

PRELIMINARY RESULTS REGARDING THE EFFECTS OF EXTREME CLIMATIC CONDITIONS ON THE YIELD QUALITY OF DIFFERENT ROMANIAN POTATO VARIETIES

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Abstract

Experiments with varieties Christian, Cumidava, Roclas and Rustic took place in Brasov, in 2012 and 2013, years, very distinct from the point of view of climate during potato growing season. Extreme climate conditions during the growing season of potatoes can strongly disrupt the tubers growth processes, this being reflected on the yield structure. Very high temperatures and drought in 2012 have affected potato crops in the most important production phenological phase, the period of budding-flourishing, when susceptibility face to soil humidity is highest. During this period was the largest consumer of water. Because of these unfavorable circumstances, the new tubers suffered quantitative and qualitative depreciations by deformation, dehydration, second growth and sprouting. In the year 2013, characterized by alternate rainy periods with periods without rain and higher temperatures than normal, have determined foliage lush growth that could not self-holds and went into a very early decline. Thus, starting with first decade of August, the plants were dried on an accelerated basis, starch accumulation and tubers growth being halted. Following the comparison of the years was found differences of varieties yield between 19.7 and 26.8 t/ha. Towards 2012, on 2013, varieties yield was 3-4 times higher and the starch content of plant varieties averaging 1.28%, significant differences being on Roclas and Rustic. In 2012 the average percentage of tubers depreciation by deformation was 84.9%, dehydration -27.9%, second growth -2.6% and sprouting -24.4%. The research, in addition to the data provided from the reaction conditions of cultivated varieties, put the bases of future research on the yield quality in different agro-climatic contexts.

Key words: potato, climate, quality, starch content

The research goal is the collection of data for the development of a monitoring system to establish quantitative and qualitative effects due to climatic conditions for different potato varieties and cultivation technologies.

By choosing varieties and cultivation technology management effect of unfavorable environmental factors may diminish, what is a particularly important reason in terms of climate change on ensuring a greater constant yield.

The features that determine the quality of potatoes are genetically determined, so they are variety characters which are strongly influenced by environmental conditions.

The scientific literature indicates substantial qualitative changes under the influence of environmental conditions and cultivation technology.

High temperatures are slowing the initiation process of tubers formation, resulting the reduction on the number of tubers in a nest and accumulation

of dry matter (Quiroz R. et al. 2011) and can affect the quality in terms of size output or may cause deformations more or less accentuated (Rousselle P., 1996)

An important limiting factor for non-irrigated crops is soil moisture deficit recorded more frequently in times of great importance for the growth and development of potato plants (Donescu V., Ianoși S., 2012).

MATERIAL AND METHOD

The study on the effects of extreme climate conditions on the quality of potato yield has been conducted in NIRSD Brașov, on four Romanian varieties: Christian, Roclas, Cumidava and Rustic in the period 2012-2013.

All four varieties were studied in the context of a growing technology experiences, on the level of fertilization with 600 kg/ha NPK (nitrogen, phosphorus, potassium) 15:15:15, un-irrigated conditions, on a cernoziomoid soil with the following characteristics: clay: 30%, pH-6, hummus-4.5%,

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mobile phosphorus-50 ppm, mobile potassium-over 100 ppm, the degree of saturation in base-over 85%.

In those two years, for each variety, were collected samples which were analyzed quantitatively and qualitatively. Thus, have been determined: the structure size of tubers mass, starch content and, the percentage of tubers which impaired the physics quality.

For the determination of starch content have been taken from tuber mass average samples of 1 kg from each variety on 3 replications. Determination of the percentage of starch was done using the Polikeit balance.

To determine the percentage of tubers which have undergone qualitative depreciation (deformation, dehydration, re-growth, sprouting) were taken average samples of 200 tubers.

Climatic conditions. In 2012, the high temperatures and the lack of water in the soil affected potato crops in the most important phenological phase for yield accumulation, budding-flourished period, when susceptibility given soil humidity is highest, a period with the highest water consumption (Ianosı S., 2002).

The drought installed on the second decade of June has deepened with the growing frequency of extremely hot days without precipitation.

