THE INFLUENCE OF AGRO-CLIMATIC CONDITIONS IN 2011-2013 INTERVAL, ON MAIZE PRODUCTION, ON A MOLIC - REDDISH PRELUVOSOIL, MEDIUM CLAY LOAM / MEDIUM CLAY LOAM, FROM VINGA PLAIN

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Abstract

The research has as purpose the support of sustainable agriculture system, responding to local requirements establishing the scientific data base necessary to support new technologies and develop integrated management measures of agro-eco-systems. The importance, originality and timeliness of work consists in the need of knowledge of environmental and soil conditions, this causing major strands of rural development, of edaphic cover and environment protection. The results presented are part of the doctoral studies and research (01.11.2011-30.10.2014) having as theme "Relations between ecopedological conditions, financing and productivity of agricultural land in the Banat Plain, Mureş-Bega interfluve" research is carried out simultaneously on experimental field and laboratory. The data in this paper are the result of research conducted in 2011-2013 range, within experiences organized in the field at Sanandrei, on the land of Soil and Agrochemical Studies Office (OSPA) in Timisoara. The experiences are located on an molic reddish preluvosoil, medium clay loam / medium clay loam, dominant in Vinga Plain and representative for a large area of Banato-Crisana plain. The paper offers basic knowledge and methodological elements for evaluation and characterization of the natural and anthropogenic resources. Such detailed knowledge of productive and technological characteristics of the contributing, restrictive or limiting factors of agricultural production, both in terms of the actual event and in terms of real possibilities for modifications, may be better for decision-making bodies (government, administration local) a valuable tool for achieving the most appropriate practical measures for the benefit of plant biomass production to improve its conditions of human life and the entire community.

Key words: *biodiversity, yield, crops, durability, evaluation*

INTRODUCTION

Increase, improve and stability of agricultural production and food security in all agricultural areas (tropical, subtropical, temperate, etc..) is achieved by cultivating certain plants, creating for them the defined technology elements, optimal growing conditions, starting to the fundamental idea that man must cooperate with the environment, to become conscious his protector. It is, therefore, necessary to achieve growth in full compliance with the requirements of conservation and protection of the environment.

Among soil properties and the main species cultivated can be established relations by a diverse and complex reciprocity. Soil properties can exert a decisive influence on the development of the root system, mineral nutrition, providing aerohidric and thermal regime needed to carry the main physiological processes and plants acts both directly and indirectly on the soil fertility status.

To determine the complex relationships that are established between various soil properties, were undertaken both in our country and in the world, numerous studies that have elucidated a number of mutual causality thereby helping to define soil taxa in terms of both genetic and the fundamental characteristics, in relation to their contribution to the differential productivity and suitability of land for plants (Borza et all., 2005, Canarache, 1980, Dicu et all., 2010, Tabără, 2001,2005,Răuţă,1997, Rogobete et all., 1997, Teaci, 1980,1995).

The research of this project lies in the accumulation of scientific data on the evolution of components productivity of agricultural land on the atmospheric, cosmic-telurico-edaphic offer, necessary to support new technologies, through an complexes approach of physical, geographical, edaphic and climatic conditions from Banat Plain (Mures-Bega interfluve).

In this paper are presented the result of research conducted in 2011-2013 range, at wheat on an molic reddish preluvosoil, medium clay loam / medium clay loam, dominant in Vinga Plain and on a typical chernozem, gleyed weak, proxicalcaric, medium loam / medium clay, dominant in Jimbolia - Bulgăruş Plain.

MATERIALS AND METHODS

The research in the field began in the autumn of 2011, when, on the land of OSPA Timisoara, located in Sanandrei territorial administrative unit was located the wheat crop and continued in the spring of 2012 with maize crop establishment and then in 2012 -2013 agricultural year using the same culture as results from the masthead of each of those cultures.

