INFLUENCE OF FERTILIZERS AND GROWTH REGULATORS ON YIELD AND NUTRIENTS CONTENT IN ONION (*ALLIUM CEPA L)* CULTURE FROM THE WEST SIDE OF ROMANIA

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Abstract. *Onion (Allium cepa L.) is an important food product in our daily diet and is a source of nutrients for human body. The purpose of this research was to determine the influence of different doses of fertilizers and growth regulators on macro and micronutrients accumulation and yield of onion culture, during three experimental years, 2011-2013. Field trials were conducted during 2011-2013, on a black Chernozem soil, the experiment was laid out in Randomized Complete Block Design with four replications. The nutrients analysis were carried out using AAS in the Laboratory of Soil Science and Plant Nutrition, Faculty of Agriculture, Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara. Most of studied nutrients in onion samples were significantly influenced by the sole application of NPK fertilizers rates and growth regulators (Aqzyme and Pervaide). Copper (Cu) content reveals a deficiency compared to the normal level, in all variants during the three experimental years. Results demonstrated that nutrients content varied considerably depending on the fertilization doses and climatic conditions. Among the three experimental years were significant differences in mineral content of onion culture, being registered higher values in 2011 both for macronutrients (P,K and Mg) and for micronutrients (Fe, Cu, Zn and Mn).*

Keywords: *onion, fertilizers, macronutrients, micronutrients, yields.*

INTRODUCTION

Onion (*Allium cepa L.*) is a species of greatest economic importance of the *Allium genus*. The main cultivation objects are the bulbs, which are widely used mostly for seasoning, although leaves are also of economic interest. Onion food value is given by the carbohydrate content (7-11%); protides (1.2 to 1.9%), vitamin C (8-16 mg/100 g). Onion is an integral part of our daily diet and its use is very common in almost all food preparations (*HOSSAIN AND ISLAM 1994*). It is also used as preservative and medicine (*YOLDAS et al. 2011*). Micro and macro components have essential and complex specific role in plant metabolism, have direct action, are involved in enzyme activity, serve as a cofactor in many enzyme compositions, influence the photosynthesis, transfer, transport and storage of substances, water consumption. Their insufficiency prevents fulfillment of plants life cycle (*ARGESANU 2010*). Fertilization is the most important and controllable factor affecting nutritional value of vegetables. The type and value of fertilizer and the level of application directly influence the level of plant available nutrients and indirectly influence plant physiology and nutrient content (*GRIEPENTROG AND PORTER 2002*). Plants require a variety of elements for growth and development of which N, P, and K are the most important of the essential nutrients to plants because they are required in large quantities (*ALEXA 2008*). The deficiency of these elements is manifested in the detrimental effects on the growth, development and yield of the plants (*TUDORANCEA 2008*). Phosphorus has major role in germination and emergence, promotes early root formation and growth and improves the quality of vegetables. Phosphorus is an adenosine triphosphate component which supplies the energy for plant processes (*RABINOWITCH and BREWSTER 1990*). Magnesium is vital in chlorophyll and it has important role in carbohydrate synthesis.

Magnesium stimulates ribosome accumulation during protein synthesis and ATP production (*SAMUEL et al. 2008*). The Zinc is one of the essential micronutrients require for optimum crop growth and deficiency of Zn, cause varies adverse effect on growth and yield of crops. Zinc in involved in formation of Chlorophyll and carbohydrate (*SINGH et al. 2010*). Iron is an essential component of various proteins and pigments in plants. Redox cycling between the ferric and ferrous forms of iron cans also catalyzes the production of dangerous free radicals and iron homeostasis is therefore tightly regulated (*GREENSHIELDS et al. 2007*). Manganese (Mn) is an essential micronutrient in most organisms. In plants, it participates in the structure of photosynthetic proteins and enzymes (*MILLALEO et al. 2010*). Its deficit is dangerous for chloroplasts because it affects the water-splitting system of photosystem II (PSII), which provides the necessary electrons for photosynthesis (*BUCHANAN et al. 2000*).

