Results Obtained from Maize Production During the Period 2012-2013 in Minimum Tillage, at Ards Turda

Felicia CHEȚAN^{1,2}, Teodor RUSU², Cornel CHEȚAN^{1,2}, Alina ȘIMON^{1,2}, Mircea IGNEA¹

¹Agricultural Research and Development Station, Turda, 27 Agriculturii Street, Cluj County, Romania, Email: felice_fely@yahoo.com

²University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5, Manastur Street, 400372, Romania, Email: trusu@usamvcluj.ro

Bulletin USAMV serie Agriculture 71(1-2)/2014

Print ISSN 1843-5246; Electronic ISSN 1843-5386

DOI: 10.15835/buasvm-agr: 10256

Abstract

Minimum tillage systems on soil chasing the conservation and efficient use of natural resources, biological and water. By surrendering to ploughing with moldboard plow in whole or in part by streamlining periodic tillage and keep at the ground surface of at least 15-30% of all plant debris, protect soil the sheeterosion, it also eliminating at the same time the phenomenon of soil compaction. A proper crop rotation is alternating in culture plants with strong rooting with shallow rooting plants, leguminous plants have favorable effect for the successor cultures, soil nitrogen improvement and contributing to the development of the root system. In research conducted at ARDS Turda on 2012-2013, in the cultivation of maize in the system with minimal compared to classic productions obtained system reflects the fact that maize is still a pretentious plant both climatic conditions and approach towards soil requirements. The influence of the year are very strong for corn production, the differences being of 689 kg/ha in the variant with a seeding and fertilization along with 414 kg/ha in the variant with additional fertilization. By applying minimum tillage system soil aims primarily to combat soil erosion and water retention in the soil so it is so specially important to watch the long term effect of applying them to the environment.

Keywords: *maize, minimum tillage system, climatic condition, yield*

INTRODUCTION

World demand and grain growing, being subject to overload earth it will exhaust resources, accelerating the process of erosion with serious long-term consequences (Brown, 1984). Agricultural technology used by mechanization, chimization, the man and the master component aware of the biological processes taking place in the agroecosystems can use rational these ecological conditions, the development of large production and at the same time ensuring a constant proper preservation of all habitats.

Maintaining a certain ballances in agroecosystem is the foundation of sustainable agriculture through agrotechnics measures and the works required, ensure the adjustment its components, without irreversible ecological consequences (Rusu et al., 2005). The ecological framework on

Transylvania is the existence of the interaction of a large number of factors, two of which manifest a dominant action for agroecosystem; the first is to fund the level or low temperature, and with large temporal variation, the features which require significant restriction for thermophilic plants such as: maize, sunflower, soybean, sorghum and the second is hilly orographics. The interaction of environmental factors in relation to antropogenic land condition influenced with many soil degraded by erosion or temporaly excess of moisture (Rusu et Gus, 2007; Gus et Rusu, 2011) which impose restrictions on the structure of the system, machine and tractor station to ensure the mechanization on the slope.

Large corn-growing countries in Europe in 2012 were: Romania with an area of, 2,722,180 hectares (but second place as total yields obtai-

Fig. 1. The largest surfaces cultivated with maize in Europe, 2012

ned), France from, 1,718,600 hectares (first as total production) and Hungary with 1,190,000 hectares (fig. 1, INS, 2013). The total area of land cultivated with corn from EU States was 9,789,512 hectares and World USA is in first place with a surface of 35,259,790 hectares of maize.

Maize is one of the most important culture crops worldwide, its use is: people food, feedstuff industry in the manufacture of bioethanol (Scurtu, 2001). Corn has high demands of climatic factors and approach towards edaphic, temperature being the limiting factor in the area of culture's expansion throughout the duration of vegetation and requiring monthly average temperatures: 20°C in 16 may, 19-20°C in June, than 21°C -23°C in July, 19-22°C in august and 14-17°C in September, in close conection with the production. Approach towards moisture, corn is pretentious but, due to the coefficient reduced sweating (230-440), a well developed root system and opportunities opening not only to reduce the surface of sweating through the leaf in case of twining leaves, is considered a plant resistance to drought (Muntean et al., 2008; Haș et al., 2010). Of great importance are high rainfall from October to April, and soil water reserve in the magic corectă to entail the establishment of sowing density (Guș et al., 2004).