Very high maximum temperatures have

exceeded in majorityt days the temperature threshold for starch formation and for the growth of tubers that was appreciated by Constantinescu Ecaterina (1969) and Burton W.G. quote by Ianosi S., (2002), to 29°C or event 25°C on drought conditions. Due reduced development of the foliage in non-irrigated conditions, since the beginning of July was registered the intensely senescence of canopy.

The average temperature for the period 1 March to 30 September 2013 has surpassed 1,9°C MMA, and the total amount of rainfall fell was close (92,3%) of multiannual amount for Brașov (*figure 1*).

In 2013, the last decade of April and the first decade of May have achieved optimum conditions for planting of potatoes. After emerging, rainy periods alternated with periods without rain and higher temperatures than normal ones, which have remained below the values recorded in the same period of the year 2012, have boosted the lush growth of potato foliage (*figure 2*).

This context has favoured tubers growth and starch accumulation until mid-July, when, due to low rainfall and high temperatures, the foliage has been unable to sustain itself, photosynthetic activity going into decline as early as the first decade of August. The plants were dried on an accelerated basis, starch accumulation and growing of tubers being halted.

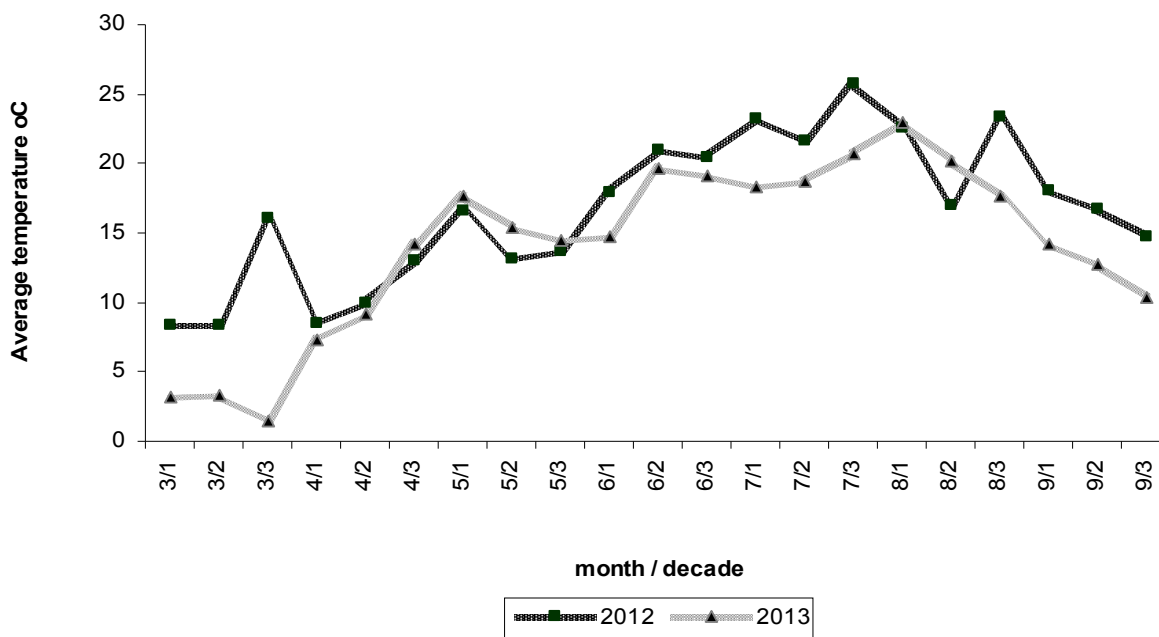


Figure 1 Average temperatures (monthly decade) during the growing season, Brașov 2012-2013

RESULTS AND DISCUSSION

Research report a number of important issues related to the influence of climate conditions on the reaction in production conditions and on the physical and technological qualities of potato native varieties.

As a result of observations made there have been yield differences, especially in the size structure of the tubers mass, the number of harvested tubers, in the starch content, and the percentage of tubers from which impaired the physics quality.

The yield obtained from all varieties was approximately 3-4 times higher in 2013

than in 2012, with yield over 30 t/ha, as we observed to Christian, Cumidava and Roclas varieties.