The purpose of this research was to determine the influence of different doses of fertilizers and growth regulators on macro and micronutrients accumulation and yield of onion (*Allium cepa L.*) culture during 2011-2013**.**

MATERIALS AND METHODS

Field trials were conducted during 2011-2013, on a black Chernozem soil, in Becicherecu mic city, Timis County, Romania. The experiment was laid out in Randomized Complete Block Design with four replications, was prepared in 28 beds of 1 x 1 m^2 each in size with a buffer zone of 0.5 m between all plots. The trial consisted in 7 treatment combinations: v_1-N0P0K0, v_2-N60P45K45, v_3-N90P60K60, v_4-N120P60K60, v_5-N60P60K60 + Aqzyme 1 l/ha, v_6-N60P60K60 + 2 x Pervaide 1 l/ha, v_7-Manure 20 t/ha. The fertilizers used were NPK complex type 16:16:16, and a supplement of NH_4NO_3. *De Stuttgart* variety was used as onion test crop. Aqzyme and Pervaide growth regulators are ideally suited to supply the micronutrients in a balanced way for better vegetable growth and yield. Aqzyme is a liquid micronutrient fertilizer which contains Fungi enzymes (99%), Copper (0.05%), and Iron (0.10%), Manganese (0.05%), Zinc (0.05 %) (http://agconcepts.com/products/agzyme/). Pervaide is a uniquely formulated high grade non-ionic soil penetrant with added enzymes and a bio-stimulant. It is designed to decrease the surface tension between water and soil while improving the growth and activity of micro-organisms necessary for a healthy soil environment (http://agconcepts.com/products/pervaide/).

The soil supply with soil nutrients was proper, for phosphorus (P) was registered 121 mg/kg, the range for vegetables grown in the field, is 108.1 – 144.0 mg/kg according to studies of literature (*MOIGRADEAN et al. 2007*). The copper (Cu) concentration in soil samples from the experimental trial was 0.25 mg/kg, lower than 0.5 mg/kg mentioned in literature studies as a medium Cu content in soil for proper development of vegetables, also same studies indicate the average content of Zn in soil between 1.5 - 3.0 mg/kg. Zn content determined in the experimental field was 1.9 mg/kg, the soil being medium supplied with Zn (*NEGREA et al. 2012*).

The onions were sampled from the experimental field to complete maturity of plant and 3 g of each onion sample was burned in mini muffle furnace (LE2/11 Nabertherm) to a temperature of 600°C during 8h. The ash was dissolved in HCl 20 % in a volumetric flask brought to 20 ml. The macronutrients (K, P, Mg) and micronutrients (Fe, Cu, Zn and Mn) determination were carried out using AAS in the *Laboratory of Soil Science and Plant Nutrition*, Faculty of Agriculture, USAMVB Timisoara. The AAS (Varian 220 FAA equipment) was calibrated for all the nutrients by running different concentrations of standard solutions.

The detection limits for Cu, Zn, Fe and Mn were 0.02 mg/L, 0.005 mg/L, 0.06 mg/L and 0.02 mg/L, respectively. For macronutrients K, P and Mg were 0.03 mg/L, 0.01 mg/L and 0.02 mg/L respectively. WHO/FAO Guidelines for metals concentration in vegetables established for Cu and Zn are 73.3 mg/kg and 99.40 mg/kg respectively.

All chemicals and solvents used in this study were of analytical grades. The samples were analyzed fresh and each value is the average of three (n=3) independent determinations.

Order no. 640 of 19/09/2001 regarding security and quality conditions of fresh vegetables and fruits for human consumption established maximum admitted limit of heavy metals in fresh vegetables, which are *Cu 5 mg/kg*, *Zn 15 mg/kg*. For Mn and Fe were not established maximum allowable limits but literature studies highlighted values between *3-5 mg/kg for manganese* and *5 mg/kg* for iron (*ARGESANU 2010; BANU et al. 2007; GHERGHI et al. 2001*).