Part of the conservative, non-conventional systems agriculture, minimum soil tillage system that represents one of the most important elements of technology. Unconventional system,

means giving up plowing with moldboard plow total or periodically, the rationalization of the number of works and keeping the soil surface of at least 15-30% of the total vegetable scraps (Rusu, 2005; Marin et al., 2012; Chețan et al., 2013; Simon et al., 2013). By applying this system aims to reduce soil erosion and compactation, soil and water conservation, protection of plants with non-polluting substances to the environment (Fabrizzi et al., 2005; Moraru et al., 2010; Bucur et al., 2011; Rusu et al., 2014; Ivaș et al., 2013; Malschi et al., 2013).

The conservative soil tillage of the maintenance of the soil must be aimed at in accumulation and keeping of water in the soil. Considering the upcoming plants (Chețan et al., 2013) the degree of weeds, the pedoclimatic factors, these condition are differentiated executed, with chisel since autumn with incorporation plant debris in the firsts 20 cm in the soil (Rusu, 2005; Rusu et al., 2005). The climate changes taking place both locally and globally, require the adoption of new agricultural technologies, suitable to the new climatic conditions (Grecu et al., 2011; Rusu et al., 2014).

Purpose of research is the development an the conservativ system through the experimentation in conventional system and minimum tillage in relation with fertilization and combinations of treatments with fertilisers, fungicides and insecticides.

MATERIALS AND METHODS

The experiment realised in 2012-2013 at ARDS Turda, situated in Transylvania Plain, on a preluvosol with texture sandy loam-clay type, pH-neutral, supply good and very good with mobile phosphorus (more than 4.5% mg P_2O_5 /100 g soil) and potassium (more than 30 mg K_2O /100 g soil), soil in humus content is medium (3.5%). Characteristically this type of soil is the rapid subsidence, when passing with of heavy aggregates on the surface or where tillage is carried out under conditions of high humidity. The experiment realised is an threefactorial experiment, type $A \times B \times C$ -R:2x2x4-3. Experimental plots is a surface of 48 m² (12 m in lenght x 4 m in width).

The experience is being organized by the method of the plots subdivided. Determination of production was achieved through harvesting (manually), weighing the cobs, separating seeds of cobs (manually), calculated per hectare production, followeed by correcting the STAS humidy of 15.5%. In the experience of maize seeding he was realised with, MT 6-Maschio Gaspardo machine, used Turda Star hybrid (midle

early hybrid, the FAO group 300-400, created at ARDS Turda, 2005), seeds treated with insecto-fungicides against deseases and pest (Royal Flo 42 S 3.5 l/ton of seeds). Density of seeding was 65,000 plants/ha and incorporation depth 5 cm.

The experimental factors are: The system of soil work (**A**): 2 graduation: A_1 – conventional method with plowghing – preparation of the soil – seeding + fertilizing; A_2 – minimum tillage: work with chisel. Fertilization (**B**): 2 graduation: B_1 – fertilizing with $N_{40}P_{40}$ at the same with seeding; B_2 - fertilizing with $N_{40}P_{40}$ at the same with seeding + fertilizing with N_{40} in 4 - 6 leaves of maize. Factor (**C**) treatments, include combination with foliar fertilizers, fungicides and insecticides. Application of the treatments are done in two important phenological moments during the growing season: I phenophases 3-5 leaves with foliar fertilizers + insecticide. For weed control, herbicide was applied Esteron (0.8 l per ha + Trend 0.3 l per ha); II phenophases 7-9 leaves, foliar fertilizer + insecticide + fungicide (*table 1*).

The climatic conditions of the experimental period are presented in *table 2* and *table 3* (Turda Weather Station).

Tab. 1. Application of the maize treatments

Variances	Phenophases 3-5 leaves	Phenophases 7-9 leaves
C_1	IF+IS	IF+IS
C_2	IS	IF
C_3	IS+IF	IF
C_4	IF	-

Legend: IF - foliar fertilizer, IS - insecticide, FG - fungicide.

