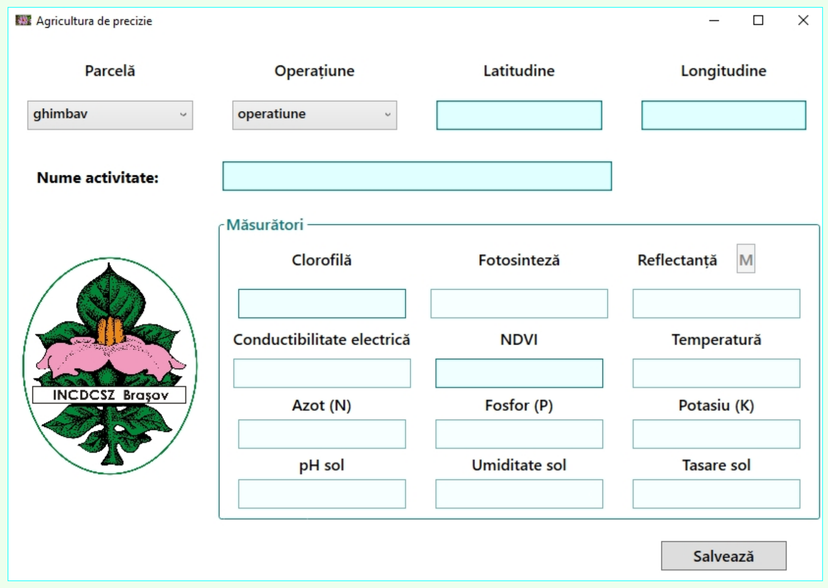


CropScan MSR-16R Multispectral

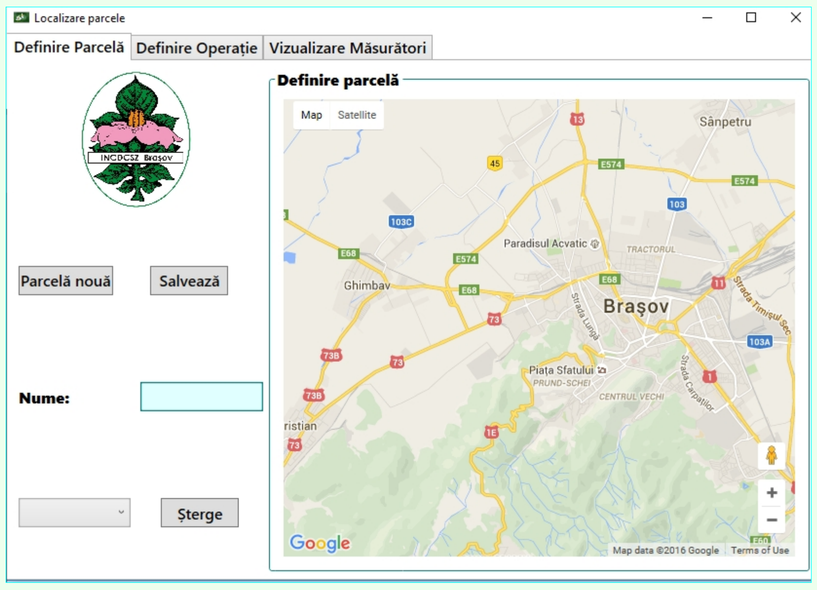
Development of applications support for automation process on georeferenced data acquisition in agriculture (precision farming).

Data analysis software application





The data acquisition of the application



The management of the application

ANSWER

```
IRR: 1851.0 mV
DATE:  7022014
TIME:   93000
  3: 2944.5
  4: 5.1799
 17: 1771.9
 18: 1977.9
 19: 1774.3
 20: 1930.7
 21: 1629.7
 22: 1807.2
 23: 1881.9
 24: 2025.2
 25: 1803.8
 26: 1935.9
 27: 1685.6
 28: 1845.8
 29: 1825.0
 30: 1939.6
 31: 1297.7
 32: 1702.3
 33: 1779
 34: 2080
 35: 1852
 36: 2009
 37: 1848
 38: 1980
 39: 1869
 40: 1968
 41: 1834
 42: 1991
 43: 1856
 44: 1962
 45: 1836
 46: 1959
```