The experimental year 2011 was characterized by a high monthly temperature, higher than multiannual average and low rainfall that leaded to drought, the monthly average of rainfall in 2011 was 390 mm, much lower than multiannual average of 631 mm.
(http://www.asas.ro/wcmqs/sectii/stiinta-solului/documente/ZMM%20ASAS%20FINAL.pdf)
In 2012, was reported in the Banat region an optimal rainfall of 201-277 l / square m, which ensures the water needs of crops, the monthly average for 2012 being 611 mm, close to multianual average of 631 mm (http://www.indal.bioresurse.ro/docs/et2/raport2.pdf).

Periods of heavy rainfall in short time sequences generating quick flash floods and flooding were reported in spring and fall 2013. In 2012 and 2013 there were small oscillations of the mean annual temperature, easy excess from the annual average of 10.85 ° C. The year 2011 was extremely hot, especially in the first half the annual average temperature value being 12.17 ºC.
(http://www.asas.ro/wcmqs/sectii/stiinta-solului/documente/ZMM%20ASAS%20FINAL.pdf).

Data obtained regarding macro and micronutrients were statistically analyzed (SD and Cv %) by OriginPro 8.1 SR 1 software for Microsoft Windows. Data regarding yield of onion were analyzed using analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

The results obtained regarding the macronutrients (K, P and Mg) are presented in figures 1-3 and micronutrients (Fe, Cu, Zn, Mn) level in onion samples from experimental field, during 2011-2013, are presented in tables 1-3.

The macroelements (K, Ca, Mg) are indispensable for plant methabolism, participating in the aminoacid and proteine synthesis (*ALEXA E., 2008)*.

In 2011 were registered high amounts of K, in all experimental variants, ranging between 1757.3 mg/kg (v7) - 2822.24 mg/kg (v4), than control variant (v1- 1147.58 mg/kg). NPK fertilization did influenced significant changes in potassium (mg/kg) content in onion samples, especially in variants with high K dose of 60 kg/ha (v3 – 1634.53 mg/kg and v4 – 1710.15 mg/kg) (figure 1). In 2012 were registered lower values of K in all variants, these framing between 1011.05 mg/kg (v1) – 2351.84 (v4) and even lower in 2013, variation limits being 860.43 mg/kg (v1) – 1916.61 mg/kg (v6) (figure 1).

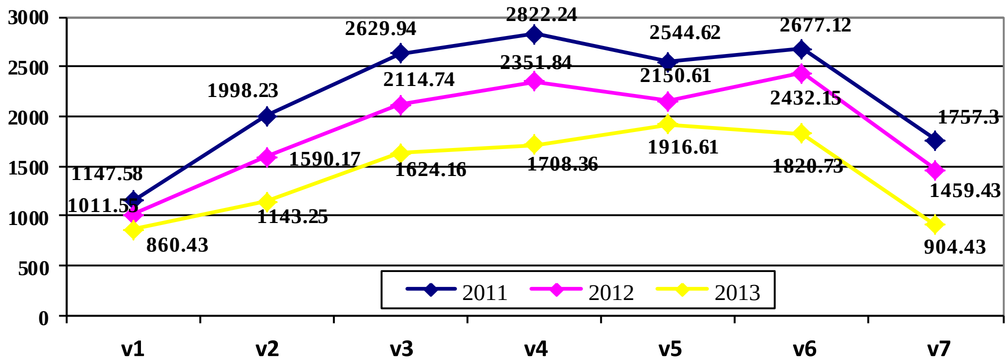

Figure 1. Potassium (mg/kg) content in onion samples during 2011-2013 (n=3)