As noted in *table 1*, the yield differences in the years 2013 and 2012 were placed between 19.7 t/ha - Cumidava and 26.8 t/ha- Christian.

As regards the relationship between the yield level of two years they are particularly high compared to the varieties characteristic in years without climatic excesses, in non-irrigated conditions at Brașov. At Rustic and Christian varieties yield ratio being of 4.7 and 4.0, while at Cumidava and Roclas varieties they were located between 2.8 and 3.2.

On all varieties studied, amplitude ratio values indicate a particularly large variation

in yield from one year to another (*figure 2*).

Figure 3 shows comparatively, for 2012-2013, the size structure of the potato varieties yield.

It is found that in the year 2012, the growth and development of tubers has been halted by lack of rainfall during yield accumulation.

On all varieties the yield of tubers larger than 55 mm was less than 1 t/ha and the yield of seed potato fraction ranged between 4.0 and 8.1 t/ha. Comparatively, in 2013 yield of fraction greater than 55 mm from varieties taken into study were between 3.9 t/ha (Rustic) and 14.8 t/ha (Cumidava) and yield with a diameter of 30-55 mm was between 14.7 and 24.5 t/ha (*table 2, figure 4*).

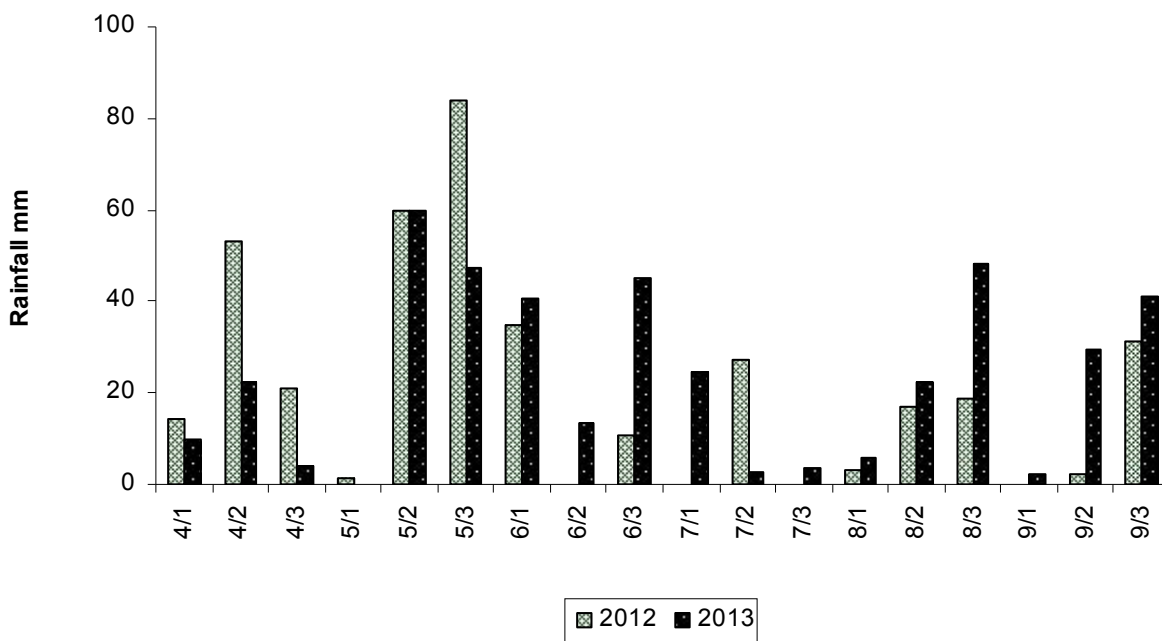


Figure 2 The amount of rainfall during vegetation period (monthly decade), Brașov 2012-2013

Table 1

The magnitude variation of total yield in 2012-2013

Variety	Average yield	Minimum (2012)	Maximum (2013)	Maximum-minimum	Maximum/minimum
	t/ha				
Christian	22.3	8.9	35.7	26.8	4.0
Cumidava	20.5	10.7	30.4	19.7	2.8
Roclas	20.8	9.9	31.6	21.7	3.2
Rustic	17.4	6.1	28.7	22.6	4.7
Average		8.9	31.6	21.7	3.7

Due to different climatic conditions, in 2013 the proportion of accumulated starch was on average with 1.28 % higher at potato varieties investigated (19.7%).

