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# ABOVE-GROUND BIOMASS AT DIFFERENT HYBRIDS OF MAIZE (*ZEA MAYS* L.) CULTIVATED IN SOUTH ROMANIA IN DROUGHT CONDITIONS

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***Abstract***

*Maize (Zea mays L.) is one of the most important crops for biomass production as source for producing biogas. The water stress affects significantly the maize biomass production. However, there is a wide response of maize plant to drought according to the cultivated hybrid. That is why the maize hybrids behaviour to specific climatic and soil conditions has to be well known in view to be cultivated the right hybrid for producing biomass for energetic purposes.*
*The aim of the paper was to present the results obtained at an assortment of maize hybrids regarding the above-ground biomass under the soil and climatic conditions from South Romania in the drought year 2012. Ten hybrids created in Romania were studied, respectively: CERA 270, CERA 290, CERA 370, CERA 390, CERA 6, CERA 420, CERA 2504, CERA 4505, Bărăgan 48, and CERA 10. The hybrids were studied in four different locations in South Romania, respectively: Fundulea – Călăraşi County; Vâlcelele – Călăraşi County; Vişani – Brăila County; Poşta Câlnău – Buzău County.*
*In the climatic conditions of 2012 in South Romania, five of the ten studied hybrids (CERA 2504, CERA 270, CERA 390, CERA 10, and CERA 420) registered values of the above-ground dry biomass production higher than 9 tons per hectare. Dry biomass production of stem and leaves that could present importance for different uses after harvesting ranged between 3.2 and 4.6 tons per hectare.*

***Key words:*** *maize, hybrids, biomass, drought.*

## INTRODUCTION

Advanced development of human society was made possible by exploiting the huge stocks of energy deposited over millions of years in fossil biomass.
Biomass can be considered as a strategic resource because: it is renewable, it is accessible to any area, it provides products of vital interest (e.g. food, feed, raw materials for various industries, biofuels, and others), and it support the environmental and socio-economic development, providing jobs especially in rural areas (Epure, 2006).
Biomass presents an increasing importance as source of fuels (solid, liquid and gas). Traditionally, harvested and dry biomass can be used to produce heat through combustion. There are still zones, in which from different reasons the biomass represents for the inhabitants the main source of energy available; available because it exists at their own, and they can get it, transport and store with their means (Roman et al., 1996). Modern use of biomass consists in converting it into biofuel through different complex processes (gasification, pyrolysis, catalytic liquefaction).
Biogas production from agricultural biomass is of growing importance as it offers considerable environmental benefits (Chynoweth, 2004) and is an additional source of income for farmers (Amon et al., 2007).
Among the crops used for biogas production, maize is the most important crop (Amon et al., 2007; Balodis, 2011), which can produce between 205 and 450 $m^3$ of methane per tonne volatile solids (Murphy et al., 2011). The advantage of maize as C4 crop is less water requirement for plants dry matter production (Dubrovskis, 2010). However the water stress affects significantly the maize biomass production. There is a wide response of maize plant to drought according to the cultivated hybrid, respectively according to the capacity

of genotype to adapt to the environmental conditions and to tolerate water stress. Nevertheless the maize hybrids behaviour to specific climatic and soil conditions has to be well known in view to be cultivated the right hybrid and the farmers to take the appropriate technological decisions.

The aim of the present paper was to study an assortment of maize hybrids regarding above-ground biomass production in the specific soil and climatic conditions from South Romania. The study was realised under field conditions in year 2012, which is characterised as being a drought year.

## MATERIALS AND METHODS

Researches were performed in the year 2012 on an assortment of ten hybrids of maize created in Romania for grain production, respectively: CERA 270 (FAO group 270), CERA 290 (FAO group 290), CERA 370 (FAO group 370), CERA 390 (FAO group 390), CERA 6 (FAO group 390), CERA 420 (FAO group 420), CERA 2504 (FAO group 440), CERA 4505 (FAO group 450), Bărăgan 48 (FAO group 480), and CERA 10 (FAO group 540).

The hybrids were studied in four different locations in South Romania, respectively:

- Fundulea – Călăraşi County (average multiannual temperature of 10.4°C; sum of precipitation of about 550 mm);
- Vâlcelele – Călăraşi County (average multiannual temperature of 11.2°C; sum of precipitation of about 514 mm);
- Vişani – Brăila County (average multiannual temperature of 11.0°C; sum of precipitation of about 460 mm);
- Poşta Câlnău – Buzău County (average multiannual temperature of 11.8°C; sum of precipitation of about 410 mm).

The year 2012 can be characterized as been a warm and dry year in early spring, summer and autumn. With the exception of February, when temperatures were below the multiannual average, in all other months till November temperatures were higher than multiannual averages, especially in April and August.

March and April registered a rainfall deficit, while May was very wet with a rain rate of 160 mm, which means more than double compared to the normal value. After May month followed a dry period which has been extended until autumn, period that culminated in July with only 2 mm precipitation (about 70 mm deficit). The lack of water has affected the good plant growth and development, and as a result the biomass accumulation.