Potassium is a key nutrient in the plants tolerance to stresses such as cold/hot temperatures, drought. Potassium acts as catalysts for many of the enzymatic processes in the plant that are necessary for plant growth to take place. Another key role of potassium is the regulation of water use in the plant (*MCAFEE 2008*). In 2011 were registered higher amounts of K, in all experimental variants, ranging between 1757.3 mg/kg (v7) - 2822.24 mg/kg (v4), than control variant (v1- 1147.58 mg/kg). NPK fertilization did influenced significant changes in potassium (mg/kg) content in onion samples, especially in variants with high K dose of 60 kg/ha (v3 – 1634.53 mg/kg and v4 – 1710.15 mg/kg) (figure 1). In 2012, were registered lower values of K, than in 2011, in all variants, these framing between 1011.05 mg/kg (v1) – 2351.84 (v4) even lower in 2013, variation limits being 860.43 mg/kg (v1) – 1916.61 mg/kg (v6) (figure 1), being correlated with climatic conditions of experimental years, high values of K (mg/kg) in 2011 characterized by drought and high annual average temperature. Similar values were reported by *RESENDE G.M. and COSTA, N. D. in 2014.*

In experimental variant v7 fertilized with manure 20 t/ha have been registered values lower than in the case of variants with NPK and growth regulators application. The recorded concentrations were 1757.3 mg/kg (2011), 1459.43 mg/kg (2012) and 904.43 mg/kg (2013) (figure 1). These results are in agreement with studies made by *YOLDAS et al. 2012*, who reported that the decrease in the elements content of bulbs by applying manure would be due to the element which causes enlargement of bulb, and increasing yield consequently reduces the unit amount of these elements (dilution effect).

The phosphorus (mg/kg) content in onion samples from experimental variants of culture, studied during 2011-2013, in experimental field, is shown in figure 2.

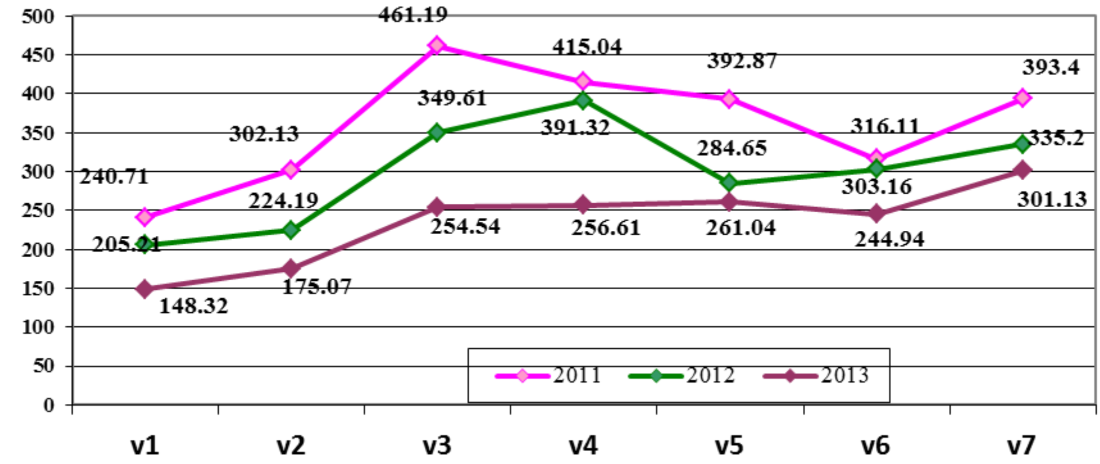

Figure 2. Phosphorus (mg/kg) content in onion samples in 2011-2013 (n=3)

The phosphorus levels registered in 2011, widely range from 240.71(v1) - 461.19 (v3) mg/kg, in 2012, the K values frame between 205.21 mg/kg (v1) – 391.11 mg/kg (v4) and in 2013 the phosphorus content was between 148.32 mg/kg (v1) – 301.12 mg/kg (v7) (figure 2). In all of three years of research the P (mg/kg) content in onion samples increased in variants with higher mineral fertilizers doses. In agreement with the current finding, *TEKALIGN in 2012* reported that the quality of onion can be affected by mineral nutrition and particularly, phosphorus content in bulbs increases once with the increase of NPK fertilizer doses.