The starch content was not significantly

differentiated in two years, at Christian (17.00%) and Cumidava (21.25%) varieties.

On Roclas and Rustic varieties, in 2012 conditions, unfavorable for starch accumulation, percentages of starch were

significantly reduced than in 2013, respectively 16.08% given to 19.52% (Roclas) and 19.08% given to 21.25% (Rustic).

In 2012, due to the persistence of very high temperatures and drought, the new tubers suffered serious quantitative and qualitative

declines by dehydration, second growth and sprouting. Thus, the lowest percentage of deformed tubers (40%) was recorded at Christian, while to Cumidava, Roclas and Rustic varieties the percentage of deformed tubers rised to 100% (table 3, table 4).

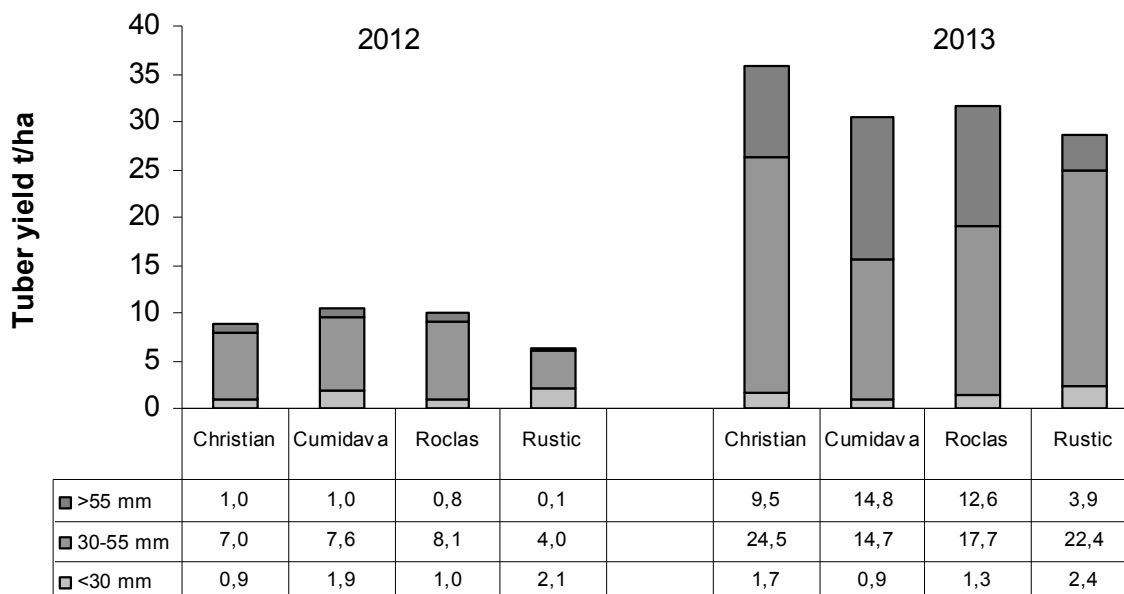


Figure 3 The tubers yield on size fractions of different potato varieties.

Table 2

The average level and variation of starch content in 2012-2013

Variety	2012		2013		Average 2012-2013	
	% starch	Test Duncan	% starch	Test Duncan	% starch	Test Duncan
Christian	16.75	CD	17.25	C	17.00	D
Cumidava	21.75	A	20.75	A	21.25	A
Roclas	16.08	D	19.52	B	17.80	C
Rustic	19.08	B	21.25	A	20.17	B
Average	18.42	-	19.70	+1.28*	19.05 (CV=2.87%)	

LSD5% (average year) = 0.36%

LSD5% average variety) = 0.69%

LSD5% (interaction year*variety) = 0.97%

Table 3

The amplitude variation of starch in 2012-2013

Variety	% starch	Minimum (2012)	Maximum (2013)	Maximum-Minimum %	Maximum/minimum
	%				
Christian	17.0	16.8	17.3	0.5	1.0
Cumidava	21.3	21.8	20.8	-1.0	1.0
Roclas	17.8	16.1	19.5	3.4	1.2
Rustic	20.2	19.1	21.3	2.2	1.1
Average		18.4	19.7	1.28	1.1