Source lines of code for application Cropscan

```
port.Write("\r");
Thread.Sleep(700);
port.Write<"\r");
Thread.Sleep(7O0);
port.Write("\r");
Thread.Sleep(700);
port.Write<"\r");
Thread.Sleep(3500);

port.Write<"S");
Thread.Sleep(300);
port.Write("\r");
Thread.Sleep(300);

port.ReadExisting();
port.Write("S");
Thread.Sleep(2500);
String rawMeasurement = port.ReadExistingO;

port.Write("M\r");
Thread.Sleep(760);
port.Write("10\r");
Thread.Sleep(1700);
port.ReadExisting();
```

Start
Measuring
Stop

GGA —Global Positioning System Fixed Data

Note - Fieids marked in italic red apply only to NMEA version 2.3 (and later) in this NMEA message description.

Table 1-3 contains the values for the following example:

SGPGGA, 161229.487,3723.2475,12158.3416,WtlJ07J1.0,9.0,M1 , , ,0000*18

Table 1-3 GGA Data Format

Name	Example	Units	Description
Message 1D	SGPGGA		GGA protocol header
UTCTime	161229.487		hhmmss.sss
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Long trude	12158.3416		dddmmmmmm
E/W Indicator	VV		E=east or W=west
Position Fix Indicator	1		Sec Table 4
Satellites Used	07		Range0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude	9.0	meters	
Units	M	meters	
Geoid Separation		meters	
Units	M	meters	
Age of Diff. Corr. Diff		second	Null fieids when DGPS is not use
Ref. Station ID	0000		
Checksum	*18		
<CR><LF>			End of message termination

Acknowledgement

*We are grateful to **National Institute of Research and Development for Potato and Sugar Beet** for financial support (project no. PN-II-PT-PCCA-2013-4-1629 and PN-II-PT-PCCA-2013-4-0452).*

MONITORING CROP GROWTH AND DEVELOPMENT THROUGH THE USE OF CLIMATE INFORMATION FROM AUTOMATIC WEATHER STATIONS

Continuous tracking of microclimate conditions has become very important to areas like improved management of crops and promotion of precision farming. Challenges are the real-time collection of reliable crop environment information and methods for adaptation of these innovative systems by farmers to change from traditional practices to new methods.

SENSORS

Weather Station:

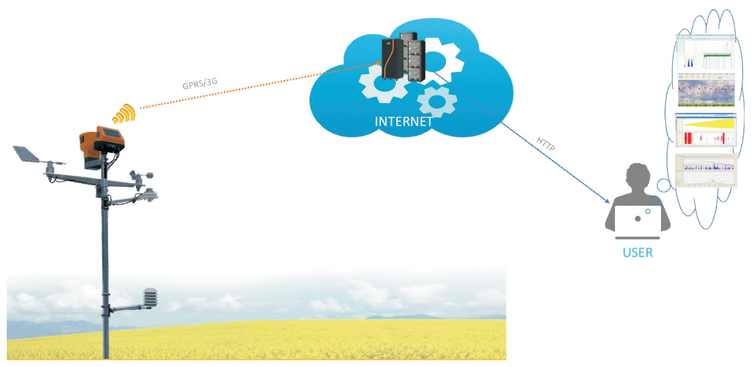
- Air Temperature
- Relative Humidity
- Rainfall
- Wind Speed
- Wind Direction
- Solar Radiation
- Sensor Gateway GPRS/3G

Soil Moisture Station:

- Soil Temperature
- Rainfall
- Soil Moisture
- Sensor Gateway GPRS/3G

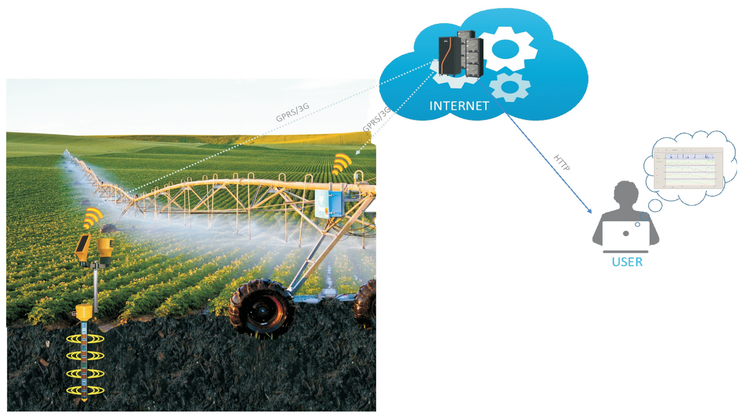
OPERATING MODE

Microclimate Data:



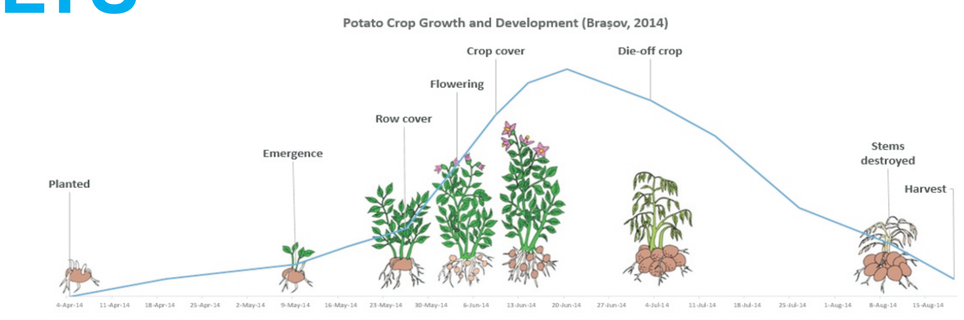
Growers are able to continuously monitor the vegetation condition and microclimate of plants, as well as other crop factors.The data is collected by each sensor of the weather station continuously and it is sent hourly to the central server via a wireless network (GPRS/3G).

Irrigation Management:

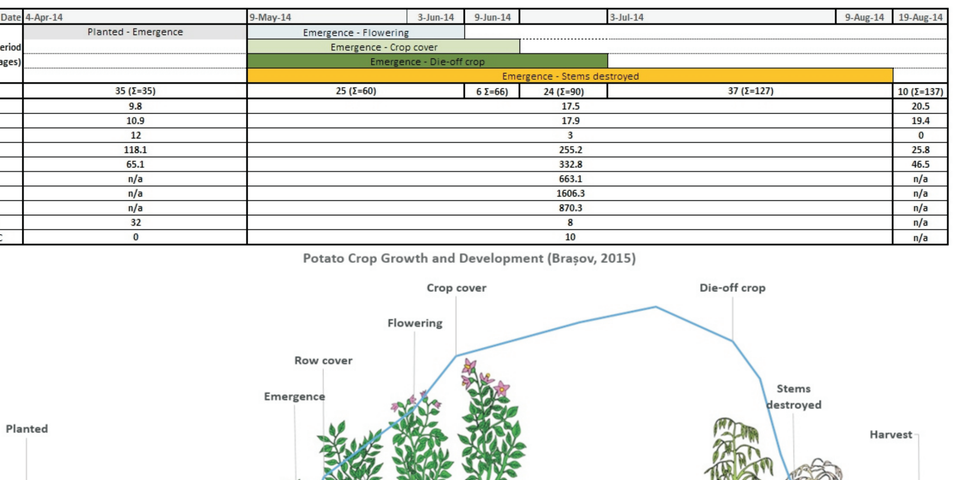


Using a soil moisture sensor in the grower's field, the Irrigation Management System shows the hourly and daily water consumption of the crop at different levels in the soil. These data together with the weather forecast help to determine the optimal moment for irrigation. This prevents damage due to both drought and excessive watering.