Like K and P content, in all experimental variants the Mg (mg/kg) concentration was higher in 2011 the values ranging between 38.38 mg/kg (v1) – 80.37 mg/kg (v4) (figure 3). At highest nitrogen rate, associated with large potassium dose, variant v4 $N_{120}P_{60}K_{60}$, magnesium content in onion samples was ranged between 80.37 mg/kg (2011) to 66.05 mg/kg (2012) and 48.21 mg/kg (2013), being correlated with climatic conditions drought and high temperatures in 2011 and normal air temperature in 2012 and 2013 close to the normal climatologically conditions for west of the Romania.

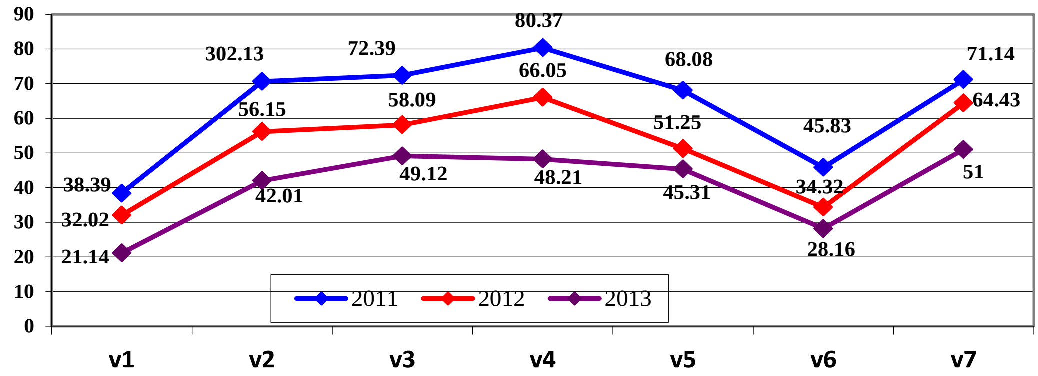

Figure 3. Magnesium (mg/kg) content in onion samples in 2011-2013 (n=3)

The content and absorption of Mg in vegetables are influenced by the antagonist interaction that occurs between magnesium and other nutrients. Application of high potassium rates and growth regulator *Pervaide* diminishes the magnesium content in onion samples in variant v6, the concentration recorded the following values: 45.83 mg/kg (2011), 34.32 mg/kg (2012) and 28.16 mg/kg (2013). The results regarding K, P and Mg concentration, in onion culture, are in accordance with researches made by *COOLONG et al. 2004*, which stated that in onion bulbs the three macronutrients content mentioned before was increased by NPK application.

Therefore is needed to make a gradual fertilization especially of those with high leaching rate, such as nitrogen fertilizers. Products slow leaching rate such as of phosphorus fertilizer can be applied once with basic preparation of seedbed (*ISLAM et al. 2007*).

The results regarding the micronutrients (Fe, Cu, Zn and Mn) level in onion samples from experimental field, during 2011-2013, are presented in tables 1-3.

Table 1.

Microelements level in onion samples studied in 2011

Experimental variants	**Fe mg/kg**	**Cu mg/kg**	**Zn mg/kg**	**Mn mg/kg**
v_1 - $N_0P_0K_0$	2.87±0.464	0.819±0.106	5.20±*0.691*	1.17±*1.351*
v_2 – N60P45K45	3.95±0.12	1.035±0.065	6.17±*0.225*	2.72±*0.692*
v_3 – N90P60K60	3.25±0.137	0.119±0.034	6.58±*0.859*	2.83±*0.38*
v_4 – N120P60K60	3.13±0.372	0.218±0.024	6.25±*0.994*	2.47±*0.447*
v_5-$N_{60}P_{60}K_{60}$ + Aqzyme 1 l/ha	**6.62**±0.87	1.558±0.191	**8.98**±*1.127*	**3.79**±*0.736*
v_6-$N_{60}P_{60}K_{60}$ + 2 x Pervaide 1 l/ha	4.43±0.399	**1.732**±0.133	1.59±*1.284*	1.63±*1.238*
v_7 – Manure 20 t/ha	4.88±0.353	0.925±0.117	0.85±*0.769*	1.23±*1.065*
Cv %	*0.314*	*0.659*	*0.567*	*0.437*

**Results are given as average ± standard deviation (n = 3); Cv%= coefficient of variation for average*

Table 2.