The average plant population for the ten studied hybrids was of 66.0 thousand plants per hectare in Fundulea location, 62.6 thousand plants per hectare in Vâlcelele location, 63.4 thousand plants per hectare in Visani location, 62.8 thousand plants per hectare in Poşta Câlnău location.

In each location and for each hybrid, two plants in four replications (in total eight plants per replication) were analysed at physiological maturity. The analysed plants were representative (average plants) for the plant population in the crop.

For each plant of maize, biometric determinations (plant height, number of leaves per plant, and stem diameter at base of the plant) were performed in view to better appreciate the fresh and dry biomass.

The fresh matter was determined by weighing the plants by components, respectively: stem; leaves; ear; husks, stalk and silk; panicle.

The dry matter was determined by oven drying the plant components 24 hours at a temperature of 80°C.

Based on fresh and dry matter values, humidity content of the whole plant and plant components was calculated.

Based on plant population in each location and for each hybrid the biomass production was calculated.

The obtained data were statistically processed by analyses of variance (Anova-single factor).

## RESULTS AND DISCUSSIONS

Average plant height at the studied maize hybrids ranged from 144.0 to 259.9 cm in South Romania and in 2012 climatic conditions (Table 1). As average value for all the four locations in which the hybrids were studied, the highest value was obtained at CERA 2504 hybrid (224.6 cm), while the smallest value was obtained at CERA 10 hybrid (189.8 cm).

The ten maize hybrids studied in different locations had a comparable height in three of the locations (220.5 cm in average at Vâlcelele – Călăraşi County, 217.1 cm in average at Fundulea – Călăraşi County, and 215.5 cm in

average at Vişani – Brăila County). Among the locations where maize hybrids were studied, stood out location Vâlcelele – Călăraşi County where the maize hybrids had the highest height. In the conditions from Poşta Câlnău – Buzău County, the height plant at the studied hybrids showed the lowest values (average value 172.8 cm), which means that studied maize hybrids here did not find very favourable growing conditions under specific climatic conditions of 2012 year.

Climatic and soil conditions influenced different the studied hybrids. However, it is noted that compared to average the CERA 2504 hybrid registered positive statistically differences in three locations (Vişani, Poşta Câlnău, and Vâlcelele), while the hybrids Bărăgan 48 and CERA 10 registered negative statistically differences assured in three locations (Fundulea, Poşta Câlnău, and Vâlcelele).

In average for all the hybrids and locations the height plant in the 2012 climatic conditions registered 206.5 cm.

Table 1. Plant height (cm) at an assortment of maize hybrids studied in different locations in South Romania, in drought year 2012

| Maize hybrid | Locations | | | | *Average (hybrid)* |
|---|---|---|---|---|---|
| | Fundulea | Vişani | Poşta Câlnău | Vâlcelele | |
| CERA 270 | 228.0 | 223.1 | 187.4 | 228.5 | *216.8* |
| CERA 290 | 212.6 | 190.3$^{ooo}$ | 156.5$^{o}$ | 202.5$^{o}$ | *190.5* |
| CERA 370 | 237.1** | 207.1 | 165.9 | 198.3$^{o}$ | *202.1* |
| CERA 390 | 234.0** | 216.9 | 182.3 | 236.9 | *217.5* |
| CERA 6 | 212.9 | 202.4$^{oo}$ | 180.5 | 259.9*** | *213.9* |
| CERA 420 | 211.0 | 217.3 | 165.8 | 216.9 | *202.8* |
| CERA 2504 | 216.8 | 236.3*** | 199.9** | 245.3** | *224.6* |
| CERA 4505 | 203.5$^{o}$ | 211.5 | 183.9 | 238.3 | *209.3* |
| Bărăgan 48 | 201.4$^{o}$ | 225.6* | 162.4 | 201.5$^{o}$ | *197.7* |
| CERA 10 | 213.8 | 224.4 | 144.0$^{ooo}$ | 176.8$^{ooo}$ | *189.8* |
| *Average (Control)* | *217.1* | *215.5* | *172.8* | *220.5* | *206.5* |
| *LSD 5%* | *12.5* | *20.2* | *15.5* | *17.8* | *20.9* |
| *LSD 1%* | *16.8* | *27.2* | *20.8* | *24.0* | *28.1* |
| *LSD 0.1%* | *22.3* | *36.1* | *27.7* | *31.8* | *37.3* |

Number of leaves per plant is a hybrid-specific genetic characteristic, but it is still influenced by environmental conditions. In South Romania and in 2012 climatic conditions, the average number of leaves per plant ranged from 9.1 to 16.9 (Table 2).

The highest number of leaves per plant was recorded in Fundulea (Călăraşi County) climatic and soil conditions. The smallest number of leaves per plant was recorded in Vişani (Brăila County) climatic and soil conditions. It is also interesting to note that the number of leaves per plant did not correlate with plant size.