At Sânandrei, the experiences are bifactorial, of type 3 x 4 with plots in four replications (48 plots). The area of a parcel is 40 m^2 (4 x 10), the total area is 1920 square meters and experience are located on molic reddish preluvosoil, medium clay loam / medium clay loam, dominant in Plain Vinga and representative of a surface significant in Banato-Crisana Plain, the experimental factors being:

Factor A	Factor B
Phosphorus fertilization	Nitrogen fertilization
a 1- P_0	b1- N_0
a 2- P_{50}	b 2- N_{50}
a 3- P_{100}	b 3 – N_{100}
	b 4 – N_{150}

The basic agricultural works were executed by machines and equipment of OSPA Timisoara, it also providing seed, fertilizer and chemicals needed. Specific experimental technique works were carried out by PhD student under the guidance of scientific coordinator, using specific means of experimental technique.

In order to grasp the influence of eco-pedological conditions and technological elements on land productivity, especially in the area of the two locations, considered complex from both pedological and morphologicalpoint of view, were opened soil profiles of which were collected a series of samples.

These samples were investigated in relation to environmental factors, natural or man-made change, which makes the existence, together forming units of homogeneous ecological area (TEO) with the specific suitability or different technological requirements.

The research of ecopedological conditions was made according to "Soil Survey Elaboration Methodology " (Vol. I, II, III) developed by ICPA Bucharest in 1987, supplemented by specific elements of Romanian System of Soil Taxonomy (SRTS - 2012).

Analyzes and other determinations were carried out in the Research Laboratories of Physical-Chemical OSPA-USAMVB Timişoara, laboratory recognized by RENAR, according with National Standards and Rules approved by the Romanian Standardization Association.

RESULTS AND DISCUSSIONS

To characterize the specific climatic conditions for agricultural years 2011-2012 and 2012-2013, were used data recorded by OSPA Timisoara at Sanandrei Experimental Center (located on Route 56 Timisoara-Arad, Km 15.4) .

Regarding the rainfall, it may be noted that compared to the annual average was a deficit of 174.2 mm (tab 1) in 2011-2012 agricultural year, ie 18.1 mm in the 2012-2013 agricultural year.

Table 1

Monthly rainfall average, annual (2011-2013), at Center of Experimental Sanandrei and multiannual rainfall from 1931-2012 range (mm), Timisoara Weather Station

Agricultural year	Montly												Annual
	IX	**X**	**XI**	**XII**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
11—12	10,5	29,5	0,0	11,5	49,5	65,0	6,5	81,2	40,5	38,5	113,0	10,0	455,7
12—13	17,0	62,8	18,6	77,5	49,0	39,0	104,0	40,9	77,0	78,5	10,5	37,0	611,8
normal	**46,1**	**54,8**	**48,6**	**47,8**	**40,9**	**40,2**	**41,6**	**50,0**	**66,7**	**81,1**	**59,9**	**52,2**	**629,9**

Differences

Agricultural year	Montly												Annual
	IX	**X**	**XI**	**XII**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
11—12	-35,6	-25,3	-48,6	- 36,3	+ 8,6	+24,8	-35,1	+31,2	-26,2	-45,6	+56,1	-42,2	-174,2
12—13	-29,1	+ 8,0	-30,0	+29,7	+8,1	- 1,2	+62,4	- 9,1	+10,3	- 3,6	-49,4	-15,2	-18,1

To assess the impact of weather conditions on land productivity in the two stationary, the data were compared with significance of rainfall (reference limits in relation to the requirements of agriculture, tab. 2) using data from agro-climatic resources of Timis County.

Table 2

The significance of rainfall (reference limits in relation to the requirements of agriculture)

Interval	Significance of rainfall				
	Very dry	Dry	Satisfactory	Optimum	Excedentary
September-October	Under 40	41-60	61-80	81-150	Over 150
November-March	Under 100	101-150	151-200	201-300	Over 300
April	Under 20	21-30	31-40	41-70	Over 70
May-July	Under 100	101-150	151-200	201-300	Over 300
Annual	Under 350	351-450	451-600	601-700	Over 700

The analysis of rainfall data from the 2011-2012 agricultural year, it was a satisfactory year (Table 3) in the high plain and dry of the lower plain, as well as the agricultural year 2012-2013.

