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STUDY ON THE IDENTIFICATION OF *AMARANTHUS* VARIETIES FOR FRESH CONSUMPTION

Luminița GĂITĂNARU[1], Costel VÎNĂTORU[2], Elena DOBRIN[1], Elena Maria DRĂGHICI[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest,
59 Mărăști Blvd, District 1, Bucharest, Romania
[2]Plant Genetic Resources Bank for Vegetables, Floricultural,
Aromatic and Medicinal Plants Buzău, Romania

Corresponding author emails: draghiciem@yahoo.com; elena.dobrin@gmail.com

Abstract

Amaranthus spp. has demonstrated a special vitality, growing in many types of environments, the genus having pioneer species that have found unoccupied niches in nature, such as colonizing affected lands. It produces many seeds that germinate quickly, staggered and the productivity is exceptional, allowing several harvests per year. The leaves are edible and have a taste similar to loboda (Atriplex hortensis), being more succulent and making culinary preparations denser. It has a tendency to assimilate nitrogen in the form of nitrates and cultivated on soils on which excess nitrogen fertilizers have been applied, it becomes toxic to humans and animals, such as cattle and pigs, causing indigestion and bloating. The study aims to analyze and identify Amaranthus varieties that are recommended for consumption.

Key words: *amaranth, cultivars, identification, nutrients.*

INTRODUCTION

Amaranthus, known as "știr" in Romanian, is a plant with a long history of use in nutrition due to its high nutritional value and adaptability to various environmental conditions. In recent years, research has focused on identifying *Amaranthus* varieties suitable for fresh consumption, considering their health benefits and potential to diversify the human diet (Popescu, 2021).

These crops are highly nutritious and environmentally resistant. They can be adapted to different environmental conditions, being cultivated in poor soils and high altitudes (Valcárcel-Yamani & Caetano, 2012).

Studies have shown that different varieties of *Amaranthus* exhibit significant variations in terms of phytochemical composition and antioxidant activity. For example, research has indicated that "amaranth seeds represent a potentially rich source of polyphenols and gluten-free protein compounds, with cultivars such as Hopi Red Dye being the richest in such compounds" (Ionescu & Radu, 2020).

Additionally, amaranth is recognized for its high content of antioxidants, such as gallic acid, p-hydroxybenzoic acid, and vanillic acid, which can help protect against diseases (Dumitru et al., 2019).

These antioxidant properties contribute to reducing inflammation and preventing chronic conditions, making amaranth a valuable component of modern diets (Mihai, 2022).

Amaranth foliage is used as a vegetable and as animal feed, especially in the tropics and subtropics. It is an excellent source of bioavailable iron (Rangarajan & Kelly, 1994).

Given these aspects, identifying and cultivating *Amaranthus* varieties suitable for fresh consumption represents an opportunity to improve dietary diversity and promote healthy nutrition. It is essential to continue research to evaluate the potential of these varieties in different agroecological conditions and to fully understand their benefits for human health (Georgescu & Marin, 2023).

MATERIALS AND METHODS

Study area

The study was conducted within the Bucov Botanical Garden, located in Prahova County, Romania.

This location was chosen due to the favorable pedoclimatic conditions for cultivating species of the genus *Amaranthus*. The soil in this area is cambic chernozem, with a medium texture, moderate humus content, and a neutral pH (6.5-7.0).

The climate is temperate continental, with an average annual temperature of approximately 10°C and an average annual precipitation ranging between 650 and 700 mm.

Biological Material

In this study, five lines of *Amaranthus* were used, selected for both their food value and ornamental value:

L1 - *Amaranthus cruentus* (food variety, known as "red știr");

L2 - *Amaranthus cruentus* (food variety, intended for popcorn production)

L3 - *Amaranthus caudatus red* (food and ornamental variety);

L4 - *Amaranthus retroflexus* (food and energy variety);

L5 - *Amaranthus caudatus* (ornamental variety).

The seeds of each line were selected from certified batches and tested for viability before sowing.

The experiment was conducted in open-field conditions, following a completely randomized experimental design with three replications for each line.

Sowing was carried out at the end of April, using a row spacing of 50 cm and 15 cm between plants within a row.

During the growing season, the following technological measures were applied:

Irrigation - drip irrigation was used to ensure consistent soil moisture.

Fertilization - organic compost-based fertilizer was applied at a rate of 10 t/ha.

Weed control - manual weeding was performed to maintain the ecological nature of the crop.

Parameters analyzed

For each *Amaranthus* line, the following agronomic and nutritional parameters were monitored: plant height, number of leaves, and leaf area.

Statistical analysis

The experimental data were processed using analysis of variance (ANOVA), and significant differences between lines were tested using Duncan's test ($p < 0.05$). The software used for statistical processing was SPSS.

RESULTS AND DISCUSSIONS

The analysis of morphological and physiological parameters of different *Amaranthus* lines is essential for identifying the most suitable varieties intended for fresh consumption. In this study, characteristics such as plant height, branching, leaf size, and inflorescence length were evaluated, considering their impact on yield and production quality.

The results obtained highlight significant differences between the analyzed lines, each having specific traits that can influence both agricultural production and food use.

Below, we will present and interpret the data, emphasizing the strengths and limitations of each variety.

Plant Height

L4 and L3 were the tallest lines, with average heights of 111 cm.

L1 had the smallest height (78 cm), which may indicate slower growth or a different adaptation to environmental conditions (Table 1).

Stem Height

L3 and L5 had taller stems, 11.6 cm and 11.8 cm, respectively, which may indicate a more robust plant structure.