Table 2. No of leaves per plant at an assortment of maize hybrids studied in different locations in South Romania, in drought year 2012

| Maize hybrid | Locations | | | | *Average (hybrid)* |
|---|---|---|---|---|---|
| | Fundulea | Vişani | Poşta Câlnău | Vâlcelele | |
| CERA 270 | 12.0$^{ooo}$ | 11.9* | 11.8 | 13.3** | *12.3* |
| CERA 290 | 13.6$^{o}$ | 9.1$^{ooo}$ | 9.4$^{oo}$ | 12.3 | *11.1* |
| CERA 370 | 14.4 | 10.3 | 10.0$^{o}$ | 11.1$^{oo}$ | *11.5* |
| CERA 390 | 14.9 | 11.1 | 12.9** | 12.8 | *12.9* |
| CERA 6 | 15.0 | 10.4 | 9.4$^{oo}$ | 11.8 | *11.7* |
| CERA 420 | 15.9* | 12.0* | 10.4 | 11.6 | *12.5* |
| CERA 2504 | 14.5 | 11.1 | 12.3* | 12.6 | *12.6* |
| CERA 4505 | 15.6 | 10.8 | 10.6 | 13.0* | *12.5* |
| Bărăgan 48 | 15.8 | 11.1 | 11.3 | 12.0 | *12.6* |
| CERA 10 | 16.9*** | 11.5 | 12.9** | 12.3 | *13.4* |
| *Average (Control)* | *14.9* | *10.9* | *11.1* | *12.3* | *12.3* |
| *LSD 5%* | *1.0* | *0.9* | *1.0* | *0.7* | *1.3* |
| *LSD 1%* | *1.3* | *1.3* | *1.4* | *0.9* | *1.8* |
| *LSD 0.1%* | *1.8* | *1.7* | *1.8* | *1.2* | *2.4* |

At the studied maize hybrids, the stem diameter at base of the plant ranged from 10.5 to 20.1 mm in South Romania and in 2012 climatic conditions (Table 3). The highest average value for all the four areas in which the hybrids were studied was obtained for CERA 2504 hybrid (18.5 mm), while the smallest average value was obtained for Bărăgan 48 (14.7 mm). Among the areas where the hybrids were studied, the highest average value was obtained in Vişani area from Brăila County (18.2 mm), while the smallest value was obtained in Vâlcelele area from Călăraşi County (16.1 mm).

The above-ground dry biomass production at the studied maize hybrids ranged from 5 to 13 tons per hectare in South Romania and in 2012 climatic conditions (Table 4). The highest average value for all the four areas in which the hybrids were studied was obtained for CERA 2504 hybrid (9.8 tons per hectare), while the smallest average value was obtained for CERA 4505 (6.7 tons per hectare). Among the areas where the hybrids were studied, the highest average value was obtained in Fundulea area from Călăraşi County (10.3 tons per hectare), while the smallest value was obtained in Poşta Câlnău area from Buzău County (7.3 tons per hectare). The lowest above-ground dry biomass production registered at Poşta Câlnău from Buzău County correlates with the lower height

plant and the small number of leaves per plant obtained under these conditions.
In average for all the hybrids and locations the above-ground dry biomass production in the 2012 climatic conditions registered 8.5 tons per hectare.

Table 3. Stem diameter (mm) at an assortment of maize hybrids studied in different locations in South Romania, in drought year 2012

| Maize hybrid | Locations | | | | *Average (hybrid)* |
|---|---|---|---|---|---|
| | Fundulea | Vişani | Poşta Câlnău | Vâlcelele | |
| CERA 270 | 14.0 | 18.0 | 17.6 | 14.3 | *16.0* |
| CERA 290 | 15.3 | 16.5 | 18.0 | 17.5 | *16.8* |
| CERA 370 | 18.2 | 17.5 | 16.8 | 16.0 | *17.1* |
| CERA 390 | 15.9 | 19.4 | 15.9 | 17.1 | *17.1* |
| CERA 6 | 13.0$^{o}$ | 17.3 | 19.9 | 17.1 | *16.8* |
| CERA 420 | 18.1 | 18.9 | 14.5 | 17.4 | *17.2* |
| CERA 2504 | 16.9 | 18.6 | 19.9 | 18.4 | *18.5* |
| CERA 4505 | 16.0 | 17.9 | 20.1 | 16.3 | *17.6* |
| Bărăgan 48 | 15.6 | 18.0 | 14.8 | 10.5$^{oo}$ | *14.7* |
| CERA 10 | 19.6 | 20.0 | 14.3 | 16.8 | *17.7* |
| *Average (Control)* | *16.2* | *18.2* | *17.2* | *16.1* | *16.9* |
| *LSD 5%* | *3.2* | *3.0* | *3.6* | *3.4* | *2.7* |
| *LSD 1%* | *4.3* | *4.1* | *4.9* | *4.5* | *3.6* |
| *LSD 0.1%* | *5.7* | *5.4* | *6.5* | *6.0* | *4.8* |