In the high plains, the agricultural year 2011-2012 started with a very dry period in September and October (tab.3), then continuing with a dry period in winter, the period from November to March, followed in April to have a surplus character in both cases generating a series of problems for good crop development (uneven emergence, low resistance to freezing

point of the chain to exit winter) adding their character issues surplus of April (weeds, diseases attack , reduce the period of cultural works suitability in terms of current and sanitation).

Agricultural year 2012-2013 is characterized by values of rainfall within the overall optimum and satisfactory characteristic, periods during which moisture deficit was offset by accumulated water reserves in the soil (Table 3).

Table 3

The significance of precipitation in relation to the requirements of agriculture, the 2011-2013 agricultural years, at Experimental Center Sanandrei

Characteristic periods										
Agricultural year	IX-X	Semnif.	XI-III	Semnif.	IV	Semnif.	V-VII	Semnif.	Annual	Semnif.
11-12	40,0	very dry	132,5	dry	81,2	excedentary	192,0	satisfactory	455,7	satisfactory
12-13	79,8	satisfactory	288,1	optimum	40,9	satisfactory	166,0	satisfactory	611,8	optimum

Regarding the evolution of soil moisture, the observations made (through soil sampling and laboratory determinations) in the two sites revealed the following (Table 4 and Table 5).

Table 4

Soil moisture (U%) reported to the values of useful water capacity (CU%) in the 2011-2012 agricultural year

Location		Interval 0-10 cm				Interval 10-25 cm				Interval 25-50 cm			
		U%	CC%	CU%	Difference from CU%	U%	CC%	CU%	Difference from CU%	U%	CC%	CU%	Difference from CU%
Sânandrei (Maize)	24.10.2011	21,45	23,70	8,40	+13,05	14,91	23,70	8,40	+ 6,51	16,77	24,60	8,80	+ 7,97
	15.11.2011	11,90	23,70	8,40	+ 3,50	11,57	23,70	8,40	+ 3,17	11,54	24,60	8,80	+ 2,74
	21.12.2011	21,36	23,70	8,40	+12,96	19,20	23,70	8,40	+10,80	18,94	24,60	8,80	+10,14
	13.01.2012	**24,92**	23,70	8,40	+16,52	21,94	23,70	8,40	+13,54	20,54	24,60	8,80	+11,74
	26.03.2012	21,07	23,70	8,40	+12,63	18,87	23,70	8,40	+10,47	18,50	24,60	8,80	+ 9,70
	04.05.2012	22,49	23,70	8,40	+14,09	21,79	23,70	8,40	+13,38	21,61	24,60	8,80	+12,81
	06.06.2012	15,19	23,70	8,40	+ 6,79	16,04	23,70	8,40	+ 7,64	20,74	24,60	8,80	+11,94
	29.06.2012	11,58	23,70	8,40	+ 3,18	12,43	23,70	8,40	+ 4,03	18,46	24,60	8,80	+ 9,66
	23.07.2012	7,50	23,70	8,40	- 0,90	7,51	23,70	8,40	- 2,89	11,18	24,60	8,80	+ 2,38
	21.08.2012	*10,32*	23,70	8,40	+ 1,92	9,25	23,70	8,40	+ 0,85	14,55	24,60	8,80	+ 5,75
	18.09.2012	*8,71*	23,70	8,40	+ 0,31	8,45	23,70	8,40	+ 0,05	10,06	24,60	8,80	+ 1,26
Location		Interval 50-75 cm				Interval 75-100 cm				Interval 1 00-125 cm			
		U%	CC%	CU%	Difference from CU%	U%	CC%	CU%	Difference from CU%	U%	CC%	CU%	Difference from CU%
Sânandrei (Maize)	24.10.2011	17,09	22,80	7,90	+ 9,19	16,87	22,80	7,90	+ 8,77	18,04	22,80	7,90	+10,14
	15.11.2011	16,39	22,80	7,90	+ 8,49	16,17	22,80	7,90	+ 8,27	15,39	22,80	7,90	+ 7,49
	21.12.2011	13,79	22,80	7,90	+ 5,89	14,47	22,80	7,90	+ 6,57	14,93	22,80	7,90	+ 7,03
	13.01.2012	16,30	22,80	7,90	+ 8,40	16,28	22,80	7,90	+ 8,38	17,42	22,80	7,90	+ 9,52
	05.03.2012	22,29	22,80	7,90	+14,39	20,29	22,80	7,90	+12,39	19,02	22,80	7,90	+11,12
	04.05.2012	**20,87**	22,80	7,90	+12,97	19,61	22,80	7,90	+11,71	20,07	22,80	7,90	+12,80
	06.06.2012	17,61	22,80	7,90	+ 9,71	18,36	22,80	7,90	+10,46	20,96	22,80	7,90	+13,06
	29.06.2012	22.08	22,80	7,90	+14,18	20,50	22,80	7,90	+12,35	20,79	22,80	7,90	+12,89
	23.07.2012	12,59	22,80	7,90	+ 4,69	12,28	22,80	7,90	+ 4,38	12,66	22,80	7,90	+ 4,76
	21.08.2012	*14,95*	22,80	7,90	+ 7,05	*16,23*	22,80	7,90	+ 8,33	*16,10*	22,80	7,90	+ 8,20
	18.09.2012	*15,24*	22,80	7,90	+ 7,34	*15,50*	22,80	7,90	+ 7,60	*16,76*	22,80	7,90	+ 8,86

