



## New Single Hybrid Popcorn Variety “ATASAM”

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### ABSTRACT

The aim of this study is to present the yield and quality characteristics of ATASAM hybrid single-hybrid popcorn variety developed by pure line selection method to the scientific world. ATASAM is a new popcorn hybrid produced by single crossing of pure lines “TCK77” as the male parent and “Yerli Yug Sarı” as the female parent. It was registered under the name ATASAM at the STK (Vegetable Registration Committee) meeting in March 2022 on behalf of the Black Sea Agricultural Research Institute. This variety, which popping in the shape of a butterfly, has an orange-yellow grain color and anthocyanin content in the cob tassel. In yield trials conducted in different regions of Turkey, it gave an average yield of 6610 kg/ha. The average popping volume is 33.3% and the rate of non-popping grain is 2.4%. The average number of flowering day of the ATASAM variety is 77 days, plant height is 215 cm, cob height is 85 cm, 1000 grain weight is 158 g, and hectoliter content is 79.8 kg/hl. The average protein content was measured as 11.2%, fat content as 3.6%, Ca content as 60.6 mg/kg, Fe content as 30.3 mg/kg, Zn content as 29.2 mg/kg, Cu content as 4.1 mg/kg and Manganese content as 11.4 mg/kg. ATASAM variety is 18.6% higher than the standards average in terms of yield and 12% higher in terms of popping volume.

**Keywords:** Popcorn, macro and micro elements, quality ratio and energy value

### Introduction

Popcorn, which is among the oldest and most popular snacks consumed extensively in the world, can be easily popped with different popping methods (oil, air and microwave). Popcorn is constantly increasing in popularity for breakfast and meals today, as it is a high-quality and concentrated source of nutrients with its chemical content (proteins, antioxidants, fiber, vitamin B). In the USA, where popcorn consumption is the highest in the world although the majority of consumption is at home, the intense work tempo of today's life contributes to the continuous development of the ready-made food industry. It is reported that the world popcorn market will be at the level of 5.54 billion US dollars in 2022. It is estimated that this market will reach 13.53 billion US dollars with an annual increase of 11.10% in 2030 (Anonymous, 2023a).

Although there are no reliable statistics and systematic production data regarding popcorn production and consumption in Turkey, it is reported that 50-60 thousand tons of the product is produced in an area of 8-10 thousand hectares. Turkey's annual popcorn consumption is 22-25 thousand tons. The remaining part is exported to 26 countries, which contributes to it being among the top ten countries in terms of exports in the world (Anonymous, 2023b). However, the production remains well below the market potential. However, the limited number of varieties with both satisfactory agronomic characteristics and high popping volume is one of the main obstacles to the expansion of Turkey's popcorn crop. Although 19 popcorns are registered in Turkey according to the Standard Seed registration list, only a few varieties can be produced due to the contracted farming model. The contract farming model is widely used in popcorn production in Turkey.

In this model, seeds and other inputs are provided by the companies, so the seeds provided by the company are used extensively. This situation partially restricts the availability of these varieties in the market. It is of great importance for the producer and the company that contracted farming companies give new varieties a chance. The high efficiency and/or high popping volumes that developed and registered varieties can offer can contribute to increasing the income of the producer and the company. The use of new varieties in production will contribute to increasing the income obtained from unit area (Anonymous, 2023c).

The aim of this study is to introduce the ATASAM hybrid popcorn variety, which ranks first in terms of yield and quality (popping volume and non-popping grain ratio, etc.), to the scientific world.

### Materials and Methods

ATASAM hybrid popcorn variety was obtained by crossing the main line (Yerli Yug Sarı) and TCK 77 sire lines. The main line of the ATASAM variety was bred by the Batı Akdeniz Agricultural Research Institute, and the sire line TCK 77 was bred by the Black Sea Agricultural Research Institute according to the pure line selection method. The lines were obtained by allowing domestic and foreign interaction materials to open pollination and then by selecting them according to their agro-morphological characteristics and transferring them to the next generation. Hybrid combinations were made during the 2016 corn growing season in the Samsun location. The breeding population was created by obtaining from domestic and international sources. Initially, 2000 cobs were selected from approximately 200 populations obtained from different sources (During inbreeding, selection was made according to agro-morphological characteristics (number of days to flowering, tassel spikelet density, cob shape and firmness). Single ear selection method was used during the breeding period (Table 1) Lines selected according to agro-morphological characteristics were crossed with two testers to determine their General Combination compatibility. The resulting hybrids were put into the test hybrid yield trial. Here, efficiency, blasting volumes and heterosis rates were the main selection criteria. It was decided that TCK 77, one of the parents of ATASAM popcorn variety, would be used as the father line due to its high burst volume and tassel spikelet density, and the Yerli Yug Sarı line would be used as the main parent due to its high popping volume and ear structure.

