

RESEARCH REGARDING THE INFLUENCE OF SOME TECHNOLOGICAL FACTORS ON THE *AMARANTHUS SP.* YIELDS OBTAINED IN TEIUȘ 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 Teiuș area, Alba County. 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 Teiuș, 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 October, 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 cruentus*), 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 a₁-not irrigated, respectively a₂-irrigated), fertilization conditions with three gradations (noted with b₁-not fertilized, b₂-fertilized with (organic) stable manure, b₃-complex fertilizer (NPK), and sort with four gradations (noted c₁-Golden Giant, c₂-Plenitude, c₃-Amont, c₄-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 m²), 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

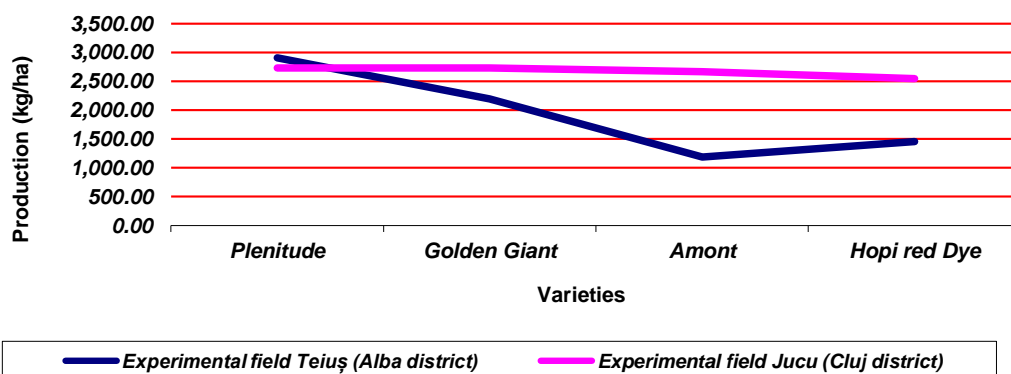


Fig. 1. Comparative data regarding theyields obtained in different climate and soil (pedo-climatic) conditions within four cultures of *Amaranthus*

In figure 1 are presented comparative data regarding the productions obtained in the conditions of the experimental field Teiuș, 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
a1 – non-irrigated	1793.52	100.0	-	Controller
a2 - 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
b1- non-fertilized	1789.79	100.0	0.00	Controller
b2-organic fertilized	1881.33	105.1	91.53	***
b3-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
c1- Golden Giant	2193.28	100.0	0.00	Controller
c2-Plenitude	2907.99	132.6	714.71	***
c3-Amont	1182.55	53.9	-1010.72	000
c4-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 tables 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: a₁-not irrigated, respectively a₂-irrigated; b₁.not fertilized, b₂-fertilized with (organic) stable manure, b₃- complex fertilizer (NPK).

Table 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: a₁-not irrigated, respectively a₂-irrigated; c₁-Golden Giant, c₂-Plenitude, c₃-Amont, c₄-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: b₁.not fertilized, b₂-fertilized with (organic) stable manure, b₃- complex fertilizer (NPK), c₁-Golden Giant, c₂-Plenitude, c₃-Amont, c₄-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: a₁-not irrigated, respectively a₂-irrigated; b₁-not fertilized, b₂-fertilized with (organic) stable manure, b₃- complex fertilizer (NPK), c₁-Golden Giant, c₂-Plenitude, c₃-Amont, c₄-Hopi Red Dye

CONCLUSIONS

It has been concluded, based on the results presented above, that in the conditions of Teiuș 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 than non-irrigation conditions.

Golden Giant and Hopi Red Dye sorts showed lower average yields in irrigation conditions than 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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