Having as pre-plant the wheat, the soil being retained as a field to the establishment of culture, the values of moisture were retained near field capacity until the beginning of July,

they recorded values below those of useful water capacity both on the range 0 - 10 cm and the range of 10 to 25 cm (Table 4). This is due to some extent the climate of the agricultural year 2011-2012, on rainfall and could be found that compared with the average yearly rainfall was recorded a deficit of 174.2 mm (Table 1) .

In 2012-2013 agricultural year, the soil being retained as a field to set up of crop, soil moisture values were kept near field capacity until the beginning of August when they recorded values below those of useful water capacity both on the range 0 - 10 cm and the 10-25 cm interval (Table 5), with a deficit of rainfall of 18.1 mm (Table 1).

Table 5

Momentary soil moisture (U%) reported values of useful water capacity (CU%) in the 2012-2013 crop year

Location		Interval 0-10 cm				Interval 10-25 cm				Interval 25-50 cm			
		U%	CC%	CU%	Difference from CU%	U%	CC%	CU%	Difference from CU%	U%	CC%	CU%	Difference from CU%
Sânandrei (Maize)	18.09.2012	9.35	23,70	8,40	+0.95	11.47	23,70	8,40	+3.07	14.41	24,60	8,80	+5.61
	23.10.2012	16.25	23,70	8,40	+7.85	13.03	23,70	8,40	+4.63	14.70	24,60	8,80	+5.90
	27.12.2012	22.56	23,70	8,40	+14.16	22.72	23,70	8,40	+14.32	23.05	24,60	8,80	+14.25
	13.02.2013	22.86	23,70	8,40	+14.46	20.54	23,70	8,40	+12.14	20.45	24,60	8,80	+11.65
	13.03.2013	23.42	23,70	8,40	+15.02	20.08	23,70	8,40	+11.68	21.41	24,60	8,80	+12.61
	11.04.2013	24.55	23,70	8,40	+16.15	20.61	23,70	8,40	+12.21	22.67	24,60	8,80	+13.87
	10.05.2013	19.36	23,70	8,40	+10.96	17.82	23,70	8,40	+9.42	18.94	24,60	8,80	+10.14
	06.06.2013	19.51	23,70	8,40	+11.11	18.68	23,70	8,40	+10.28	19.25	24,60	8,80	+10.45
	16.07.2013	10.27	23,70	8,40	+1.87	11.20	23,70	8,40	+2.80	14.16	24,60	8,80	+5.36
	09.08.2013	7.34	23,70	8,40	-1.06	7.91	23,70	8,40	-0.49	11.31	24,60	8,80	+2.51
	18.09.2012	9.35	23,70	8,40	+0.95	11.47	23,70	8,40	+3.07	14.41	24,60	8,80	+5.61
Location		Interval 50-75 cm				Interval 75-100 cm				Interval 1 00-125 cm			
		U%	CC%	CU%	Difference from CU%	U%	CC%	CU%	Difference from CU%	U%	CC%	CU%	Difference from CU%
Sânandrei (Maize)	18.09.2012	10.06	22,80	7,90	+2.16	15.24	22,80	7,90	+7.34	15.50	22,80	7,90	+7.60
	23.10.2012	14.50	22,80	7,90	+6.60	14.52	22,80	7,90	+6.62	15.79	22,80	7,90	+7.89
	27.12.2012	23.46	22,80	7,90	+15.56	21.27	22,80	7,90	+13.37	19.06	22,80	7,90	+11.16
	13.02.2013	20.78	22,80	7,90	+12.88	20.80	22,80	7,90	+12.90	20.35	22,80	7,90	+12.45
	13.03.2013	20.74	22,80	7,90	+12.84	20.67	22,80	7,90	+12.77	20.29	22,80	7,90	+12.39
	11.04.2013	22.03	22,80	7,90	+14.13	20.58	22,80	7,90	+12.68	19.77	22,80	7,90	+11.87
	10.05.2013	17.84	22,80	7,90	`+9.94	17.49	22,80	7,90	+9.59	18.56	22,80	7,90	+10.66
	06.06.2013	19.60	22,80	7,90	+11.70	18.35	22,80	7,90	+10.45	18.02	22,80	7,90	+10.12
	16.07.2013	14.35	22,80	7,90	+6.45	14.52	22,80	7,90	+6.62	15.08	22,80	7,90	+7.18
	09.08.2013	10.81	22,80	7,90	+2.91	11.75	22,80	7,90	+3.85	12.05	22,80	7,90	+4.15
	18.09.2012	10.06	22,80	7,90	+2.16	15.24	22,80	7,90	+7.34	15.50	22,80	7,90	+7.60