Table 4

The percentage of tubers depreciated due to excessive climatic conditions, Brașov-2012

Variety	The percentage of tubers depreciated through:							
	Deformation		Dehydration		Second growth		Sprouting	
	%	*Test Duncan	%	*Test Duncan	%	*Test Duncan	%	*Test Duncan
Christian	40.4	B	5.6	B	0	B	29.8	AB
Cumidava	95.8	A	28.0	AB	0	B	51.9	A
Roclas	100.0	A	22.3	A	0	B	4.2	B
Rustic	100.0	A	55.7	A	10.3	A	12.0	B
Media	84.9		27.9		2.6		24.4	

* Test Duncan $p = 0.05\%$

Dehydration has been present at all potato varieties, the lowest percentage of dehydrated tubers (5,6%) was recorded at Christian, the maximum being recorded to Rustic (55,7%).

The second growth of tubers have been reported only to Rustic variety on which 10.3% of tubers have manifested this impairment.

Sprouting was present at all varieties, the most intense being to Cumidava (51.9%) and Christian (29.8%) varieties.

At the observations carried out in 2013 the impairment phenomena of physical quality of the tubers (second growth, deformation, dehydration and sprouting) were absent.

CONCLUSIONS

Extreme climate conditions, with very high temperatures and low level of rainfall led to achieve in 2012 very low yields from the point of view of quantity and quality.

In 2013 the early collapse of foliage led in halting of yield accumulation.

Following the comparison of the years, have found differences in yield between 19.7

and 26.8 t/ha

Towards 2012, on 2013 potato varieties yield was 3-4 times higher and starch content was on average 1.28%, the differences being significantly to Roclas and Rustic varieties.

In 2012, the average percentage of tubers impaired by deformation was 84,9%, by dehydration -27,9%, second growth - 2,6% and sprouting - 24,4%.

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CONTENTS

<p>Petr KONVALINA, Ivana CAPOUCHOVÁ, Hana HONSOVÁ, Evženie PROKINOVÁ, Dagmar JANOVSÁ, Jaroslav BERNAS, Marek KOPECKÝ, Jan MOUDRÝ jr., Zuzana JELÍNKOVÁ, Jan MOUDRÝ ORGANIC WHEAT SEED QUALITY.</p>	11
<p>Jan MOUDRÝ jr., Zuzana Jelínková, Marek KOPECKÝ, Jaroslav BERNAS, Jan MOUDRÝ, Petr KONVALINA, Václav KALKUŠ EMISSIONS OF GREENHOUSE GASES FROM THE EGG PRODUCTION WITHIN THE CONVENTIONAL AND ORGANIC FARMING SYSTEM</p>	17
<p>Zuzana JELÍNKOVÁ, Jan MOUDRÝ, , Jan MOUDRÝ sr., Jaroslav BERNAS, Marek KOPECKÝ, Petr KONVALINA LCA METHOD - TOOL FOR FOOD PRODUCTION EVALUATION.....</p>	23
<p>Jaroslav BERNAS, Marek KOPECKÝ, Jan MOUDRÝ jr., Jan MOUDRÝ, Zuzana JELÍNKOVÁ, Petr KONVALINA COMPARISON OF GERMINATION OF SELECTED ENERGY GRASSES SPECIES WITHIN DIFFERENT WATER REGIMES</p>	29
<p>Karoly BODNAR, Margit SZEL HODI, Erika SKOBRAK BODNAR¹ ACCEPTANCE OF THE MEAT OF WILD UNGULATES AMONG THE HUNGARIAN CONSUMERS</p>	35
<p>Fatma GOKMEN YILMAZ, Mustafa HARMANKAYA, Sait GEZGIN YIELD, PROTEIN AND NITROGEN USE EFFICIENCY IN BREAD WHEAT GENOTYPES</p>	39
<p>Valeriu MOCA, Daniel BUCUR UPDATING OF THE CARTOGRAPHIC DATABASE OF THE ADMINISTRATIVE TERRITORIAL - UNITS FROM THE SURFACE DRAINAGE AND UNDERGROUND PIPE DRAINAGE SYSTEMS</p>	43
<p>Oprea RADU, Daniel CUREA PEDO-GEOMORPHOLOGICAL FACTORS LIMITING SOIL FERTILITY IN MĂDĂRJAC COMMUNE, IAȘI COUNTY</p>	51
<p>Oprea RADU, Daniel CUREA AGRICULTURAL LAND QUALITY IN MĂDĂRJAC COMMUNE, IAȘI COUNTY</p>	57
<p>Cristian HUȚANU ASPECTS OF ORCHARDS CADASTRAL INFORMATIONAL SYSTEM</p>	63
<p>Ioan ROTAR, Florin PĂCURAR, Roxana VIDICAN, Anca PLEȘA OLIGOTROPHIC GRASSLANDS AND THEIR CONTEXT IN INTENSIFICATION</p>	69