Microelements level in onion samples studied in 2012

Experimental variants	**Fe mg/kg**	**Cu mg/kg**	**Zn mg/kg**	**Mn mg/kg**
v_1 - $N_0P_0K_0$	2.59±*0.236*	0.685±*0.151*	1.99±*0.205*	0.87±*0.267*
v_2 – N60P45K45	3.70±*0.131*	0.799±*0.046*	2.88±*0.405*	2.44±*0.416*
v_3– N90P60K60	4.44±*0.215*	0.612±*0.111*	2.57±*0.18*	2.68±*0.379*
v_4– N120P60K60	4.81±*0.404*	1.072±*0.089*	2.93±*0.322*	2.26±*0.408*
v_5-$N_{60}P_{60}K_{60}$ + Aqzyme 1 l/ha	**5.65**±0.277	**1.132**±*0.098*	**7.51**±*0.382*	**3.68**±*0.389*
v_6-$N_{60}P_{60}K_{60}$ + 2 x Pervaide 1 l/ha	4.19±*0.131*	1.032±*0.140*	3.14±*0.365*	1.54±*0.253*
v_7– Manure 20 t/ha	4.20±*0.423*	0.812±*0.102*	3.01±*0.255*	1.05±*0.216*
Cv%	*0.224*	*0.229*	*0.535*	*0.478*

**Results are given as average ± standard deviation (n = 3); Cv%= coefficient of variation for average*

Table 3.

Microelements level in onion samples studied in 2013

Experimental variants	**Fe mg/kg**	**Cu mg/kg**	**Zn mg/kg**	**Mn mg/kg**
v_1 - $N_0P_0K_0$	2.45±*0.385*	0.608±*0.928*	1.79±*0.327*	0.69±*0.953*
v_2 – N60P45K45	3.12±*0.792*	0.715±*0.639*	2.41±*0.982*	2.13±*0.165*
v_3 – N90P60K60	4.19±*0.847*	0.595±*0.468*	2.79±*1.127*	2.33±*0.872*
v_4– N120P60K60	4.24±*0.973*	0.799±0.*755*	2.09±*0.846*	2.09±*0.136*

v_5-$N_{60}P_{60}K_{60}$ + Aqzyme 1 l/ha	**5.31**±*1.124*	1.002±*0.553*	**6.49**±*0.982*	**3.24**±*0.884*
v_6-$N_{60}P_{60}K_{60}$ + 2 x Pervaide 1 l/ha	4.15±*0.328*	**1.052**±*0.872*	2.69±*0.391*	1.25±*0.292*
v_7– Manure 20 t/ha	4.03±0.456	0.795±*1.061*	2.92±*0.782*	1.00±*0.671*
Cv%	*0.231*	*0.223*	*0.522*	*0.487*

**Results are given as average ± standard deviation (n = 3); Cv%= coefficient of variation for average*

Micronutrients level registered in all experimental variants in 2011, are framing in the variation limits cited in literature studies for each element analyzed (*GARBAN 2004; GHERGHI et al. 2001)*. Iron registered values in the range of 2.87 mg/kg (v1) – 6.62 mg/kg (v5), framing in the level of literature studies. Regarding Zn content was set out a maximum admitted limit in fresh vegetables of 15 mg/kg. In 2011 the variation limits were 0.85 mg/kg (v7 – manure 20 t/ha) to 8.98 mg/kg (v5 - $N_{60}P_{60}K_{60}$ + Aqzyme 1 l/ha). Higher value registered in v5 variant is due to Aqyzme growth regulator which contains Zn in a proportion of 0.05 %.