Tab. 2. Thermic regime for period 2012-2013, ARDS Turda

Years	Temperatures registred, °C											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2012	-2.3	-6.1	4.7	11.8	16.2	21.0	24.0	22.3	19.1	11.4	5.2	-2.6
2013	-2.4	2.0	3.5	12.3	16.8	19.4	20.9	22.1	13.8	11.2	7.1	-1.7
Average from 55 years	-3.5	-0.9	4.1	9.8	14.7	17.7	19.6	19.2	14.9	9.6	3.7	-1.5

Tab. 3. Pluviometric regime for period 2012-2013, ARDS Turda

Years	Precipitation registred, mm											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2012	26.2	30.7	5.3	78.4	89.2	67.4	52.4	28.0	30.2	42.0	9.6	45.0
2013	19.8	10.3	57.9	53.3	79.3	86.2	37.6	44.0	57.8	67.8	5.9	3.3
Average from 55 years	21.3	18.6	23.1	44.7	67.7	84.5	76.7	55.9	40.3	32.0	28.7	26.9

RESULTS AND DISCUSSIONS

Maize production, is influenced by the system tillage, influences induced by it in the culture protection, but also under the influence of climatic factors, in specially temperature and precipitation. Environmental conditions characteristic of the Transylvanian Plain, will result in a favourable microclimate, frequent manifestation of disease especially *Fusarium root* (caused by the fungus of the genus *Fusarium*) stem and cob that may diminish the harvest by up to 50% and pitch (*Ustilago maydis*) requiring mandatory treatment with the fungicide seed used in the experiment (e.g. Royal Flo 42 S, 3 l/t seed).

Corn is attacked by numerous pests of seedlings from sprays against pests and until after 8 leaf sprays against pests (*Agriotes spp.*, *Autographa spp.*, *Ostrinia nubilalis*, *Phyllotreta Diabrotica virgifera virgifera* etc) that's why seed should be treated with insecticide plus fungicide treatments on vegetation. Weeds present frequently in culture, in the area, *Echinochloa crus-galli*, *Setaria spp.*, monocotyledonous annual; *Agropyron repens*, monocotyledonous perennial; *Xanthium strumarium*, *Amaranthus sp.*, *Atriplex*, *Chenopodium album* ap *Galeopsis tetrahit*, *Hibiscus trionum*, *Polygonum convolvulus*, *Sonchus oleraceus*, *Raphanus raphanistrum*, dicotyledonous plants, annuals; *Convolvulus arvensis*, *Cirsium arvense*,

Lathyrus tuberosus, *Lepidium draba*, *Rubus caesius*, *Symphitum officinale*, a perennial dicotyledonous plants.

At the cultural hygiene corn contributes directly a rotation crops, work the soil (soil preparation for sowing), fertilization, sowing, crop-weed maintenance, disease, pests. Choosing the right hybrid that take full advantage of the potential of soil and climatic factors along with compliance with all technological chain, represents the basic element to produce a healthy and high production. Periodical review of the evolution of climatic factors is fully justified, especially in the current context, when numerous information from literature draws attention to changes on the local level, global warming.

Maize has demonstrated, since the first year of the application of conservative system that needs a piece of soil aeration. That is why it calls each year to a slaughter of the experimental plots where they are planting corn. Slaughter was realised at 30 cm depth for the maintenance of plant debris from the surface of the soil. This cannot be considered a departure from conservative farming but an adaptation to the conditions of the soil with clay and 46% with trends of consolidation.

Maize yields recorded in those two years are the cultivation of conventional system with

Tab. 4. The production obtained at maize to the system tillage, ARDS Turda, 2012

The variant	The average weight cobs/plot, kg	The average weight grains at 5 kg cobs	The average humidity of the grain harvested	Average yields kg/ha, 15.5 U %
A ₁ B ₁ C ₁	17215	4206	18.0	4687
A ₁ B ₁ C ₂	16084	4163	17.7	4348
A ₁ B ₁ C ₃	16669	4202	18.5	4507
A ₁ B ₁ C ₄	15993	4263	18.5	4386
A ₁ B ₂ C ₁	18926	4208	17.2	5203
A ₁ B ₂ C ₂	16709	4207	18.1	4538
A ₁ B ₂ C ₃	15718	4161	18.2	4220
A ₁ B ₂ C ₄	16917	4213	18.7	4570
A ₁ B ₃ C ₂	15000	4237	18.0	4112
A ₂ B ₁ C ₂	14585	4247	17.7	4021
A ₂ B ₁ C ₃	16701	4247	18.5	4563
A ₂ B ₁ C ₄	14116	4219	18.5	3831
A ₂ B ² C ₁	14963	4225	17.2	4131
A ₂ B ₂ C ₂	14391	4219	18.1	3919
A ₂ B ₂ C ₃	15150	4213	18.2	4116
A ₂ B ₂ C ₄	15289	4165	18.7	4084

