RESEARCH REGARDING THE INFLUENCE OF SOME TECHNOLOGICAL FACTORS ON THE *AMARANTHUS SP.* YIELDS OBTAINED IN TEIUŞ AREA, ALBA COUNTY

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Abstract. The Amaranthus species is cultivated as "pseudocereal" because of its rich contents in proteins, carbohydrates and greases, which could be compared with those of cereals. The experience intends to test the productivity of four sorts of Amaranthus sp., in order to integrate successfully within the agricultural technologies, such sorts as Amont, Golden Giant, Hopi Red Dye and Plenitude, in the climatic conditions from the Teiuş area, AlbaCounty. The Plenitude sort records the highest production increases, 1344,99 kg/ha, in irrigation conditions, whereas the Golden Giant sort, in irrigation conditions, records a decrease in production of 360,73kg/ha.

Key words: *Amaranthus*, fertilization, irrigation, yields, pseudocereals.

INTRODUCTION

The research performed has started from the growing interest shown recently to this plant in The European Community (Akinola and Eresama, 2009).

The *Amaranthus* sort is cultivated most frequently in zones as: Mexic, Central America, India, Nepal, China, East Africa (Ragi Tef and Niger, 1986). It can be used as a cereal for grains, or as a vegetable for leaves, and it has great potential as fodder plant. It is also used for processed food, as breakfast cereals, biscuits, cookies, and also as flour without gluten (JEROME, 2001).

The *Amaranthus* sort comprises over 60 subsorts with over 800 species (Paredes, 1994), and its genetic diversity is due to the multitude of local varieties and populations, from which just a small part is cultivated, the rest are considered weeds (Marin *et al.*, 2008). It presents fairly diversity of colors of leaves, inflorescence, seeds, protein contents, and accommodation to the climatic and pedological conditions. The *Amaranthus* seeds have a great nourishing value due to its contents, rich in some biochemical compounds, fairly important for human food and health. Some biochemical compounds - proteins, lipids, mineral substances, vitamins, essential amino acids, are present in larger quantity, as compared to other cultivated species (Toader, 2008).

The results obtained by Toader and Roman (2007) at ”Moara Domnească” (”Lordly Mill”) experimental field, near Bucharest, show that the sorts from the species *Amaranthus cruentus* behaved well, had a springing quite uniform, and the harvests obtained were acceptable or satisfactory, both quantitatively and qualitatively. In the case of the Golden Giant sort, the plants formed 21,4 g seeds, from which resulted the relative quantity of one thousand grains (MMB) 1,32 g and productions evaluated to 21,0 q/ha.

The results obtained in the production of *Amaranthus* sp. seeds, cultivated in the climatic and pedological (pedoclimatic) conditions from Jucu experimental field (Cluj County), present an average of 2,530.36 kg/ha, variants which provide a density of 100.000 plants /ha (Rusu *et al*., 2008).

MATERIAL AND METHOD

The results obtained describe the experimental culture founded near the town of Teiuş, area positioned in the eastern central zone of Alba County. The average multi-year temperature is around 9,7° C, with maximum values registered in July. The first frost is registered around 11th Octomber, and the last one around 21st April . The months May and July are characterized as the most rainy , whereas February, together with December, the most droughty.

In the experiment four species of *Amaranthus* were used: Amont (*Amaranthus cruenthus*), Golden Giant (*Amaranthus hypochondriacus*), Hopi Red Dye (*Amaranthus hypochondriacus*), Plenitude (*Amaranthus hypochondriacus*).

The main purpose of the research was to determine the quantity of yields obtained in the climatic conditions of the 2015 year , depending on the technological factors: irrigation conditions with two gradations (noted with a_1-not irrigated, respectively a_2-irrigated), fertilization conditions with three gradations (noted with b_1-not fertilized, b_2-fertilized with (organic) stable manure, b_3-complex fertilizer (NPK), and sort with four gradations (noted c_1-Golden Giant, c_2-Plenitude, c_3-Amont, c_4-Hopi Red Dye).

The production was calculated using the average weight of seeds determined on plant, multiplied by the number of plants on each variant (30 plants/ 6 m^2), values reported to kilograms at hectare (kg/ha).

The experimental design was conducted as a trifactorial type (2x3x4), placed in three repetitions. The obtained experimental data were worked out with the help of the ANOVA soft.