Vasile VÎNTU, Costel SAMUIL, Constantin Iulian POPOVICI, Cătălina BOUREANU (CIOBANU), Mihai STAVARACHE MANAGEMENT OF <i>Nardus stricta</i> L. AND <i>Festuca rubra</i> L. GRASSLANDS IN THE DORNA BASIN	73
Vlad STOIAN, Roxana VIDICAN, Ioan ROTAR, Florin PĂCURAR IMPACT OF FERTILIZER AND TREATMENT RECIPE ON MYCORRHIZAL FUNGI PROGRESS IN THE ROOT SYSTEM OF <i>Festuca rubra</i> PLANTS	79
Constantin Iulian POPOVICI, Vasile VÎNTU, Costel SAMUIL, Mihai STAVARACHE, Cătălina BOUREANU (CIOBANU) TURFGRASS GROWN ON SAND-BASED ROOTZONE MIXTURE FOR INDOOR PURPOSE	85
Mihai STAVARACHE, Costel SAMUIL, Doina TARCĂU, Constantin Iulian POPOVICI, Vasile VÎNTU VARIATION IN CALCIUM AND PHOSPHORUS CONTENT OF <i>Medicago sativa</i> L.	89
Elena TROTUȘ, Alexandra Andreea BUBURUZ, Margareta NAIE, Simona Florina POCHIȘCANU RESEARCH ON THE EVOLUTION OF <i>Amathes c-nigrum</i> L. SPECIES (ORD. LEPIDOPTERA, FAM. NOCTUIDAE) UNDER CENTRAL OF MOLDAVIA CONDITIONS	97
Anca PLEȘA, Ioan ROTAR, Florin PĂCURAR, Roxana VIDICAN THE SEMI-NATURAL GRASSLANDS IN DIFFERENT SUCCESSIONAL STAGES OF ABANDONMENT	105
Tamara LEAH THE EFFECTS OF VITICULTURE ON THE SOIL QUALITY STATUS IN THE REPUBLIC OF MOLDOVA	111
Victor STARODUB THE EVALUATION OF THE PRODUCTION OF "KUIALNIK" AUTUMN COMMON WHEAT VARIETY IN POLYFACTORIAL EXPERIENCES	115
Alexandru TELEUȚĂ, Victor ȚÎȚEI BIOLOGICAL AND NUTRITIONAL VALUE OF THE GENUS <i>Medicago</i> L. IN THE CONDITIONS OF THE REPUBLIC OF MOLDOVA	119
Andreea-Mihaela BĂLĂU, Florin Daniel LIPȘA, Eugen ULEA RESEARCH REGARDING DISEASE RESISTANCE OF SOME WHEAT VARIETIES IN THE CLIMATIC CONDITIONS DURING THE YEARS 2012-2013 AT EZĂRENI FARM, IASI	125
Andreea-Mihaela BĂLĂU, Florin-Daniel LIPȘA, Eugen ULEA THE EVALUATION OF FUNGAL LOAD OF WHEAT KERNELS IN STORAGE CONDITIONS	129
Cătălina-Ioana IACOB, Eugen ULEA REASERCH REGARDING THE PATHOGEN AGENT <i>Phytophthora parasitica</i> Dast. ON THE HOST <i>Petunia hybrida</i> Hort.	133