ploughing system compared to the minimum work with chisel plough, have demonstrated once again that year (climatic conditions of temperature and precipitation) makes the harvest. Thus in the year 2012 (*table 4*) characterized as a dry year, prolonged drought from June to August have had a negative effect on the crop. In the 3 leaf phenophases, when the root of maize has already recorded a rapid growth and capacity of absorption of nutrients and water, additional fertilization is very important, an addition of nutrients.

However, due to low soil moisture, nitrogen fertilizers applied were decomposed more slowly was absorbed later. In the year 2013 (*table 5*) precipitation in the months of April-May-June (53.3-79.3-86.2 mm value) compared to the average over the past 55 years in those months

(44.7-67.7-84.5 mm value) resulted in higher production compared to the previous year, differences in both systems work. However corn grown in conventional system achieved higher yields from the minimum system with chisel plough in those two years, differences between 352-689 kg/ha in the variant with a single fertilization (to sow) and 414-572 kg/ha in the version with basic fertilization (the seeding) additional fertilization in 3-5 leaf swsprays against pests of maize.

The treatments on vegetation, tilling, fertilizing, taken alone does not ensure significant production increases without insurance statistics (*table 6*). But this has been found not to waive treatments that ensure the protection of culture. Instead, however, the year in complex with other factors influencing production (*table 7*). Higher

Tab. 5. The average production obtained at corn according to the system tillage, ARDS Turda, 2013

The variant	The average weight cobs/plot, kg	The average weight grains at 5 kg cobs	The average humidity of the grain harvested	Average yields kg/ha, 15.5 U %
A ₁ B ₁ C ₁	20930	4056	19.9	5365
A ₁ B ₁ C ₂	20520	4021	19.4	5248
A ₁ B ₁ C ₃	20229	4069	18.7	5278
A ₁ B ₁ C ₄	20576	4104	19.3	5377
A ₁ B ₂ C ₁	20164	4082	18.8	5273
A ₁ B ₂ C ₂	19792	4017	18.7	5099
A ₁ B ₂ C ₃	18322	4053	18.6	4773
A ₁ B ₂ C ₄	18899	4080	19.0	4930
A ₁ B ₁ C ₂	18543	4023	24.3	4456
A ₂ B ₁ C ₂	19816	3992	24.3	4726
A ₂ B ₁ C ₃	19498	3984	23.7	4675
A ₂ B ₁ C ₄	19677	4001	25.1	4656
A ₂ B ² C ₁	19012	4017	24.3	4562
A ₂ B ₂ C ₂	19994	4019	24.6	4784
A ₂ B ₂ C ₃	19666	4003	25.2	4644
A ₂ B ₂ C ₄	18370	4045	24.5	4429

Tab. 6. Maize yields recorded in the two systems work, studied, during the period 2012-2013

The variant	Yield, kg/ha	
	2012	2013
A ₁ B ₁	4484	5317
A ₂ B ₁	4132	4628
Differences	352	689
A ₁ B ₂	4633	5019
A ₂ B ₂	4063	4605
Differences	570	414

Tab. 7. Influence of technological factors on the production of maize, ARDS Turda, 2012-2013

The factor	System of soil work		Treatments		Agrofond		Year	
Value	SC	4131 ^{Mt}	T3 ^{Mt}	4117	A ₁ ^{Mt}	4127	D ₁ ^{Mt}	4212
	MT	4116	T1	4132	A ₂	4121	D ₂	4035
			T2	4111				
			T4	4136				
Differences	MT	-16	T1	15	A ₂	-7	D ₂	-177
			T2	-6				
			T4	20				
Semnification	MT	-	T1	-	A ₂	-	D ₂	000
			T2	-				
			T4	-				
DL	5%	46		27		15		22
	1%	106		38		20		30
	0.1%	338		54		28		40