ATASAM popcorn variety was tested together with standard varieties in 2017 in 4 different locations (Izmir, Isparta, Samsun and Amasya) to determine its yield and quality characteristics. In the trial, plantings

were completed in May in all locations, harvests were finished in September in Izmir location and October in other locations. Cultural procedures were carried out on time (irrigation, fertilization, pesticide application, etc.). Planting was done with two seeds in the pits, 70 cm between rows and 20 cm between rows. At harvest, the cobs were collected by hand and grain yield was arranged according to grain moisture. Hectolitre analysis of corn was done gravimetrically with a hectolitre measuring cylinder. The protein amount of the corn and the total nitrogen (N) content of the samples were determined by the Kjeldahl method (Kacar, 1972). Multi-element content in corn products was made according to Kacar and İnal 2010. In order to determine the popping volume ( $\text{cm}^3/\text{g}$ ) 50 g samples were weighed and the explosion was carried out process with 1100 W Kiwi KPM-7408 brand hot air blowing machines according to İdikut et al. (2015).

### Results and Discussion

Data obtained from four different locations in 2017 are given in Figure 1-5. The average plant height of the standards was measured as 212.3 cm, and the ATASAM variety was measured as 215.6 cm, and the plant height is high. The ear height is similar to the standard average at 85.6. (Figure 1). The average number of flowering days for the standards was determined as 77.3 days, and for the ATASAM variety as 77.9 days. ATASAM variety is in the mid-late group with the number of flowering days similar to the standards (FAO 550-580). The grain/cob ratio of ATASAM popcorn variety was measured as 80.3% and the standard average was 81.2% (Figure 1).

The thousand grain weight was 157.8 g, close to the average of the standards (160.6 g), and the thousand grain weight is in the large group. The hectoliter of the ATASAM variety was measured as 79.8 kg/hl, and the hectoliter of the standards was measured as 80.9 kg/hl (Figure 2). The popping rate of the standard varieties was measured as  $29.5 \text{ g/cm}^3$  and that of the ATASAM variety was  $33.3 \text{ g/cm}^3$ . When evaluated in terms of popping volume, it was determined that the popping volume was 12% higher than the standards. The non-popping grain rate of the standards was measured as 10.6%, while it was measured as 2.4% in the ATASAM variety. The low rate of non-popping grains contributed to the high measurement of the popping volume (Figure 2).

The average yield of the standards was measured as 5571.7 kg/ha, and the yield of the ATASAM variety was measured as 6610.5 kg/ha (Figure 3). K content of ATASAM popcorn variety was measured as 2757.8 mg/kg, P 1283 mg/kg, Mg 1236.8 mg/kg. According to the standards, P and Mg content is determined as high and P content as low (Figure 3).

The protein content of the ATASAM variety was measured as 11.2%, the fat content was 3.6%, the Ca content was 60.6 mg/kg, the Fe content was 30.3 mg/kg, the Zn content was 29.2 mg/kg, the Cu content was 4.1 mg/kg, and the Mn content was 11.4 mg/kg. (Figure 3 and Figure 4). The average protein content of the standards was measured as 10.8%, fat content 3.6%, Ca content 58.2 mg/kg, Fe content 27.5 mg/kg, Zn content 28.7 mg/kg, Cu content 4.0 mg/kg, Manganese content 11.4 mg/kg. Similar results were obtained in terms of macro-micro nutrient content the chemical content of the grain (Figure 4 and Figure 5). Energy values were measured as 356.7 kcal, and ATASAM variety was measured as 355.2 kcal. When popcorn, which is a whole grain food, is popping in air blowing machines, its energy values are measured to be lower than its oily and sauced versions (Figure 5).

In studies conducted in different regions of Turkey (Aegean, Mediterranean and Black Sea), ATASAM variety ranks first in terms of yield. When evaluated in terms of morphological characteristics of the variety, the presence of anthocyanin in the top tassel is absent or weak. Anthocyanin density is high in the cob tassel, but there is no anthocyanin in the stem and leaves (Table 2). The top tassel, side branches and

axis length are high, the top grain color is orange, and the popping volume is high. Introductory pictures of the ATASAM popcorn variety are given in Figure 6.