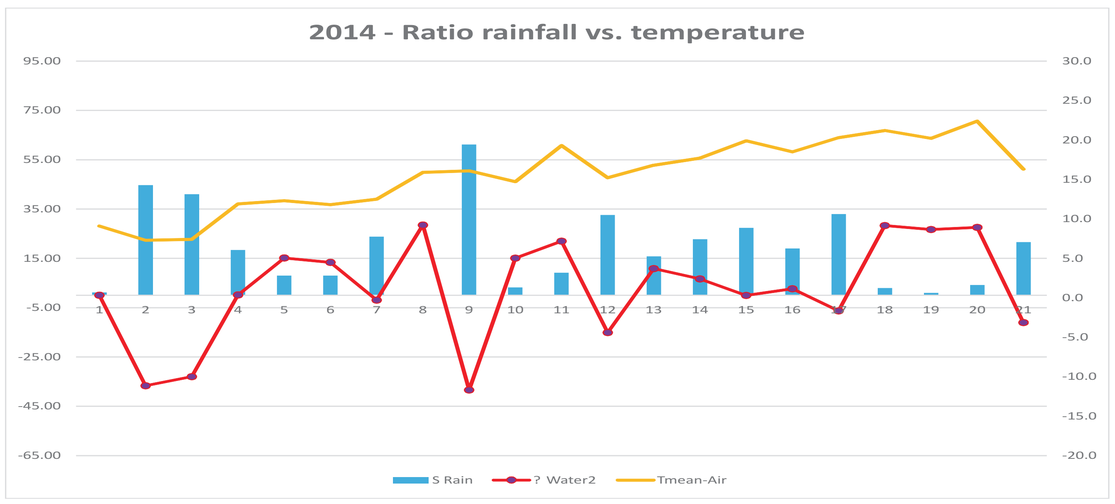
RESULTS

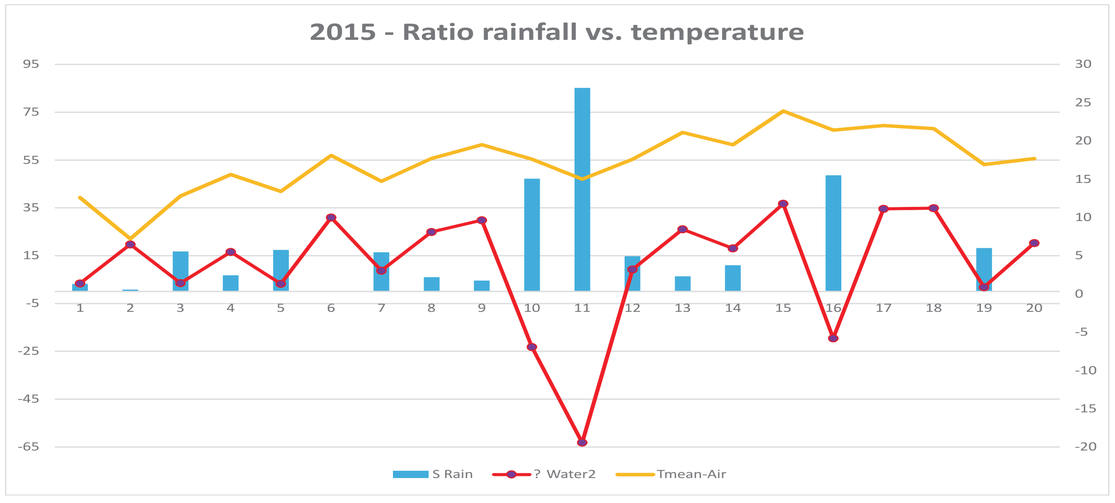


Date	4-Apr-14	9-May-14	3-Jun-14	9-Jun-14		3-Jul-14	9-Aug-14	19-Aug-14
Growth Period (cummulative phenological stages)	Planted - Emergence	Emergence - Flowering						
		Emergence - Crop cover						
		Emergence - Die-off crop						
		Emergence - Stems destroyed						
Duration (cummulative days)	35 (Σ=35)	25 (Σ=60)		6 Σ=66)	24 (Σ=90)	37 (Σ=127)		10 (Σ=137)
Tmean_Air (°C)	9.8	17.5						20.5
Tmean_Soil (°C)	10.9	17.9						19.4
No of days with Dew Point	12	3						0
Σ Precipitations (mm)	118.1	255.2						25.8
Σ ET0 (mm)	65.1	332.8						46.5
Σ Solar Radiation (kW/m2)	n/a	663.1						n/a
Σ GDD1	n/a	1606.3						n/a
Σ GDD2	n/a	870.3						n/a
No of days with Tmean_Air < 8°C	32	8						n/a
No of days with Tmean_Air > 28°C	0	10						n/a