Table 4. Above-ground dry biomass production (kg/ha) at an assortment of maize hybrids studied in different locations in South Romania, in drought year 2012

| Maize hybrid | Locations | | | | *Average (hybrid)* |
|---|---|---|---|---|---|
| | Fundulea | Vişani | Poşta Câlnău | Vâlcelele | |
| CERA 270 | 12,806* | 8,847 | 10,021* | 7,092 | *9,692* |
| CERA 290 | 9,329 | 7,583 | 7,514 | 8,699 | *8,281* |
| CERA 370 | 10,881 | 8,020 | 5,482 | 5,998 | *7,595* |
| CERA 390 | 9,187 | 11,108* | 8,604 | 8,970 | *9,467* |
| CERA 6 | 8,761 | 8,407 | 5,017 | 9,288 | *7,868* |
| CERA 420 | 12,414 | 9,649 | 6,768 | 7,912 | *9,186* |
| CERA 2504 | 10,662 | 10,417 | 10,184* | 7,987 | *9,813* |
| CERA 4505 | 7,933 | 6,036$^{oo}$ | 6,932 | 5,860 | *6,690* |
| Bărăgan 48 | 7,882 | 8,869 | 6,178 | 5,093$^{o}$ | *7,006* |
| CERA 10 | 13,041* | 9,418 | 6,331 | 8,240 | *9,258* |
| *Average (Control)* | *10,298* | *8,862* | *7,259* | *7,494* | *8,478* |
| *LSD 5%* | *2,453* | *1,967* | *2,542* | *2,249* | *1,923* |
| *LSD 1%* | *3,307* | *2,651* | *3,427* | *3,032* | *2,593* |
| *LSD 0.1%* | *4,389* | *3,519* | *4,548* | *4,024* | *3,441* |

The above-ground fresh biomass production registered a comparable situation for the studied maize hybrids and locations in South Romania with those of the above-ground dry biomass production.
The above-ground fresh biomass production at the studied maize hybrids ranged from 5.6 to 15 tons per hectare in South Romania and in 2012 climatic conditions (Table 5). In average for all the hybrids and locations the above-ground fresh biomass production in 2012 climatic conditions registered 9.7 tons per hectare.

Table 5. Above-ground fresh biomass production (kg/ha) at an assortment of maize hybrids studied in different locations in South Romania, in drought year 2012

| Maize hybrid | Locations | | | | *Average (hybrid)* |
|---|---|---|---|---|---|
| | Fundulea | Vişani | Poşta Câlnău | Vâlcelele | |
| CERA 270 | 13,304 | 10,810 | 11,448* | 9,632 | *11,299* |
| CERA 290 | 10,340 | 8,166 | 9,320 | 10,031 | *9,464* |
| CERA 370 | 14,796* | 8,714 | 5,768$^{oo}$ | 6,858 | *9,034* |
| CERA 390 | 10,030 | 12,679** | 9,592 | 9,920 | *10,555* |
| CERA 6 | 9,707 | 9,694 | 6,859 | 10,769 | *9,257* |
| CERA 420 | 13,624 | 10,396 | 7,626 | 8,995 | *10,160* |
| CERA 2504 | 11,819 | 11,568 | 11,784** | 10,637 | *11,452* |
| CERA 4505 | 8,636$^{o}$ | 6,516$^{ooo}$ | 7,674 | 7,292 | *7,530* |
| Bărăgan 48 | 8,650$^{o}$ | 10,338 | 7,134 | 5,649$^{o}$ | *7,943* |
| CERA 10 | 14,972* | 10,617 | 6,850 | 9,333 | *10,443* |
| *Average (Control)* | *11,588* | *9,950* | *8,406* | *8,912* | *9,714* |
| *LSD 5%* | *2,901* | *1,905* | *2,381* | *2,848* | *2,411* |
| *LSD 1%* | *3,911* | *2,568* | *3,209* | *3,839* | *3,250* |
| *LSD 0.1%* | *5,191* | *3,409* | *4,260* | *5,096* | *4,314* |

In average for all the four locations from South Romania and in the climatic conditions of the year 2012, dry above-ground biomass production ranged between 6,690 kg per hectare at CERA 4505 hybrid and 9,813 at CERA 2504 hybrid (Figure 1). Five of the ten studied hybrids (CERA 2504, CERA 270, CERA 390, CERA 10, CERA 420) registered values of the above-ground dry biomass production higher than 9 tons per hectare.
Dry biomass production of stem and leaves that could present importance for different uses after harvesting (heat producing through combustion, biogas producing, and other purposes) ranged between 3,166 kg per hectare at CERA 290 hybrid and 4,655 kg per hectare at CERA 2504 (Figure 1).
Compared to the average of ten hybrids in Fundulea location, Călăraşi County, in drought year 2012, the above-ground dry biomass at plant maturity showed statistically positive difference for total plant biomass at the following hybrids: CERA 4505 (192.12 g), CERA 270 (191.76 g), and CERA 10 (191.23 g). Out of these three hybrids, only CERA 4505 and CERA 10 showed statistically positive difference for stem biomass and leaves biomass. In average for all the ten hybrids, the stem biomass represents 22% from total biomass of plant, and the leaves biomass represents 22.8% from total biomass of plant (Table 6).
The total plant above-ground dry biomass showed statistically negative difference at the hybrids CERA 6 and Bărăgan 48 (Table 6).