RESULTS AND DISCUSSIONS

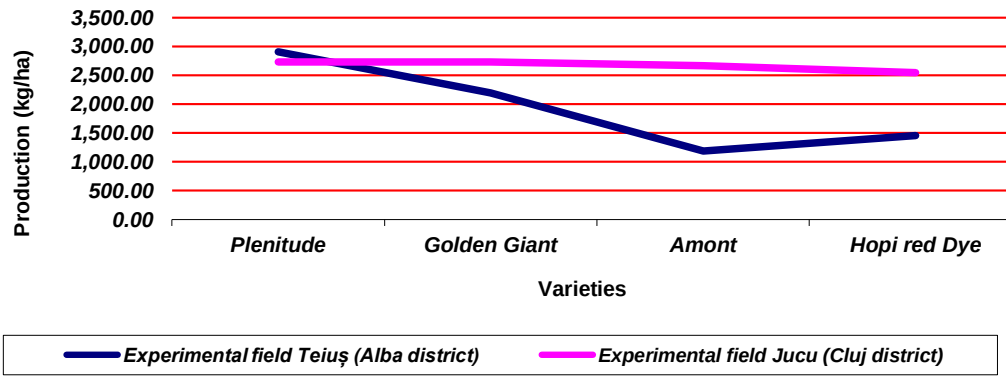

Fig. 1. Comparative data regarding theyields obtained in different climate and soil (pedo-climatic) conditions within four cultures of *Amaranthus*

In figure 1 are presented comparative data regarding the productions obtained in the conditions of the experimental field Teiuş, Alba County (personal data), respectively the experimental field Jucu, Cluj County (after Rusu *et al.*, 2008). From the graphic presentation it could be notice that only the Plenitude sort achieves similar productions within the two areas.

The yields analyz had the aim of the interpretation of the values determined and obtained depending on the individual influence of technological factors considered, as well as the influences caused by the interaction of factors.

In table 1 are showed the quantity of yields obtained depending on the influence of the irrigation conditions. Was observed that for the not irrigated variant was obtained a production of 1,793.52 kg/ha, nearly with 15,7% smaller than the production obtained in irrigation conditions. This difference, statistically assured, is fairly significant.

Table 1

The influence of irrigation conditions on the production (kg/ha) of *Amaranthus sp.*, in the year 2015, in Teiuș area, Alba County

Variant	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance of the differences
a_1 – non-irrigated	1793.52	100.0	-	Controller
a_2 - irrigated	2075.00	115.7	281.52	***
DL (p 5%)			12.86	
DL (p 1%)			29.69	
DL (p 0.1%)			94.47	

Table 2

The influence of the fertilization factor on the production (kg/ha) of *Amaranthus sp.*, in the year 2015, in the Teiuș area, Alba district.

Variant	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance of the differences
b_1- non-fertilized	1789.79	100.0	0.00	Controller
b_2-organic fertilized	1881.33	105.1	91.53	***
b_3-NPK fertilized	2131.71	119.1	341.91	***
DL (p 5%)			24.28	
DL (p 1%)			35.32	
DL (p 0.1%)			52.99	

Table 3

The influence of the sort factor on the production (kg/ha) of *Amaranthus sp,.* in the year 2015, in Teiuș area, Alba County

Variant	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance of the differences
c_1- Golden Giant	2193.28	100.0	0.00	Controller
c_2-Plenitude	2907.99	132.6	714.71	***
c_3-Amont	1182.55	53.9	-1010.72	000
c_4-Hopi Red Dye	1453.28	66.3	-740.00	000
DL (p 5%)			17.11	
DL (p 1%)			22.91	
DL (p 0.1%)			30.22	

The productions obtained under the influence of the fertilization conditions are presented in table 2. It was obtained a significant production growth, of 19.1% in the fertilization conditions with the NPK complex, very outstanding as compared to the controller variant (the not fertilized culture), respectively a production growth of 5.1% in conditions of organic fertilization. This assures a great statistical relevance.

From the four sorts of *Amaranthus sp.* used in the observations regarding the yields quantity, it is noticed that Plenitude records a superior production growth with 32.6%, significantly statistically assured, to the controller variant (Golden Giant). Amont and Hopi Red Dye, compared to the controller variant, provide inferior productions, of significant statistical relevance (Table 3).

In tabels 4, 5, 6 are displayed the average yields obtained and the significance of the differences recorded, depending on the interaction of the technological factors considered.

In table 7 are presented the yields obtained after the interaction of all the three technological factors.

Table 4

Interaction between irrigation – fertilization factors on the production (kg/ha) of *Amaranthus sp,.* in the year 2015, in Teiuș area, Alba County

Variant	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance of the differences
a_1 b_1	1540.81	100.0	0.00	Controller
a_2 b_1	2038.78	132.3	497.97	***
a_1 b_2	2049.69	100.0	0.00	Controller
a_2 b_2	1712.97	83.6	-336.72	000
a_1 b_3	1790.06	100.0	0.00	Controller
a_2 b_3	2473.36	138.2	683.30	***
DL (p 5%)			30.30	
DL (p 1%)			46.70	
DL (p 0.1%)			82.00	

Notes: a_1-not irrigated, respectively a_2-irrigated; b_1.not fertilized, b_2-fertilized with (organic) stable manure, b_3- complex fertilizer (NPK).