Date	17-Apr-15	26-May-15	12-Jun-15	18-Jun-15		28-Jul-15	6-Aug-15	27-Aug-15
Growth Period (cummulative phenological stages)	Planted - Emergence	Emergence - Flowering						
		Emergence - Crop cover						
		Emergence - Die-off crop						
		Emergence - Stems destroyed						
Duration (cummulative days)	39 (Σ=39)	17 (Σ=56)		6 (Σ=62)	40 (Σ=102)	9 (Σ=111)		21 (Σ=132)
Tmean_Air (°C)	13.7	18.9						19.5
Tmean_Soil (°C)	12.6	19.6						22.8
No of days with Dew Point	1	1						0
Σ Precipitations (mm)	53.4	231.8						18.2
Σ ET0 (mm)	132.0	297.1						88.0
Σ Solar Radiation (kW/m2)	n/a	558.0						n/a
Σ GDD1	n/a	1364.2						n/a
Σ GDD2	n/a	788.2						n/a
No of days with Tmean_Air < 8°C	18	10						n/a
No of days with Tmean_Air > 28°C	1	24						n/a

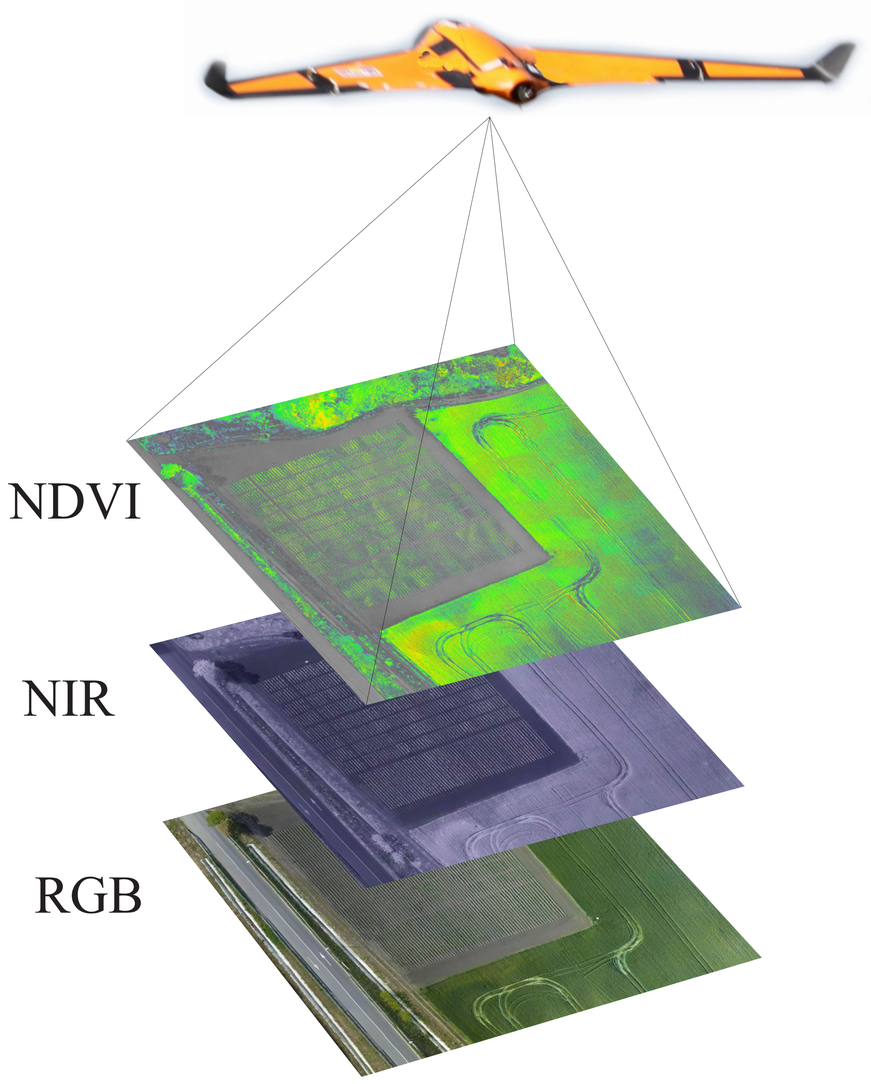




AeroDrone
AERIAL INSPECTION SERVICES

DriftData

ADVANCED DRONE-BASED APPLICATIONS FOR CROP MONITORING AND RECOMMENDATIONS

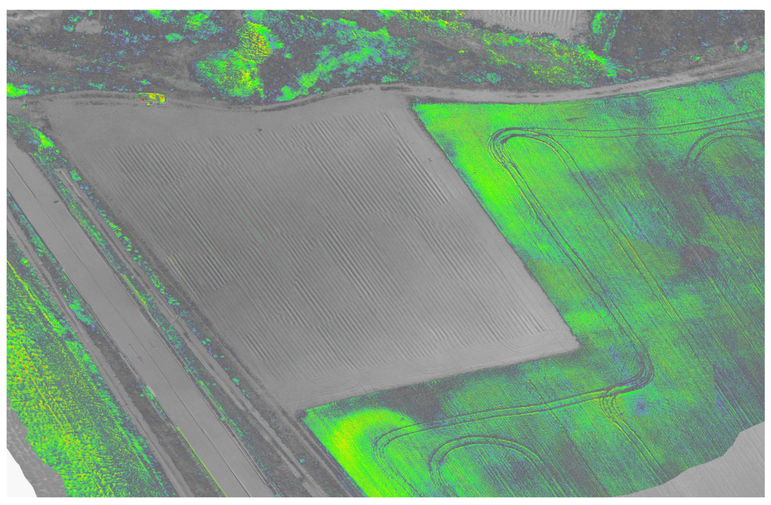


Providing automatically indexes, such as:
- **NDVI;**
- **biomass;**
- **LAI (Leaf Area Index);**