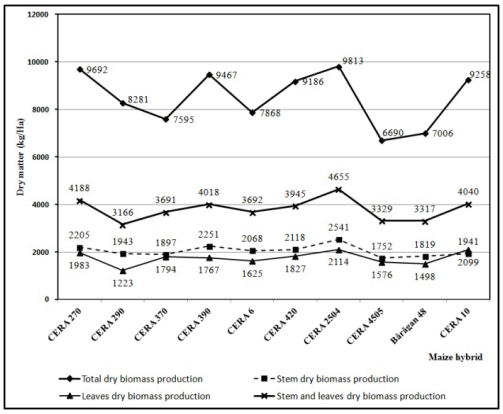


Figure 1. Dry above-ground biomass production (kg/ha) at plant maturity at an assortment of maize hybrids studied in four different locations (average values) in South Romania, in drought year 2012

Table 6. Plant above-ground dry biomass at plant maturity at an assortment of maize hybrids studied in Fundulea location, Călăraşi County, in drought year 2012

| Maize hybrid | Total-plant (g) | Stem (g) | Leaves (g) | Ear (g) | Husks, stalks and silk (g) | Panicle (g) |
|---|---|---|---|---|---|---|
| CERA 270 | 191.76* | 32.16 | 28.73 | 114.42** | 14.82** | 1.62 |
| CERA 290 | 153.12 | 31.43 | 26.10$^{o}$ | 81.21 | 12.76 * | 1.62 |
| CERA 370 | 130.62 | 28.83 | 35.72 | 56.60 | 6.73 | 2.74 ** |
| CERA 390 | 165.40 | 36.35 | 38.62 | 78.27 | 10.61 | 1.55 |
| CERA 6 | 114.60$^{o}$ | 23.65$^{oo}$ | 27.34 | 55.88 | 6.22 | 1.51 |
| CERA 420 | 158.70 | 40.48 | 36.42 | 71.07 | 8.98 | 1.76 |
| CERA 2504 | 142.26 | 32.05 | 32.98 | 70.08 | 5.01$^{o}$ | 2.15 |
| CERA 4505 | 192.12* | 41.93* | 46.86* | 90.26 | 11.58 | 1.50 |
| Bărăgan 48 | 119.31$^{o}$ | 33.92 | 33.04 | 45.38$^{o}$ | 4.94$^{o}$ | 2.04 |
| CERA 10 | 191.23* | 42.34* | 49.53** | 90.23 | 7.16 | 1.97 |
| *Average (Control* | *155.91* | *34.31* | *35.53* | *75.34* | *8.88* | *1.85* |
| *LSD 5%* | *33.58* | *6.95* | *8.58* | *24.10* | *3.48* | *0.61* |
| *LSD 1%* | *45.27* | *9.37* | *11.57* | *32.49* | *4.69* | *0.82* |
| *LSD 0.1%* | *60.09* | *12.44* | *15.35* | *43.12* | *6.22* | *1.08* |

Compared to the average of ten hybrids in Vişani location, Brăila County, in drought year 2012, the above-ground dry biomass at plant maturity showed no statistically positive differences for total plant biomass. Also, no statistically positive differences were registered for stem biomass and leaves biomass. In average for all the ten hybrids, the stem biomass represents 27% from total biomass of plant, and the leaves biomass represents 20.2% from total biomass of plant (Table 7).

The total plant above-ground dry biomass showed statistically negative difference at the hybrid CERA 6 (Table 7).

Table 7. Plant above-ground dry biomass at plant maturity at an assortment of maize hybrids studied in Vişani location, Brăila County, in drought year 2012