Legend: A-soil work system: A1-classic with ploughing, minimum tillage option A2-chisel plough; B-agrofond: B1 fertilization with NPK (20: 20: 0) 200 kg\ha s.a. together with sowing, fertilization with NPK B2 (20: 20: 0) 200 kg\ha sowing simultaneously with fertilization s.a. additional N40 in sprays against pests 3-5 leaves of corn plants. C-treatments: C1- IF +IS: (Polyfeed + Calypso) in sprays against pests 3-5 leaves of maize plus one therapy with IF +IS (Polyfeed + Calypso) sprays against pests in 7-9 leaves; C2- IS (Calypso) in 3-5 leaf sprays against pests + IF the sprays against pests and 7-9 leaf; C3- IF+IS (Polyfeed+ Calypso) in 3-5 leaves sprays against pests and IF (Polyfeed) in sprays against pests and 7-9 leaves; C4- IF (Polyfeed) in 3-5 leaves sprays against pests.

Tab. 8. The influence of interaction between tillage system x on maize yield capacity, ARDS Turda, 2012 - 2013

Year	Tillage system	Fertilization	Yield, kg/ha	Yield %	Differences, ± kg/ha	Semnification
2012	Classic	B ₁ (one fertilizing)	4209	100.0	0	Mt.
2013	Classic	B ₁ (one fertilizing)	4063	96.5	-146	000
2012	Classic	B ₂ (two fertilizing)	4197	100.0	0	Mt.
2013	Classic	B ₂ (two fertilizing)	4058	96.7	-139	000
2012	Minimum tillage	B ₁ (one fertilizing)	4237	100.0	0	Mt.
2013	Minimum tillage	B ₁ (one fertilizing)	4000	94.4	-237	000
2012	Minimum tillage	B ₂ (two fertilizing)	4206	100.0	0	Mt.
2013	Minimum tillage	B ₂ (two fertilizing)	4021	95.6	-185	000

DL 5% = 45 kg/ha; DL 1% = 60 kg/ha; DL 0.1% = 80 kg/ha.

production values are obtained in the richer in precipitation that provide fertilizer applied in solubilizing the early stages of vegetation, therefore production increases were relatively small in both 2012 and 2013 (*table 8*), the differences being between 45-80 kg/ha.

CONCLUSION

Corn production in 2012 is greater in the classic work of the soil (regarded as) with 352

kg/ha in the variant with a single fertilization (simultaneously with the sowing) and 570 kg/ha in two variant derived from the output in the system with the minimum of ground works (the chisel plough).

The influence of the years are very strong, for the production of corn, has led to the overcoming of the classical minimum system with differences being recorded productions of 689 kg/ha (variant

with a fertilization) and 414 kg/ha (two derived). In the two years taken into study, due to prolonged drought, climatic factors correlated with high temperatures of hybrid corn could not achieve production parameters in normal years of climatic point of view, are superior to the last few years.

The research results reveal that corn is snobbish towards the work of the soil, from soil type, climatic conditions, production results confirming this.

The production results obtained in the two systems work the soil have close values, but it should be borne in mind that by applying minimum tillage systems on soil chasing the fight against soil erosion and retention of water in the soil.

After a number of years (theoretically 10 years), when conservative system settled, we will be able to verify the theory of restoration of natural fertility of soil, humus content and increase biodiversity, recovery of microbial life of the soil.

Acknowledgments: This paper was published under the frame of European Social Fund, Human Resources Development Operational Programme 2007-2013, project no. POSDRU/159/1.5/S/132765.