About the yields obtained, they were statistically assured, the climatic conditions have negatively influenced the soil moisture regime, and especially the production obtained, which are lower than the potential of the investigated area (Table 6).

Table 6

Effect of nitrogen and phosphorus fertilizers on maize crop (PR 39D81 hybrid) on a molic-reddish preluvosoil from Sanandrei, in 2011-2012 agricultural year

Variant	Yields kg/ha	Differences kg/ha	%	Semnification
P_0N_0	1977	-	100	-
P_0N_{50}	2483	506	126	***
P_0N_{100}	2685	708	136	***
P_0N_{150}	2845	868	144	***

Average P_0	**2497**	-	**100**	-
$P_{50}N_0$	2033	56	103	-
$P_{50}N_{50}$	2542	565	129	***
$P_{50}N_{100}$	2616	639	132	***
$P_{50}N_{150}$	2922	945	148	***
Average P_{50}	**2528**	**31**	**101**	-
$P_{100}N_0$	2376	399	120	***
$P_{100}N_{50}$	2527	550	128	***
$N_{100}P_{100}$	2642	665	134	***
$P_{100}N_{150}$	2998	1021	152	***
Average P_{100}	**2636**	**138**	**106**	**

		A x B	B x A
DL	5%	180	189
	1%	243	265
	0.1%	323	375

Thus its output was between 1977 and 2998 kg / ha (Table 6). In the control (unfertilized) resulting a production of 1977 kg / ha, the maximum yield was recorded at P100N150 version, ie 2998 kg / ha.

Phosphorus fertilization determined to obtain production increases between 55 and 399 kg / ha, applied alone as nitrogen gave increases of between 506 and 868 kg / ha, very significant.

The application of nitrogen and phosphorus fertilizers provide high increases production, very significantly, between 565 and 1021 kg / ha.

In the 2012-2013 agricultural year, the production was achieved between 2434 and 3395 kg / ha (Table 7). In the control (unfertilized) was obtained a yield of 2434 kg / ha, the maximum yield was recorded at $P_{100}N_{150}$ version, ie 3395 kg / ha.

Phosphorus fertilization determined to obtain production increases between 601 and 816 kg / ha, applied alone as nitrogen gave increases yields, between 201 and 471 kg / ha, very significant.