| Maize hybrid | Total-plant (g) | Stem (g) | Leaves (g) | Ear (g) | Husks, stalks and silk (g) | Panicle (g) |
|---|---|---|---|---|---|---|
| CERA 270 | 141.71 | 41.18 | 32.46 | 58.80 | 7.81 | 1.47 |
| CERA 290 | 111.86 | 26.41$^{o}$ | 15.44$^{ooo}$ | 60.28 | 8.33 | 1.40 |
| CERA 370 | 136.19 | 40.78 | 24.05 | 62.97 | 7.52 | 0.88$^{oo}$ |
| CERA 390 | 163.84 | 45.33 | 33.01 | 76.99 | 6.41 | 2.10 |
| CERA 6 | 100.54$^{o}$ | 32.77 | 32.86 | 26.53$^{ooo}$ | 5.37 | 3.01* |
| CERA 420 | 120.65 | 32.08 | 25.43 | 54.31 | 7.55 | 1.28 |
| CERA 2504 | 170.05 | 39.77 | 31.91 | 83.03* | 12.20 | 3.15** |
| CERA 4505 | 166.79 | 47.07 | 32.55 | 70.89 | 14.73** | 1.55 |
| Bărăgan 48 | 128.36 | 35.43 | 29.87 | 51.39 | 9.24 | 2.44 |
| CERA 10 | 158.01 | 37.23 | 25.08 | 82.39* | 11.07 | 2.24 |
| *Average (Control* | *139.80* | *37.80* | *28.27* | *62.76* | *9.02* | *1.95* |
| *LSD 5%* | *33.61* | *9.37* | *6.37* | *18.63* | *3.89* | *0.75* |
| *LSD 1%* | *45.31* | *12.63* | *8.58* | *25.12* | *5.24* | *1.01* |
| *LSD 0.1%* | *60.13* | *16.77* | *11.39* | *33.34* | *6.95* | *1.34* |

Compared to the average of ten hybrids in Poşta Câlnău location, Buzău County, in drought year 2012, the above-ground dry biomass at plant maturity showed no statistically positive differences for total plant biomass. Statistically positive differences were registered for stem biomass and leaves biomass at the hybrid CERA 390, and only for leaves biomass at the hybrid CERA 270. In average for all the ten hybrids, the stem biomass represents 22.2% from total biomass of plant, and the leaves biomass represents 22% from total biomass of plant (Table 8).

Table 8. Plant above-ground dry biomass at plant maturity at an assortment of maize hybrids studied in Poşta Câlnău location, Buzău County, in drought year 2012

| Maize hybrid | Total-plant (g) | Stem (g) | Leaves (g) | Ear (g) | Husks, stalks and silk (g) | Panicle (g) |
|---|---|---|---|---|---|---|
| CERA 270 | 148.79 | 29.37 | 36.77*** | 70.59 | 10.33 | 1.73 |
| CERA 290 | 118.72 | 24.85 | 19.94$^{o}$ | 62.69 | 9.54 | 1.70 |
| CERA 370 | 93.03 | 25.51 | 20.59$^{o}$ | 39.37 | 5.95 | 1.61 |
| CERA 390 | 152.91 | 39.09** | 33.90** | 69.79 | 7.88 | 2.26 |
| CERA 6 | 103.26 | 24.52 | 22.93 | 46.15 | 7.39 | 2.28 |
| CERA 420 | 95.95 | 19.82 | 25.91 | 44.01 | 4.25$^{oo}$ | 1.96 |
| CERA 2504 | 140.54 | 34.21 | 27.51 | 63.22 | 13.67** | 1.93 |
| CERA 4505 | 108.38 | 20.90 | 21.14 | 56.96 | 7.50 | 1.89 |
| Bărăgan 48 | 99.23 | 21.92 | 17.38$^{oo}$ | 52.51 | 5.42 | 2.00 |
| CERA 10 | 95.00 | 16.59$^{o}$ | 28.50 | 41.56 | 6.57 | 1.78 |
| *Average (Control* | *115.58* | *25.68* | *25.46* | *54.68* | *7.85* | *1.91* |
| *LSD 5%* | *38.78* | *8.97* | *4.87* | *31.38* | *3.56* | *0.72* |
| *LSD 1%* | *52.28* | *12.09* | *6.56* | *42.30* | *4.80* | *0.97* |
| *LSD 0.1%* | *69.39* | *16.05* | *8.71* | *56.14* | *6.38* | *1.29* |

Compared to the average of ten hybrids in Vâlcelele location, Călăraşi County, in drought year 2012, the above-ground dry biomass at plant maturity showed no statistically positive differences for total plant biomass. Statistically

positive differences were registered only for leaves biomass at the hybrids CERA 420, CERA 270, and CERA 10. In average for all the ten hybrids, the stem biomass represents 25.8% from total biomass of plant, and the leaves biomass represents 16.8% from total biomass of plant (Table 9).

Table 9. Plant above-ground dry biomass at plant maturity at an assortment of maize hybrids studied in Vâlcelele location, Călăraşi County, in drought year 2012