Florin Daniel LIPȘA, Mihaela Andreea BĂLĂU, Eugen ULEA MICROBIOLOGICAL RESEARCH ON SOME YEASTS ISOLATED FROM THE MOLDAVIA VINE-GROWING REGION, ROMANIA	137
Florin Daniel LIPȘA, Mihaela Andreea BĂLĂU, Eugen ULEA OCCURANCE OF AIRBORNE FUNGAL SPORES WITH POTENTIAL ALLERGOGEN EFFECT IN URBAN AND RURAL EDUCATIONAL INSTITUTIONS FROM IAȘI COUNTY, ROMANIA	141
Evelina-Cristina MORARI, Feodor FILIPOV, Andreea-Mihaela BĂLĂU, Florin-Daniel LIPȘA, Eugen ULEA THE MICROBIOTA DYNAMICS OF A CAMBIC CHERNOZEM IN EZARENI FARM, THE RESEARCH SITE FROM IASI.....	145
Madalina-Cristina BURLACU (ARSENE, Constantin LEONTE PARTIAL RESULTS REGARDING IDENTIFICATION OF A RESISTANCE SOURCE OF OILSEED RAPE AT <i>Verticillium longisporum</i> PATHOGEN	149
Simona POCHIȘCANU, Teodor ROBU, Adina Cătălina DRUȚU, Traian-Ioan POMOHACI, Margareta NAIE, Alexandra BUBURUZ, Diana POPA PARTIAL RESULTS ON THE INFLUENCE OF FERTILIZATION ON GRAIN PRODUCTION OF <i>Sorghum bicolor</i> L., IN THE CLIMATIC CONDITIONS OF CENTRAL MOLDAVIA	155
Ioan DROCAS, Ovidiu Marius MARIAN, Ovidiu RANTA, Adrian MOLNAR, Mircea MUNTEAN, Giorgia CĂTUNESCU STUDY ON DETERMINING THE DEGREE OF COVERAGE WHEN PERFORMING PHYTOSANITARY TREATMENTS USING WATER SENSITIVE PAPER	159
Cătălina Adina DRUTU, Diana Lorena POPA, Alexandra BUBURUZ, Alexandra LEONTE, Simona POCHIȘCANU, Margareta NAIE, Traian POMOHACI, Elvira GILLE, Giorgia GAVRIL, Camelia STEFANACHE, Ana Clara APROTOSOIE, Irina MIHALACHE, Rodica MARTEA RESEARCH ON THE INFLUENCE OF NUTRITION ON THE PRODUCTION OF SPACE AND QUALITY HERBA <i>Hyssopus officinalis</i> L. (HYSSOP) CULTIVATED ECOLOGICAL CONDITIONS IN A.R.D.S. SECUIENI	165
George RACU, Mihai TĂLMACIU¹, Nela TĂLMACIU OBSERVATIONS REGARDING THE ENTOMOFAUNA OF BEETLES ORGANIC POTATO CROPS BELONGING THE SCDA SUCEAVA	171
George RACU, Mihai TĂLMACIU, Nela TĂLMACIU STRUCTURE, DYNAMICS AND ABUNDANCE OF SPECIES OF BEETLES (ORDER <i>Coleoptera</i>) FROM POTATO CROPS	175
Valentina Gabriela LAZIN RESEARCH ON THE BEHAVIOR OF SOME CORN HYBRIDS UNDER THE INFLUENCE OF TECHNOLOGICAL COMPONENTS IN THE CONTEXT OF SUSTAINABLE AGRICULTURE	179