### Conclusions

Türkiye has an important place in the world in popcorn production and consumption. Although popcorn trade in the world started in the last century, it has gained great momentum in the last decade. Although it is important to carry out productivity and quality together in breeding studies, this is even more important in popcorn. In popcorn breeding, high yield and popping volume and low non-popping grain rate are evaluated together. ATASAM hybrid popcorn variety stands out with its many advantageous aspects. ATASAM hybrid popcorn variety has high yield and popping volume and low non-popping grain ratio. Turkish plant variety protection has been applied for the variety. Breeder a foundation seed of the variety will be produced and maintained by Black Sea Agricultural Research Institute. ATASAM hybrid popcorn variety, with its high yield and popping volume, has the potential to provide additional income for producers and industrialists in contract farming. However, it will contribute positively to its place in the daily diet with its high content of macro and micro nutrients and low energy content.

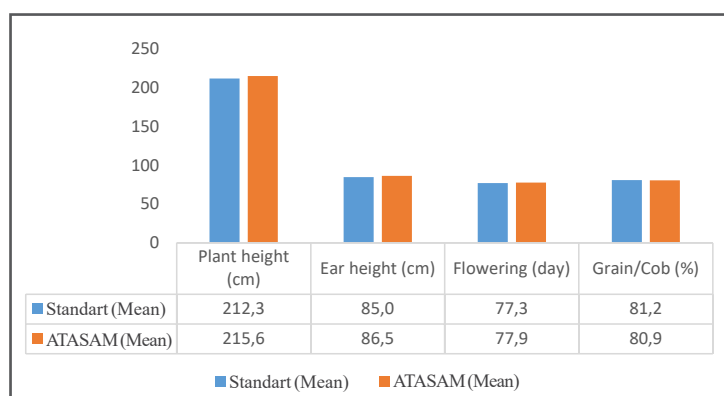


Figure 1. Averages of some agromorphological characteristics and genotypes.

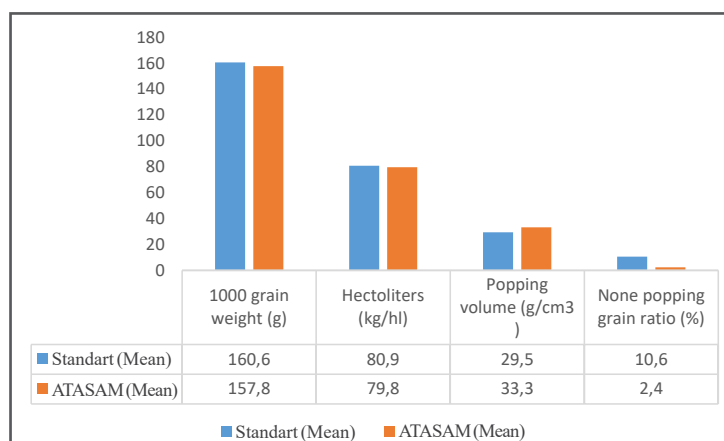


Figure 2. Averages of some yield elements and physical characteristics of genotypes.

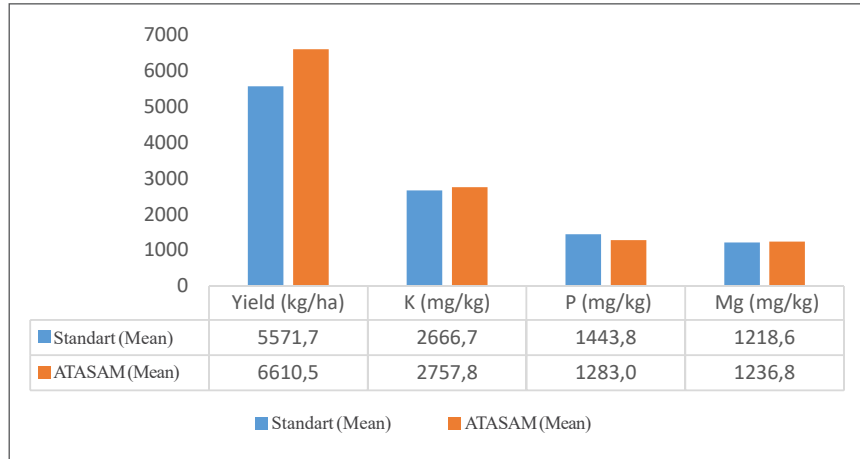


Figure 3. Yield (kg/ha) and macro nutrient content of genotypes.