- **Chlorophyll content;**
- **nitrogen absorbed;**

INCDCSZ - 2016 EXPERIMENTAL FIELD

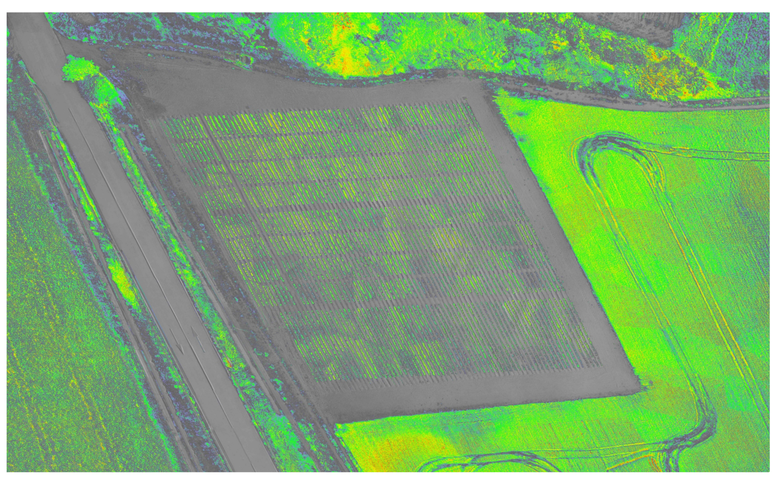
RGB 30 04 2016

NDVI 30 04 2016



RGB 22 05 2016

NDVI 22 05 2016



NDVI Legend

0.100000	0.500000	0.900000
0.200000	0.600000	1.000000
0.300000	0.700000	
0.400000	0.800000	

Design, manufacturing and testing of a mechatronic system for multispectral surveillance of crops vegetation status

MoniCult

- PN-II-PT-PCCA-2013-4-1629 -

Contract 225 / 01.07.2014

- **Total project budget: 1.437.500,00 lei** (1.250.000,00 lei from public budget and 187.500,00 lei from own budget)
- **Project duration: 39 months** (from 01.07.2014 to 30.09.2017).

  The period is divided in 4 stages:

2014	2015	2016	2017

- **Consortium structure:**
  - ***Transilvania* University of Brașov**, UTBv - **Coordinator**;
  - **National Institute of Research-Development for Potato and Sugar Beet Braşov**, INCDCSZ - **Partner 1**;
  - **Technical University of Cluj-Napoca**, UTCN - **Partner 2**;
  - **S.C. Hibridul S.A. Hărman**, HIB - **Partner 3**.