Iuliana PANCIU, Irina HOLOBIUC, Rodica CĂTANĂ THE USE OF BIOTECHNOLOGY FOR SUPPLYING OF PLANT MATERIAL FOR TRADITIONAL CULTURE OF MEDICINAL, RARE SPECIES <i>Arnica montana</i> L.	183
Nina BĂRĂSCU, Victor DONESCU, Marcel DUDA, Daniela DONESCU, Maria IANOȘI PRELIMINARY RESULTS REGARDING THE EFFECTS OF EXTREME CLIMATIC CONDITIONS ON THE YIELD QUALITY OF DIFFERENT ROMANIAN POTATO VARIETIES	189
Ioan-Nicolae RANGA, Adrian VAMANU, Petruta CORNEA ACIDIC DAIRY PRODUCTS-EVALUATION SENSORY	195
Andy Felix JITĂREANU, Aurel CHIRAN, Elena GÎNDU MARKETING STUDY ON WINE CONSUMERS' BEHAVIOR FROM IASI.....	201
Aurel CHIRAN, Elena GÎNDU, George UNGUREANU, Andy-Felix JITĂREANU ISSUES REGARDING AGRICULTURE DEVELOPMENT IN BOTOSANI COUNTY AFTER ACCESSION TO THE EUROPEAN UNION	207
Corina MATEI-GHERMAN, Vasile MATEI MARK - A PRIMARY ATTRIBUTES IN THE COMPANY.....	213
Corina MATEI-GHERMAN THE AGRICULTURE ECOLOGICAL NEED OR AN EXPERIENCED	219
Lucian SFÎCĂ, Pavel ICHIM, Cristian-Valeriu PATRICHE, Liviu IRIMIA, Liviu OANĂ COTNARI VINEYARD - A GIFT OF HYDRAULIC FOEHN?	227
Mihai STANCIU, George UNGUREANU EXAMPLES OF GOOD PRACTICE LIFELONG LEARNING DANISH ADULTS	233
Alexandru Dragoș ROBU, Ioan GÎLCĂ, Carmen COSTULEANU, Oliver Constantin PRICOP, Eduard BOGHIȚĂ STUDIES ON THE SOURCES OF POLLUTION FROM LIVESTOCK ACTIVITIES IN THE NORTH-EAST REGION	237
Camelia APETROAIE THE ROLE OF THE INFORMATION TRANSFER TOWARDS THE AGRICULTURAL PRODUCERS IN ORDER FOR THEM TO ACCESS THE EUROPEAN AND THE NATIONAL FUNDS	245
Anca Cristina COLIBABA, Claudia Elena DINU, Cintia Lucia COLIBABA, Ramona CÎRȘMARI GOERUDIO METHOD AND TOOL TO ACHIEVE NECESSARY LEVEL OF COMPREHENSION	249
Anca Cristina COLIBABA, Stefan COLIBABA, Irina GHEORGHIU, Rodica GARDIKIOTIS FIESTA'S INNOVATIVE TOOLS AND MATERIALS IN FACILITATING SEN STUDENTS' TRANSITION	253

Marilena DONCEAN THE ROLE OF EMOTIONS IN THE PROCESS OF KNOWLEDGE OF TOURISM PRODUCTS	259
Marilena DONCEAN STRATEGIC SOLUTIONS FOR POLLUTION REDUCTION AND RESTORING THE RURAL ENVIRONMENT - GREEN ROOFS	263
Cristian Laurentiu DRAGOMIR, Elena PARTAL INFLUENCE OF DIFFERENT LEVELS OF WATER SUPPLY ON PRODUCTION AND ECONOMIC EFFICIENCY UNDER MAIZE CULTIVATED IN DOBROGEA REGION OF ROMANIA	267
Roxana Valentina GÂRBEA, Simona Maria CUCIUREANU BOTOSANI COUNTY'S TOURIST IMAGE, BETWEEN PERCEPTION AND REALITY	273
Costinel Eduard STOENEL THE INFLUENCE OF TECHNOLOGY MEASURES ON THE REDUCING EFFECT OF DROUGHT AT WINTER WHEAT CROP	277
Raul BAETAN, Ion OLTEAN, Laura Ioana MACAVEI, Rocco ADDANTE, Francesco PORCELLI HOST PLANTS PREFERRED BY <i>Tuta absoluta</i> (MEYRICK, 1917) LARVAE FOR PUPATION	281
Oana ZAMFIRESCU THE CHARACTERISTICS OF THE ROMANIAN COMMON NAMES GIVEN TO LOWER PLANTS	283
Victor ȚÎȚEI BIOLOGICAL PECULIARITIES OF CUP PLANT (<i>Silphium perfoliatum</i> L.) AND UTILIZATION POSSIBILITIES IN THE REPUBLIC OF MOLDOVA.....	289