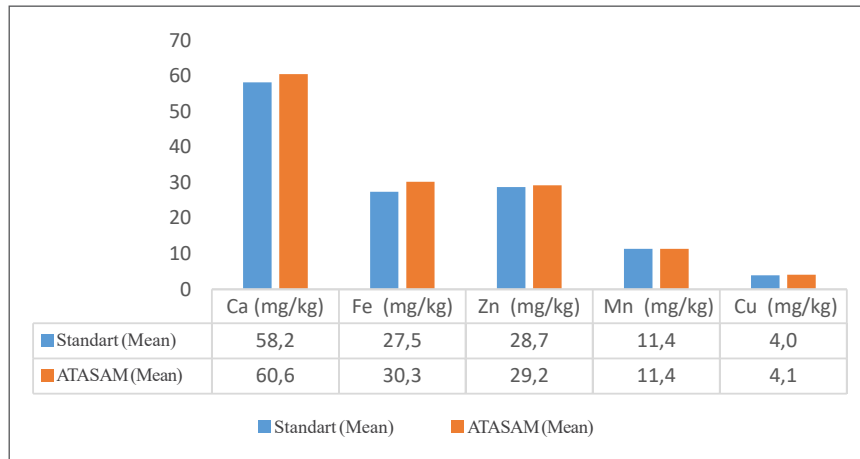


Figure 4. Micro nutrient content of genotypes.

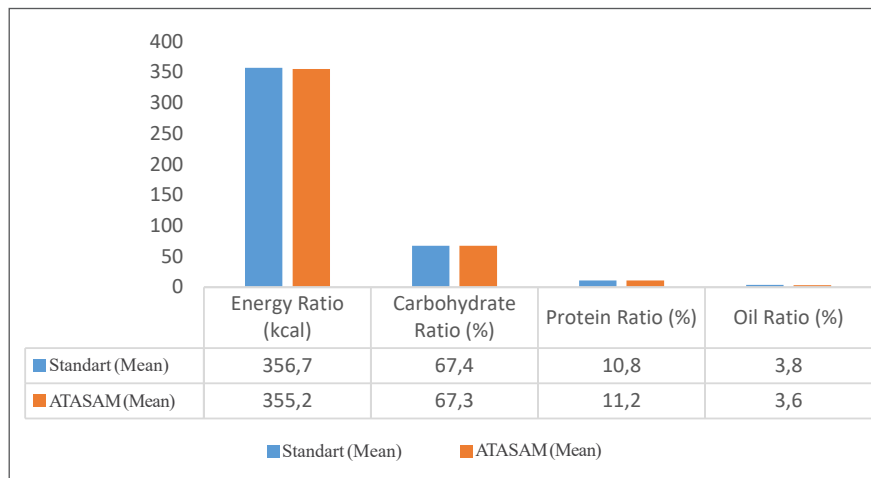


Figure 5. Grain Chemical Content of Genotypes.



Figure 6. Plant, 1000 grains, ear and popped grain view (Original).

Table 1. List of self-made materials.

Breeding Materials	Number of inbred ear plants	Selection criteria	Number of plants selected
S <sub>1</sub>	1000	Plant and cob appearance, Number of days to flowering	650
S <sub>2</sub>	650	Plant and cob appearance, Number of days to flowering	742
S <sub>3</sub>	742	Plant and cob appearance, Number of days to flowering	546
S <sub>4</sub>	546	Plant and cob appearance, Number of days to flowering	283
S <sub>5</sub>	283	Uniformity, Stability	112
S <sub>6</sub>	112	Uniformity, Stability	94
S <sub>7</sub>	94	Uniformity, Stability,	

Table 2. Some important characteristics of ATASAM popcorn variety.

Observations	Characteristics	State of expression	Note
Tassel	Time of tassel	Medium to late	6
Tassel	Anthocyanin colorations of anters	Strong	7
Ear	Time of silk emergence	Late	7
Ear	Anthocyanin colorations of anters	Strong	7
Leaf	Anthocyanin colorations of leaf	Absent or very weak	1

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