- **Project abstract.** ***Climate, economic and anthropic changes (pressure exerted by human activities on agro-systems - biodiversity loss and environmental pollution) led to alterations in the stability of agricultural systems, increasing their vulnerability and therefore reducing food safety and security. Crop management, under new conditions created in the last period, increasingly requires monitoring of the soil resources and dynamics of crop vegetation status, for real time interventions regarding the precise allocation (localized and economic) of technological inputs (fertilizers, pesticides etc.).***

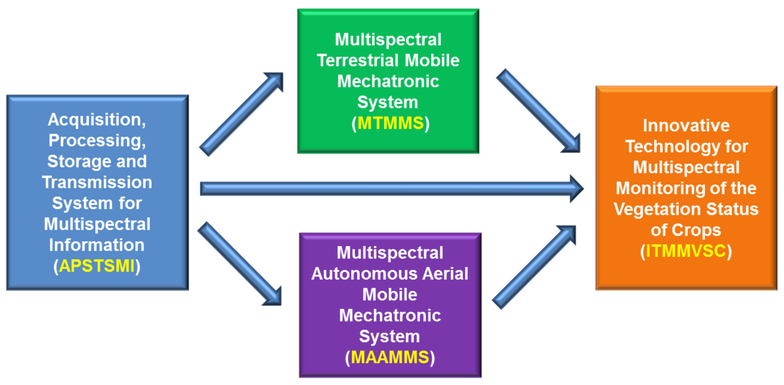
  In this context, the project entitled "Design, Implementation and Testing of a Mechatronic System for Multispectral Monitoring of Crops Vegetation Status – MoniCult" represents an efficient and effective tool for implementing the concept of precision agriculture as part of the sustainable agriculture.

  Precision agriculture management considers, among other things, also the monitoring of the crops vegetation status. This is done by calculating and interpreting vegetation indices based on spectral data collected by specialized acquisition systems. Vegetation indices are correlated with the degree of plant health and development. Information about thermal and water stress, pests and so on, are of the utmost importance for timely intervention in all that means the need for water, pesticide and fertilizer to be supplied at the proper time, in the necessary quantity and in the adequate place, leading to a major economic and environmental protection impact.

- **Project Objectives.** ***The main objective is to provide an innovative solution of multispectral monitoring of crops vegetation status, based on mechatronic systems, in order to improve precision agricultural management, solution that will lead to overcoming bottlenecks identified in this area.***

  Operational objectives:
  - ***OB1. Design, implementation and testing of an Acquisition, Processing, Storage and Transmission System for Multispectral Information (APSTSMI) for improving the management of crops;***
  - ***OB2. Design, implementation and testing of a Multispectral Terrestrial Mobile Mechatronic System (MTMMS) for multispectral monitoring of crops vegetation status;***
  - ***OB3. Design, implementation and testing of a Multispectral Autonomous Aerial Mobile Mechatronic System (MAAMMS) for multispectral monitoring of crops vegetation status;***
  - ***OB4. Design, implementation and testing of an Innovative Technology for Multispectral Monitoring of the Vegetation Status of Crops (ITMMVSC).***

- **Products developed under this project.**



- **Expected results from the project.** ***Following the project accomplishment and use of the products developed within it, important results are expected focused on increasing the agricultural management precision with major economic and environmental protection impact:***
  - ***Optimization of water resources, obtained by careful monitoring of crops vegetation status by help of calculated vegetation indices and distribution of plants water necessities only at the required moment and place;***
  - ***Optimization of irrigation expenses with positive economical impact;***
  - ***Optimization of chemical inputs (fertilizers and pesticides) allowing to know the precise moment when they are required, of the amount to be used and place to be applied (positive economic impact, especially as far as environmental protection is concerned);***
  - ***Obtaining large and quality productions, due to the precision agricultural management;***
  - ***Increasing the sustainability of agricultural systems;***
  - ***Integrated achievement of environmental protection.***

- **Project director**

Associate Professor Dr. Eng. Marius Cristian LUCULESCU

Transilvania University of Brașov, Faculty of Product Design and Environment, Product Design, Mechatronics and Environment Department

29, Eroilor Boulevard, 500036, Brașov, Phone./Fax: +40268 41.63.52, E-mail: lucmar@unitbv.ro.