Tablel 5

Interaction between factoris irrigation and sort, on the production (kg/ha) of *Amaranthus sp.*, in the year 2015, in Teiuș area, Alba County

Variant	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance of the differences
a_1 c_1	2373.64	100.0	0.00	Controller
a_2 c_1	2012.91	84.8	-360.73	000
a_1 c_2	2235.49	100.0	0.00	Controller
a_2 c_2	3580.49	160.2	1344.99	***
a_1 c_3	999.80	100.0	0.00	Controller
a_2 c_3	1265.31	136.6	365.50	***
a_1 c_4	1565.13	100.0	0.00	Controller
a_2 c_4	1341.43	85.7	-223.70	000
DL (p 5%)			23.70	
DL (p 1%)			35.21	
DL (p 0.1%)			61.81	

Notes: a_1-not irrigated, respectively a_2-irrigated; c_1-Golden Giant, c_2-Plenitude, c_3-Amont, c_4-Hopi Red Dye

Table 6

Interaction between factors fertilization – sort on the production (kg/ha) of *Amaranthus sp.*, in the year 2015, in Teiuș area, Alba County

Variant	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance of the differences
b_1 c_1	1563.47	100.0	0.00	Controller
b_2 c_1	2270.01	145.2	706.55	***
b_3 c_1	2746.35	175.7	1182.89	***
b_1 c_2	3250.31	100.0	0.00	Controller
b_2 c_2	2277.75	70.1	-972.56	000
b_3 c_2	3195.90	98.3	-54.41	00
b_1 c_3	1032.09	100.0	0.00	Controller
b_2 c_3	1248.91	121.0	216.82	***
b_3 c_3	1266.66	122.7	234.57	***
b_1 c_4	1313.30	100.0	0.00	Controller
b_2 c_4	1728.63	131.6	415.33	***
b_3 c_4	1317.91	100.4	4.61	-
DL (p 5%)			35.26	
DL (p 1%)			49.01	
DL (p 0.1%)			68.72	

Notes: b_1-not fertilized, b_2-fertilized with (organic) stable manure, b_3- complex fertilizer (NPK), c_1-Golden Giant, c_2-Plenitude, c_3-Amont, c_4-Hopi Red Dye

Table 7

Interaction between factors irrigation regime - fertilization – sort on the production (kg/ha) of *Amaranthus sp.*, in the year 2015, in Teiuș area, Alba County

Variant	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance of the differences
a_1 b_1 c_1	1836.85	100.0	0.00	Controller
a_2 b_1 c_1	1290.08	70.2	-546.77	000
a_1 b_1 c_2	2181.67	100.0	0.00	Controller
a_2 b_1 c_2	4318.96	198.0	2137.29	***
a_1 b_1 c_3	653.32	100.0	0.00	Controller
a_2 b_1 c_3	1410.86	216.0	757.55	***
a_1 b_1 c_4	1491.39	100.0	0.00	Controller
a_2 b_1 c_4	1135.21	76.1	-356.17	000
a_1 b_2 c_1	3264.27	100.0	0.00	Controller
a_2 b_2 c_1	1275.76	39.1	-1988.51	000
a_1 b_2 c_2	2012.47	100.0	0.00	Controller
a_2 b_2 c_2	2543.03	126.4	530.56	***
a_1 b_2 c_3	985.53	100.0	0.00	Controller
a_2 b_2 c_3	1512.33	153.5	526.77	***
a_1 b_2 c_4	1936.48	100.0	0.00	Controller
a_2 b_2 c_4	1520.78	78.5	-415.70	000
a_1 b_3 c_1	2019.80	100.0	0.00	Controller
a_2 b_3 c_1	3472.90	171.9	1453.10	***
a_1 b_3 c_2	2512.34	100.0	0.00	Controller
a_2 b_3 c_2	3879.47	154.4	1367.13	***
a_1 b_3 c_3	1360.56	100.0	0.00	Controller
a_2 b_3 c_3	1172.76	86.2	-187.80	000
a_1 b_3 c_4	1267.52	100.0	0.00	Controller
a_2 b_3 c_4	1368.30	108.0	100.78	***
DL (p 5%)			47.10	
DL (p 1%)			66.59	
DL (p 0.1%)			99.51	

Notes: a_1-not irrigated, respectively a_2-irrigated; b_1-not fertilized, b_2-fertilized with (organic) stable manure, b_3- complex fertilizer (NPK), c_1-Golden Giant, c_2-Plenitude, c_3-Amont, c_4-Hopi Red Dye

CONCLUSIONS

It has been concluded, based on the results presented above, that in the conditions of Teius experimental field (Alba County – Romania) the highest average yields were obtained:

1. in irrigation conditions - 2075.00 kg/ha;
2. in variants with NPK fertilizer - 2131.71 kg/ha;
3. for Plenitude sort - 2907.99 kg/ha.

The average yield obtained for variants fertilized with (organic) stable manure are lower in irrigation conditions then non-irrigation conditions.

Golden Giant and Hopi Red Dye sorts showed lower average yields in irrigation conditions then in non-irrigation conditions.

Plenitude sort showed the highest yields for non-fertilized variants.

In the variants with interaction between the three factors (irrigation regime – fertilization regime – sort) Golden Giant and Hopi Red Dye showed average yields with a decreased trend in irrigation conditions, in non-fertilized conditions, fact repeated also for variants with (organic) stable manure interactions.

In conditions created by interaction between irrigation regime – fertilization with NPK, only Amont sort showed a decreased trend for the variant were was applied irrigation within the other two interactions.

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