The application of nitrogen and phosphorus fertilizers provide high increases production, very significantly, between 702 and 961 kg / ha.

Table 7

Effect of nitrogen and phosphorus fertilizers on maize crop (PR 39D81 hybrid) on a molic-reddish preluvosoil from Sanandrei, in 2012-2013 agricultural year

Variant	Yields kg/ha	Differences kg/ha	%	Semnification
P_0N_0	2434	-	100	-
P_0N_{50}	2635	201	108	***
P_0N_{100}	2813	379	116	***
P_0N_{150}	2905	471	119	***
Average P_0	**2697**	-	**100**	-
$P_{50}N_0$	3035	601	125	***
$P_{50}N_{50}$	3136	702	129	***
$P_{50}N_{100}$	3174	740	130	***
$P_{50}N_{150}$	3184	750	131	***
Average P_{50}	**3132**	**435**	**116**	***
$P_{100}N_0$	3250	816	134	***
$P_{100}N_{50}$	3323	889	137	***
$N_{100}P_{100}$	3349	915	138	***
$P_{100}N_{150}$	3395	961	139	***
Average P_{100}	**3329**	**632**	**123**	***

AxB BxA

DL	5%	73	72
	1%	99	100
	0.1%	132	139

CONCLUSIONS

The area where they were located experiences is part of Mures Bega interfluve, part of Mures Plain. Its macroclimatic peculiarities are determined by its geographical position, which is specific to a particular movement lies at the crossroads of air masses, in addition suffering an invasion of warm air masses, from south, crossing the Mediterranean Sea.

Between telurico-edaphic factors and conditions, determined the production capacity of the land, soil conditions are a major component with multiple events both in terms of their characteristics and of the "depositary" of the influence of other environmental factors, recorded at a time in a certain place, they are more stable and easier while recording and studying (even with current equipment, specialized units, less efficient than other branches of the national economy in terms of their ecological efficiency).

Along with the particularity of eco-pedological profile, the hydric resource as environmental factors (of the atmosphere), is found in production levels that were statistically assured in the two years of experimentation.

The paper offers basic knowledge and methodological elements for evaluation and characterization of the natural and anthropogenic resources, in the hope that the information presented will arouse interest of the decision maker so in the near future agricultural research and practice with environmental protection, to strive for development interdisciplinary studies, not being able to talk about a healthy environment without a healthy soil.

BIBLIOGRAPHY

1. BORZA I., ŢARAU D., 2005, Situaţia calităţii solurilor cu privire la aprovizionarea cu fosfor şi potasiu şi măsuri de conservare a acesteia prin sistemul de producţie vegetală durabilă în vestul României, Lcr. Şt. Simp. International CIEC România-Craiova, Ed. Agris Bucureşti, pag. 115-126,
2. CANARACHE A., TEACI D. (1980). Caracterizarea tehnologică a terenurilor agricole ca bază a lucrărilor de raionare ameliorativă, *Buletin Info. ASAS Bucureşti nr. 10*;
3. DICU D., BORZA I.,ŢĂRĂU D., 2010, The influence of chemical fertilization on wheat, corn and soybean production in conventional and consevative tillage , 15th World fertilizer Congress Of the International Scientific Centre for Fertilizers (CIEC), Ed.Acad. Române Bucureşti, pag. 310-319,
4. MUNTEANU I., 2000, Despre unele aspecte privind relaţiile dintre secetă, pedogeneză şi degradarea terenurilor (deşertificare), Ştiinţa solului XXXIV, nr. 2, 127-141,
5. RĂUŢĂ C. **(**1997). Agricultura durabilă în România*, Ştiinţa Solului, Seria a III-a, vol. XXXI, nr. 1*
6. ROGOBETE GH., ŢĂRĂU D.(1997). Solurile şi ameliorarea lor. Harta solurilor Banatului, *Editura Marineasa, Timişoara.*
7. TABĂRĂ V., 2005, Fitotehnie, Ed. Eurobit Timişoara,
8. TABĂRĂ V., PUŞCĂ I., 2001, Agricultura – Obiectiv Strategic Naţional, Agricultura Romaniei nr.l6,