http://www.unitbv.ro/fdpm/CercetareStiintifica/C04Sistememecatroniceavansate/ProiectParteneriate-MoniCult/MoniCult-en.aspx

Institutul Naţional
de Cercetare – Dezvoltare
pentru Cartof şi Sfeclă de Zahăr
Brasov - ROMANIA

www.potato.ro

Activitãţile de cercetare ştiinţificã şi producere de sãmânţă din categoriile biologice superioare la cerealele de toamnă, INCDCSZ Braşov

Tican Cornelia,
Institutul Naţional de Cercetare Dezvoltare pentru Cartof şi Sfeclã de Zahãr Braşov

I. Tematici de cercetare ştiinţifică, coordonate de INCDA Fundulea, în cadrul proiectelor sectoriale:

- Identificarea unor seturi noi de soiuri de grâu şi triticale, cu adaptabilitate specificã pentru principalele zone agricole ale ţãrii;

- Creşterea eficienţei culturii grâului prin identificarea, crearea şi promovarea de soiuri superioare ca productivitate, stabilitate şi adaptabilitate la schimbãrile climatice, cu calitate corespunzãtoare cerinţelor diverse ale sectorului de prelucrare din cadrul industriei alimentare.

1.Problematica abordatã:

Stabilirea unei palete de soiuri de cereale pãioase: grâu, triticale cu adaptabilitate specificã pentru principalele zone agricole ale ţãrii, având în vedere prezenţa unor perioade lungi de secetã care provoacã puternice stresuri termo-hidrice, în special la soiurile sensibile;

- necesitatea introducerii în culturã a unor soiuri de grâu, triticale, specializate pentru anumite scopuri de folosinţã;
- zonarea soiurilor recomandate pe anumite zone de culturi;
- posibilitatea producerii de sãmânţã la grâul de toamnã, triticale de toamnã.

2. Rezultatele cercetãrilor şi importanţa acestora pentru practica agricolã:

- identificarea de soiuri rezistente la stresul termo-hidric, care sã asigure o producţie corespunzãtoare;
- identificarea soiurilor din punct de vedere al rezistentei acestora la atacul agentilor patogeni, capabile sa valorifice resursele limitate de hranã din sol;
- caracterizarea soiurilor din punct de vedere al rezistenţei la cãdere, scuturare, încolţire în spic; sterilitate, uniformitate,etc
- zonarea soiurilor recomandate a fi înmulţite cu prioritate în condiţiile specifice Ţãrii Bârsei






II: Producerea de sămânţă din categoriile biologice superioare la grâu şi triticale de toamnã, solicitate de piaţã:

1.Problematica abordatã:

- producerea de sãmânţã din categorii biologice superioare la cerealele de toamnã, o bunã adaptabilitate la condiţiile pedoclimatice din zonă, cu rezistenţã geneticã ridicatã la boli si dãunãtori, rezistente la încolţirea în spic.

2.Parametrii propuşi:

- Capacitate ridicatã de producţie;
- Rezistenţã mãritã la factorii nefavorabili;
- Calitate superioarã pentru morãrit, panificaţie şi hrana animalelor.

3.Strategii:

- identificarea genotipurilor rezistente la stresul termo-hidric;
- reducerea înãlţimii plantelor ca factor de preîntâmpinare a cãderii acestora;
- controlul agenţilor patogeni, al dãunãtorilor şi buruienilor.

4.Performanţe în procesul de producere sămânţă

- la grâul de toamnă, soiurile Glosa şi Miranda:
  - capacitate ridicatã de producţie: > 5-7t/ha;
  - masa hectolitricã: > 78kg/hl;
  - conţinutul de gluten: 25-35%;
  - gliadine şi glutenine de calitate corespunzãtoare industriei de panificaţie.

-la triticalele de toamnă, soiurile Stil şi Negoiu:
  -capacitate ridicatã de producţie: > 6-8t/ha;
  -conţinutul de proteinã: 12-13%;
  -extractive neazotate: 78-80%.

5.Categoriile biologice incluse în procesul de producere sămânţă la cereale:

- Sămânţa Amelioratorului ;
- Sămânţa de Prebază 1 şi 2;
- Sămânţa de Bază.