L1, L2 and L4 had stems shorter than 3 cm, 2 cm and 2.4 cm, respectively, which may indicate a difference in plant architecture

Table 1. Plant and stem height

Lines	Plant height (cm)	Stem height (cm)
L1	78 ± 15^{a}	3 ± 0^{a}
L2	107 ± 5^{b}	2 ± 0^{a}
L3	111 ± 16^{b}	11.6 ± 2.3^{b}
L4	111 ± 27^{b}	2.4 ± 0.5^{a}
L5	97 ± 18^{a}	11.8 ± 1.4^{b}

Number of Primary and Secondary Shoots and bush diameter can be observed in Table 2.

L2 had the highest number of primary shoots (13.4), suggesting a high branching capacity.

L4 dominates in the number of secondary shoots (21.8), which may indicate good regeneration potential and higher plant density (Table 2).

L4 had the largest bush diameter (103 cm), which requires planting to be carried out at a greater distance between plants.
L1 and L2 had smaller dimensions (59 cm and 74 cm, respectively), which can influence the plant biomass but also the planting distances (Table 2).

Table 2. Number of shoots and bush diameter

Lines	Main shoots (no.)	Secondary shoots (no.)	Bush diameter (cm)
L1	3±0^{ab}	8.8±0.8^{a}	59±10.6^{a}
L2	13.4±13.4^{d}	6.6±1.51^{a}	74±11^{ab}
L3	3.6±0.5^{b}	14.6±2.9^{b}	99±25^{a}
L4	10.8±0.8^{c}	21.8±1.7^{c}	103±27^{a}
L5	2.6±0.5^{a}	8.6±1.3^{a}	88±24^{ab}

Number of Leaves
L4 had the highest number of leaves (202 leaves), suggesting a high photosynthetic potential.
L5 had the lowest number of leaves (90.4 leaves), which may affect total biomass production.
Leaf Length
L3 and L4 had longer leaves (5.8 cm), which could make them more attractive for food consumption. The other lines have smaller leaves, L1 with 4.3 and L2 4.6 cm), which may influence texture and harvesting yield (Table 3).

Table 3. Number of leaves on plants

Lines	Leaves no.	Leaf length (cm)	Distance between leaves/plant (cm)
L1	186±20^{c}	4.3±0.6^{b}	8.4±1.1^{b}
L2	160±55^{bc}	4.6±0.4^{b}	0.5±0.5^{a}
L3	120±12^{ab}	5.8±0.9^{a}	1.4±1.4^{b}
L4	202±59^{c}	5.8±1^{a}	0.8±0.8^{a}
L5	90.4±8.2^{a}	4.6±0.4^{b}	2.5±2.5^{c}

Distance Between Leaves on the Plant
L1 had the greatest distance between leaves (8.4 cm), indicating a more open plant structure.
L4 and L2 had the smallest distances between leaves (0.8 cm, respectively 0.5 cm), which may favor denser foliage.
Inflorescence Length
L4 had the longest inflorescences (46 cm), which could be advantageous for reproduction and seed production.
L2 and L3 had shorter inflorescences (30 cm respectively 7 cm) (Table 4).

Number of Spikes per Plant
L4 had the highest number of spikes (18.8), indicating a high seed yield potential. This line appears to be the most vigorous line, with the greatest height, the most leaves, and the highest number of spikes, suggesting high potential for biomass and seed production.

Table 4. The inflorescence length and number of spikes on plant

Lines	Inflorescence length (cm)	Spikes no./plant
L1	32±6.7^{a}	7.4±1.1^{a}
L2	30±2.4^{a}	14.8±2^{c}
L3	7.7±7.7^{b}	13.4±3.3^{bc}
L4	46±5.1^{b}	18.8±3.2^{d}
L5	14.4±14.4^{b}	10.6±1.6^{ab}

The images in the study illustrate the morphological characteristics of the different *Amaranthus* lines, highlighting significant variations in plant height, leaf size and number, inflorescence length and stem structure.
Figures 1-5 present *Amaranthus* plants differences in branching, leaf density and production potential.

Figure 1. L1 - *Amaranthus cruentus*
(food variety, known as “red știr”)

Figure 2. L2 - *Amaranthus cruentus*
(food variety, intended for popcorn production)

Figure 3. L3 - *Amaranthus caudatus red*
(food and ornamental variety)

Figure 4. L4 - *Amaranthus retroflexus*
(food and energy variety)

Figure 5. L5 - *Amaranthus caudatus*
(ornamental variety)

CONCLUSIONS

It can be appreciated that the study on the identification of *Amaranthus* varieties for fresh consumption is very relevant for both the horticultural and food sectors. *Amaranthus* is a plant with multiple uses, being appreciated both for its nutrient-rich leaves and for its seeds. Therefore, the identification of the most suitable varieties for fresh consumption can contribute to increasing the diversity of products on the market but also to diversifying sustainable food sources.

The study on different *Amaranthus* lines intended for fresh consumption highlighted significant variations in the morphological and physiological characteristics of the plants. Based on the results obtained, the following conclusions can be drawn:

- *L4* stood out for its greatest height, high number of leaves, and spikes, making it a promising variety for biomass and seed production.
- *L2* demonstrated a high branching capacity, with the highest number of primary shoots, which may positively influence plant regeneration and crop yield.
- *L3 and L4* had longer leaves, which could be an advantage for fresh consumption.
- *L1 and L5* had the lowest number of spikes and leaves, which may limit their productivity compared to the other lines.
- Lines with dense foliage and vigorous growth (*L4, L2*) are the most suitable for intensive agricultural exploitation.
- *L5*, although less productive, may have ornamental applications or be used in mixed crops due to its distinctive appearance.

The results of this study confirm the need for rigorous selection of *Amaranthus* lines to optimize both agronomic yield and nutritional value.

In the future, additional studies on the phytochemical composition and health impact are necessary to confirm the benefits of consuming these varieties.

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