WHO/FAO in 1989 established maximum level of 73.3 mg/kg for cooper but Romanian Government set out a maximal level of 5 mg/kg throughout by Order no. 640 of 19/09/2001 regarding security and quality conditions of fresh vegetables and fruits for human consumption. In the onion samples studied in this study, in 2011, were registered very low values of Cu, ranging between 0.819 mg/kg for v1 (control variant) and 1.732 mg/kg for v6 ($N_{60}P_{60}K_{60}$ + 2 x Pervaide 1 l/ha) (table 1). These results are in accordance with other studies made by Romanian researchers who have shown values between 0.09 mg/kg – 5.15 mg/kg (*BANU 2007; VOHRA et al. 1994*) but other researchers (*TEKALIGN et al. 2012),* contrary reported very high values of 16.17 - 89.50 mg/kg for copper in onion culture. Plants require small amounts of copper, an average content for normal growth and are situated between 5-20 mg/kg (*ARGESANU 2010*). Above this amount copper is considered toxic. Variable quality of soil copper accumulation affects plant roots. It is supposed that some reactions that modify the qualities of the soil nitrogen content are important factors for passive transport of copper (*POIANA et al. 2009*).

Regarding Cu, Zn, Fe, and Mn content in onion samples in 2012, in all experimental variants were registered higher amounts than in control variant (v1); The variation limits for Fe (mg/kg), in 2012, were between 2.59 mg/kg (v1) – 5.65 mg/kg (v5), for Cu the range was 0.612 mg/kg (v3) and 1.132 mg/kg (v5), for Zn the values registered were between 1.99 mg/kg (v1) and 7.51 mg/kg (v5). Regarding Mn (mg/kg) content in onion samples in the 2012, were registered values between 0.87 mg/kg (v1) – 3.68 mg/kg (v5) (table 2), framing in level of 3-5 mg/kg according to literature studies (*BANU et al. 2007; GHERGHI et al. 2001; VOHRA et al. 1994*). The micronutrient fertilizer Aqzyme had a great influence in microelements accumulation, in onion culture, higher values than in other variants being registered in all three years, in variant v5 - $N_{60}P_{60}K_{60}$ + Aqzyme 1 l/ha (tables 1-3).

In all experimental years, as *tables 1-3* illustrates, the iron content in onion increases as the mineral fertilizers dose increases, the variation limits ranging between 2.87 mg/kg (v1) – 6.62 mg/kg (v5) in 2011 (table 1), 2.59 mg/kg (v1) - 5.65 mg/kg (v5) in 2012 (table 2) and 2.45 mg/kg (v1) – 5.31 mg/kg (v5) in 2013 (table 3). Similar situation was in the case of Mn, the amounts were higher in 2011 for all variants (1.17 - 3.79 mg/kg**)** (table 1), decreasing in 2012, 0.87 – 3.68 mg/kg (table 2) and in 2013, 0.69 – 3.24 mg/kg (table 3), being correlated with climatic conditions in 2011-2013. The composition of Zn and Cu varied markedly among the three years of study, so, in 2011 the level of Zn ranged between 0.85- 8.98 mg/kg, than in 2012, Zn content frame in 1.99 - 7.51 mg/kg (table 2) and in 2013 the variation limits of Zn content in onion samples at complete maturity, were 1.79 – 6.49 mg/kg (table 3), the values obtained were below maximum admitted limit of Zn (mg/kg) in fresh vegetables of 15 mg/kg established by *WHO/FAO Guidelines*.

The researches made in Romania and presented in this paper are according with researches made by *YOLDAS et al. in 2011*, regarding micronutrients accumulation in onion culture to different organic and mineral fertilizers doses, which highlighted that the content of Zn, Cu, Fe and Mn in onion increases as the fertilizers dose increases. Results are also similar with studies made in Poland that showed that the vegetables could generally be characterized by low levels of cadmium and lead (less than 0.1 mg/kg^{-1}), and relatively high levels of zinc, iron, and manganese (3-10 mg/kg^{-1}) (*CZECH et al. 2012*). Other studies made by *COOLONG et al. in 2004*, stated that Mn, Fe and Zn contents have the tendency to increase by NPK application and Cu content is not affected.

The applications of fertilizers and growth regulators affected onion yield. Average of yield in the experimental variants to onion culture is shown in table 4 and the influence of fertilizers and growth regulators on yield to onion (*Allium cepa L.)* culture in table 5.