REFERENCES

- Brown, L., R., 1988, Probleme globale ale omenirii, pag:158, Ed. Tehnică, Oradea.
- Bucur, D., G. Jitareanu, C. Ailincăi, 2011, Effects of long-term soil and crop management on the yield and on the fertility of eroded soil. Journal of Food, Agriculture & Environment Vol.9 (2): 207 - 209.
- Chețan, F., Deac, V., Șimon, A., Chețan, C., 2013, The influence of Tillage System on production and quality of soybean yield at Agricultural Research-Development Station Turda. The 7th International Symposium, „Soil Minimum Tillage Systems” vol.6 .No.14: 362, Ed.Bioflux, Cluj - Napoca.
- Chețan, F., Chețan, C., Deac, V., Șimon, A., Ignea, M., 2013, The cultivation of soybean in Agricultural Conservative System and its role in protection of the environment. The 12th International Symposium Prospects for the 3rd Millennium agriculture.
- Fabrizzi, K.P., F.O. Garcia, J.L. Costa, L.I. Picone, 2005, Soil water dynamics, physical properties and corn and wheat responses to minimum and no-tillage systems in the southern Pampas of Argentina. Soil & Tillage Research 81: 57 - 69.
- Grecu, C., Ignea, M., Copândeian, A., 2011, Evoluția regimului termic și pluviometric la Turda în perioada 1957 - 2010. Agricultura Transilvană, Buletin informativ, martie, nr. 14. Ed.Ela Design SRL, Turda.
- Guș, P., S. Cernea, T. Rusu, I. Bogdan, 2004, Sisteme de semănat, fertilizat și întreținere a culturilor. Editura Risoprint, Cluj-Napoca, p. 52.
- Guș, P., Rusu, T., 2011. Unconventional soil tillage systems, agrotechnical and economical alternative for durable agriculture. The 6th International Symposium, „Soil Minimum Tillage Systems”, p: 11-21. Ed. Risoprint, Cluj-Napoca.
- Haș, V., Haș, I., Antohola, I., Copândeian, A., Nagy, E., 2010, Variabilitatea capacității de producție și calității boabelor la hibridii de porumb din diferite grupe de maturitate FAO. Anale INDCA Fundulea, vol. XXVIII, pag: 38 - 47.
- Ivaș Adina, Felicia Mureșanu, Voichița Haș, 2013, The Evolution of the most important pest species of maize crops in different soil tillage systems at ARDS Turda. In The 7th International Symposium „Soil Minimum Tillage Systems” Cluj-Napoca, 2 - 3 May 2013, p. 144 - 150.
- Malschi, D., Ivas, A. D., Ignea, M., Chetan, F., Chețan C. „Adequate Integrated Control of Wheat Pest in No - tillage Conservative System”. The 7th International Symposium „Soil Minimum Tillage Systems” Cluj-Napoca, 2 - 3 May 2013.
- Marin, D. I., T. Rusu, M. Mihalache, L. Ilie, C. Bolohan, 2012, Research on the influence of soil tillage system upon pea crop and some properties of reddish preluvo soil in the Moara Domneasca area. Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series, Vol. 42, No 2: 487 - 490.
- Moraru, P. I., T. Rusu, M. L. Sopterean, 2010, Soil Tillage Conservaton and its Effect on Erosion Control, Water Management and Carbon Sequestration. In ProEnvironment/ProMediu no. 3.
- Moraru, P. I., T. Rusu, 2010, Soil tillage conservation and its effect on soil organic matter, water management and carbon sequestration. Journal of Food, Agriculture & Environment, 8 (3 - 4), 309 - 312.
- Muntean, L., S., Cernea, S., Morar, G., Duda, M., Vârban, D., Muntean, S., 2008, *Fitotehnie*, Editura Academic Pres, Cluj - Napoca.
- Rusu, T., P. I. Moraru, C. L. Coste, H. Căcovean, F. Chețan, C. Chețan, 2014, Impact of climate change on climatic indicators in Transylvanian Plain, Romania. Journal of Food, Agriculture & Environment Vol. 12 (1): 469 - 473.
- Rusu, T., Guș, P., 2007, Soil Compaction, Processes and consequences, pag: 24 - 24, Ed. Risoprint, Cluj - Napoca.
- Rusu, T., Imre, A., Bodiș, A., 2005, Metode și tehnici de producție în agricultura ecologică, Ed. Risoprint, Cluj - Napoca.
- Rusu, T., 2005, Agrotehnica, pag: 221- 222; 414. Ed. Risoprint Cluj-Napoca.
- Scurtu I., 2001, Economia și tehnologia culturilor agricole, pag: 231-232-236. Ed. Independența economică, Pitești.
- Șimon A, Chețan C, Chețan F, Deac V, Ignea M, The 12th International Symposium „ Prospects for the 3rd millenium agriculture”, The influence of different densities on production of maize hybrids cultivated in the conservative agricultural system”, Cluj-Napoca, 26 - 28 septembrie 2013.
- FAOSTAT | © FAO Statistics Division 2014 | 27 May 2014.