| Maize hybrid | Total-plant (g) | Stem (g) | Leaves (g) | Ear (g) | Husks, stalks and silk (g) | Panicle (g) |
|---|---|---|---|---|---|---|
| CERA 270 | 113.49 | 33.98 | 24.17* | 41.13 | 12.62 | 1.59 |
| CERA 290 | 132.20 | 37.92 | 15.08$^{o}$ | 67.14 | 10.40 | 1.66 |
| CERA 370 | 145.48 | 38.27 | 23.61 | 69.87 | 11.60 | 2.14 |
| CERA 390 | 115.83 | 33.88 | 23.36 | 51.74 | 4.96$^{o}$ | 1.88 |
| CERA 6 | 95.67 | 28.72 | 14.69$^{oo}$ | 45.08 | 5.74 | 1.43 |
| CERA 420 | 112.05 | 28.90 | 28.20*** | 42.27 | 10.47 | 2.20 |
| CERA 2504 | 142.63 | 35.65 | 18.57 | 71.65 | 14.95* | 1.81 |
| CERA 4505 | 130.46 | 28.63 | 17.73 | 72.01 | 10.21 | 1.89 |
| Bărăgan 48 | 83.03 | 19.91$^{o}$ | 10.81$^{ooo}$ | 45.59 | 5.30 | 1.42 |
| CERA 10 | 126.85 | 23.91 | 24.97* | 65.40 | 10.79 | 1.78 |
| *Average (Control* | *119.77* | *30.98* | *20.12* | *57.19* | *9.70* | *1.78* |
| LSD 5% | *39.32* | *8.75* | *3.80* | *27.35* | *4.67* | *0.60* |
| LSD 1% | *53.01* | *11.79* | *5.12* | *36.87* | *6.29* | *0.81* |
| LSD 0.1% | *70.35* | *15.65* | *6.79* | *48.94* | *8.35* | *1.07* |

In South Romania for the climatic conditions (drought) of the year 2012, the plant above-ground dry biomass ranged within the following limits (Tables 6, 7, 8 and 9):

- from 83.03 to 192.12 g for total plant dry biomass;
- from 16.59 to 47.07 g for stem dry biomass;
- from 10.81 to 49.53 g for leaves dry biomass;
- from 26.53 to 114.42 g for ear dry biomass;
- from 4.25 to 14.95 g for husks, stalks and silk dry biomass;
- from 0.88 to 3.15 g for panicle dry biomass.

In average for all the four locations from South Romania and in the climatic conditions of 2012, the total dry above-ground biomass of plant ranged between 103.52 g at CERA 4505 hybrid and 149.5 g at CERA 2504 hybrid (Figure 2). Five of ten hybrids (CERA 4505, CERA 420, CERA 270, CERA 390, and CERA 10) registered values for total above-ground dry biomass of plant higher than 140 g. In the total dry above-ground biomass of plant, the most important contribution is that of dry biomass of ears. After the ears biomass, the dry biomass of stems is the most important in the total plant biomass, except the CERA 10 hybrid for which the dry biomass of leaves is more important than the dry biomass of stems.

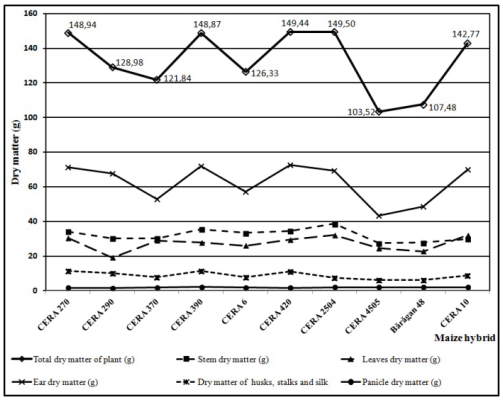


Figure 2. Dry above-ground biomass of plant (g) at plant maturity at an assortment of maize hybrids studied in four different locations (average values) in South Romania, in drought year 2012

Plant above-ground dry matter, in average for the ten studied maize hybrids and for the specific conditions from South Romania and under drought conditions of the year 2012, is composed of (Figure 3):

- 46.9% ear dry matter;
- 24.4% stem dry matter;
- 20.7% leaves dry matter;
- 6.6% husks, stalks and silk dry matter;
- 1.4% panicle dry matter.

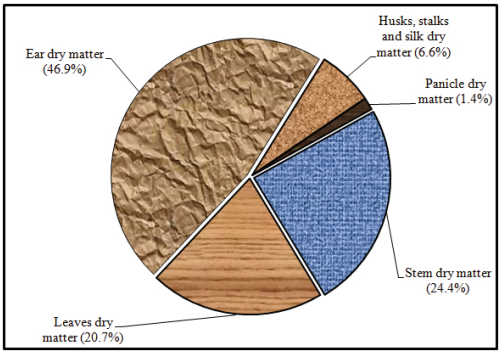


Figure 3. Plant components dry matter ratio (%) of total plant dry matter at an assortment of maize hybrids studied in different locations in South Romania, in drought year 2012

Maize plant is dry at physiological maturity and plant components have low humidity values, namely: stem humidity ranged between 6.29% (CERA 390 hybrid at Fundulea, Călăraşi

County) and 30.29% (CERA 270 hybrid at Vâlcelele, Călăraşi County) (Table 11); leaves humidity ranged between 5.6% (CERA 270 hybrid at Poşta Câlnău, Buzău County) and 29.1% (CERA hybrid 370 at Fundulea, Călăraşi County) (Table 12).