Table 4.

Average of yield in the experimental variants to onion culture 2011-2013

Experimental variants	Yield average / variant (g/m^2) ± SD*
V6 - $N_{60}P_{60}K_{60}$ + 2 x Pervaide 1 l/ha	3050±*0.150*
V4 - N120P60K60	2832±*0.080*
V3 - $N_{90}P_{60}K_{60}$	2462±*0.197*
V5 - $N_{60}P_{60}K_{60}$ + Aqzyme 1 l/ha	2380±*0.440*
V2 - $N_{60}P_{45}K_{45}$	2287±*0.230*
V7 - Manure 20 t/ha	2262±*0.180*
V1 - $N_0P_0K_0$	1363±*0.710*

*SD-Standard deviation

Table 5.

Influence of fertilizers and growth regulators on yield to onion culture 2011-2013

Experimental variants	Absolute yield (t/ha)	Relative yield (%)	Yield difference (t/ha)	Significant differences
V6	30.500	128.31	+ 6.730	xxx
V4	28.320	119.14	+ 4.550	xx
V3	24.620	103.58	+ 0.850	-
V5	23.880	100.46	+ 0.110	-
Average x	**23.770**	**100.00**	**Control**	-
V2	22.870	96.21	- 0.900	-
V7	22.620	94.76	- 1.150	-
V1	13.630	57.34	- 10.14	000

$DL_{5\%}$= 2.325 t/ha
$DL_{1\%}$= 3.472 t/ha
$DL_{0.1\%}$= 4.983 t/ha

The yield average/ experimental variant range between 1363 g/m^2 in v1 (control) and 3050 g/m^2 v6 (N60P60K60 + 2 x Pervaide 1 l/ha) (table 4).
The absolute yield (t/ha) registered in the seven experimental variants frame between 13,630 t/ha (v1) to 30,500 t/ha (v6) (table 5).

The applications of fertilizers and growth regulators affected onion yield. The highest yield was obtained in variant v6 with the application of mineral fertilizers at a dose of $N_{60}P_{60}K_{60}$ + 2 x Pervaide 1 l/ha. This application increased yield by 28.31% compared to the control plot.

Compared to the control (unfertilized) variant (v1), variant v6 ($N_{60}P_{60}K_{60}$ + 2 x Pervaide 1 l / ha) achieves a very significant differences of yield of *6730 kg/ha* and variant v4 ($N_{120}P_{90}K_{90}$) presents significant differences of production being recorded *4550 kg/ha* (table 5).

The other variants (v3, v5, v2, v7) have recorded very significant differences compared to yield mean, instead control variant (v1) have been recorded a relative production only of 57,34% (table 5). Similar findings were also reported by *ISLAM et al., in 2007* and *YOLDAS et al. in 2011*, regarding yield and growth of onion.

CONCLUSIONS

Climacteric conditions of the 3 experimental years influenced the nutrients accumulation in onion samples, in 2011 a year characterized by drought and high temperatures. Phosphorous (P) and potassium (K) content, increased with increasing K and P up to 60kg/ha. NPK fertilization did influenced significant changes in potassium (mg/kg) content in onion samples, especially in variants with high K dose of 60 kg/ha.

Copper (Cu) content reveals a deficiency in onion culture, compared to the normal level, in all experimental variants in the 2011 and 2012.

The composition of Zn varied markedly among the three experimental years, the values obtained were below maximum admitted limit of Zn (mg/kg) in fresh vegetables of 15 mg/kg.

The applications of fertilizers and growth regulators affected onion yield. The highest yield was obtained in variant v6 with the application of mineral fertilizers at a dose of N60P60K60 + 2 x Pervaide 1 l/ha which increased yield by 28.31% compared to the control plot.

In conclusion we could say that our results demonstrated that nutrients content varied considerably depending on the fertilization doses and climatic conditions. Among the three experimental years were significant differences in mineral content of onion culture, being registered higher values in 2011 both for macronutrients (P,K and Mg) and for micronutrients (Fe, Cu, Zn and Mn).

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