Table 10. Stem humidity (%) at an assortment of maize hybrids studied in different locations in South Romania, in drought year 2012

| Maize hybrid | Locations | | | | *Average (hybrid)* |
|---|---|---|---|---|---|
| | Fundulea | Vişani | Poşta Câlnău | Vâlcelele | |
| CERA 270 | 9.53 | 23.20 | 8.13 | 30.29 | *17.79* |
| CERA 290 | 11.43 | 10.40 | 7.65 | 12.84 | *10.58* |
| CERA 6 | 7.18 | 23.95 | 10.27 | 18.82 | *15.06* |
| CERA 2504 | 6.64 | 11.07 | 15.18 | 31.33 | *16.06* |
| CERA 4505 | 10.30 | 16.85 | 7.32 | 23.62 | *14.52* |
| CERA 370 | 22.52* | 9.13 | 13.42 | 20.67 | *16.44* |
| CERA 390 | 6.29 | 17.95 | 11.23 | 9.82 | *11.32* |
| CERA 420 | 6.69 | 10.82 | 18.22 | 16.08 | *12.95* |
| Bărăgan 48 | 8.85 | 8.66 | 23.52* | 30.17 | *17.80* |
| CERA 10 | 14.77 | 17.93 | 7.07 | 14.72 | *13.62* |
| *Average (Control)* | *10.42* | *15.00* | *12.20* | *20.84* | *14.62* |
| *LSD 5%* | *10.11* | *14.65* | *8.90* | *20.52* | *8.76* |
| *LSD 1%* | *13.63* | *19.75* | *11.99* | *27.66* | *11.81* |
| *LSD 0.1%* | *18.09* | *26.22* | *15.92* | *36.71* | *15.67* |

Table 11. Leaves humidity (%) at an assortment of maize hybrids studied in different locations in South Romania, in drought year 2012

| Maize hybrid | Locations | | | | *Average hybrid* |
|---|---|---|---|---|---|
| | Fundulea | Vişani | Poşta Câlnău | Vâlcelele | |
| CERA 270 | 7.36 | 15.56** | 5.60 | 14.87 | *10.85* |
| CERA 290 | 11.37 | 6.41 | 9.16 | 7.76 | *8.68* |
| CERA 6 | 9.52 | 8.50 | 6.56 | 7.35 | *7.98* |
| CERA 2504 | 11.21 | 9.01 | 15.70* | 15.19 | *12.78* |
| CERA 4505 | 6.03 | 7.56 | 8.06 | 17.72 | *9.84* |
| CERA 370 | 29.10** | 8.71 | 6.89 | 9.62 | *13.58* |
| CERA 390 | 7.41 | 7.25 | 7.38 | 12.13 | *8.54* |
| CERA 420 | 8.82 | 7.28 | 7.25 | 11.54 | *8.72* |
| Bărăgan 48 | 10.76 | 7.32 | 9.09 | 16.70 | *10.97* |
| CERA 10 | 17.98 | 9.15 | 7.98 | 11.00 | *11.53* |
| *Average (Control)* | *11.96* | *8.67* | *8.37* | *12.39* | *10.35* |
| *LSD 5%* | *11.92* | *6.31* | *7.20* | *7.59* | *6.13* |
| *LSD 1%* | *16.07* | *8.50* | *9.71* | *10.24* | *8.27* |
| *LSD 0.1%* | *21.34* | *11.28* | *12.89* | *13.58* | *10.97* |

## CONCLUSIONS

In the drought conditions of the year 2012 in South Romania, the average plant height at the ten studied maize hybrids ranged from 144.0 to 259.9 cm, with an average value for all hybrids of 206.5 cm.

The average number of leaves per plant at the studied maize hybrids ranged from 9.1 to 16.9, with an average value for all hybrids of 12.3.

The stem diameter at base of the plant at the studied maize hybrids ranged from 10.5 to 20.1 mm, with an average value for all hybrids of 16.9 mm.

The above-ground dry biomass production at the studied maize hybrids at physiological maturity of plant ranged from 5 to 13 tons per hectare, with an average value for all the ten hybrids of 8.5 tons per hectare.

In the climatic conditions of 2012 in South Romania, five of the ten studied hybrids (CERA 2504, CERA 270, CERA 390, CERA 10, and CERA 420) registered values of the above-ground dry biomass production higher than 9 tons per hectare.

The above-ground fresh biomass production at the studied maize hybrids at physiological maturity of plant ranged from 5.6 to 15 tons per hectare, with an average value for all hybrids of 9.7 tons per hectare.

Dry biomass production of stem and leaves that could present importance for different uses after harvesting ranged between 3.2 and 4.6 tons per hectare.

Plant above-ground dry biomass ranged from 83.03 to 192.12 g.

Plant above-ground dry matter, in average for the ten studied maize hybrids and for the specific conditions from South Romania and under drought of the year 2012, is composed of: 46.9% ear dry matter; 24.4% stem dry matter; 20.7% leaves dry matter; 6.6% husks, stalks and silk dry matter; 1.4% panicle dry matter.

At physiological maturity of plant, stem humidity ranged between 6.3 and 30.2%, and leaves humidity ranged between 5.6 and 29.1%.

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