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THE CULTURE BEHAVIOR OF SOME POTATO CULTIVARS (*SOLANUM TUBEROSUM* L.) GROWN IN THE POIANA AREEA, CONSTANȚA COUNTY, BETWEEN 2021 AND 2024

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ABSTRACT

The paper presents the results of research conducted between 2021 and 2024 in the vegetable-growing area of Poiana (Constanța County), aiming to evaluate the agronomic performance of five potato cultivars (Arizona, Evolution, Queen Anne, Riviera, and Labella) grown in an early field cropping system under full irrigation conditions.

The main morpho-productive indicators were assessed: number of aerial stems per plant, number of tubers per hill (cluster), average hill weight, and total yield (t/ha). The results revealed significant differences among cultivars. Arizona recorded the highest values for all evaluated parameters (8.3 stems/plant, 12.6 tubers/hill, 42.3 t/ha), followed by Evolution and Queen Anne. Riviera and Labella stood out due to tuber uniformity and earliness, features relevant for fresh market production.

Correlation analysis showed a strong positive relationship between annual precipitation and yield ($r = 0.96$), as well as between relative air humidity and yield ($r = 0.97$). Average annual temperature had a low influence ($r = 0.15$), suggesting good thermal adaptability of the tested cultivars.

The results support practical recommendations for cultivar selection based on local agroclimatic conditions and cropping system requirements in southeastern Romania.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important crops for human nutrition worldwide, being a major source of carbohydrates, vitamins, and antioxidants (Brown, 2005). With global production exceeding 350 million tons annually, potato ranks fourth after wheat, maize, and rice in terms of its role in global food security (Stark et al., 2020). Its ability to adapt to various climatic and soil conditions, along with its relatively short growing cycle, makes it a key crop for diversifying agricultural systems and maintaining resilience in the face of climate change (Kooman and Haverkort,1995; Hijmans, 2003).

In Romania, potato cultivation has a deep-rooted tradition, supported by research networks, breeding stations, and specialized growers, particularly in mountainous, hilly, and vegetable-growing areas. However, production is vulnerable to biotic pressures (diseases and pests), increasingly frequent water stress, and fluctuations in the agricultural market (Brașovean et al., 2009; Karasev & Gray, 2013). Additionally, the use of inconsistent technologies and the lack of certified seed potatoes contribute to high yield variability (Cretu et al., 1982; Bartha, 2000).

One of the current research priorities is the testing of commercial varieties under specific local conditions to identify genotypes that ensure yield stability and high tuber quality. Choosing regionally adapted varieties is essential for crop optimization, as it directly influences technological requirements, the farming calendar, and the farm's economic efficiency (Berindei et al., 1980; Zamir et al., 2010).

Moreover, the integrated application of plant protection measures and the use of modern adjuvants, such as Silwet L-77, contribute to increasing treatment efficiency and reducing the use of active substances, in line with the requirements of sustainable agriculture (Oltean et al., 2025). Recent studies on integrated pest management in potato cultivation highlight the need to correlate preventive measures with well-timed chemical interventions (Kreuze et al, 2020; Alyokhin et al., 2022; Bîtlan, 2025), especially in the context of emerging resistant pest biotypes such as *Leptinotarsa decemlineata* (Colorado potato beetle).

In southeastern Romania, the Poiana vegetable-growing area (Constanța County) has experienced significant development in potato cultivation in recent years, due to the extended growing season and the presence of mechanized farms. According to climate studies in Dobrogea, the region has high agricultural potential, but requires specific technological adaptations, particularly concerning water management and soil protection (Saplacan et al., 1981; Lungu et al., 2012).

This paper aims to analyze the agronomic behavior of five commercial potato varieties (Riviera, Evolution, Arizona, Labella, and Queen Anne), cultivated in the locality of Poiana, Constanța County, between 2021 and 2024. The study focuses on evaluating the productive potential, vegetative parameters, and adaptability of each variety under the specific conditions of the area, with the goal of formulating recommendations applicable to agricultural practice in the vegetable-growing basin of Dobrogea.

MATERIAL AND METHODS

The research was conducted between 2021 and 2024 in the Poiana vegetable-growing area, located in the south-central part of Constanța County, within the Southern Dobrogea Plain. The site features flat, mechanizable terrain and fertile chernozem soils, under a moderately continental climate. The experimental farm was equipped with a pivot irrigation system. The site coordinates were 44.58° N, 28.55° E.

Five potato cultivars were selected based on their frequency in Romanian and European agriculture, their adaptability to semi-arid conditions, and their production potential. Certified seed potatoes (base and C1 categories) sourced from the Netherlands and Germany were used, treated in accordance with phytosanitary regulations.

The trial covered 65 hectares, equally divided among the five cultivars with four replications each, using a randomized block design. Technological practices: including fertilization, planting, crop protection, and harvesting, were applied uniformly across all variants. Full irrigation was provided throughout each season.

Planting was carried out between April 15–20 each year, depending on weather, using certified C1 seed tubers. Planting depth was 6–8 cm, with a row spacing of 70 cm and 28–30 cm between plants. Seeding rates varied from 2500 to

2800 kg/ha, depending on cultivar. Irrigation was applied via pivot in 4 to 6 interventions per year, adjusted to crop stage and evapotranspiration.

Measurements were conducted throughout all four growing seasons. The analyzed parameters included: number of stems per plant, number of tubers per hill, total tuber weight per hill, average yield (t/ha), average tuber weight, and average tuber diameter. Data were averaged and analyzed to evaluate the mid-term performance of each cultivar.

Statistical analysis was performed using SPSS v26. One-way ANOVA was used to identify significant differences between cultivars ($p < 0.05$ and $p < 0.01$). Tukey's HSD test was applied for pairwise comparisons where applicable. Pearson correlation coefficients were calculated to assess relationships among variables, and linear regression models were used to estimate the influence of vegetative parameters on yield, evaluated by R^2 and slope significance

RESULTS AND DISCUSSIONS

Between 2021 and 2024, the Poiana area (Constanța County) demonstrated high agricultural potential for early field potato cultivation, due to its chernozem soils, irrigation access, and extended growing season. The local climate was marked by atmospheric instability and frequent heatwaves, especially in 2023 and 2024, with temperatures consistently exceeding 32–35 °C during critical crop stages. Annual average temperatures ranged from 10.8 °C to 11.6 °C, slightly above the multiannual mean, with june and july often registering highs of 32–35 °C. Heat stress episodes, particularly in 2022 and 2023, coincided with tuberization and dry matter accumulation phases, negatively affecting sensitive cultivars in the absence of consistent irrigation.

Rainfall patterns varied significantly across the years. In 2021, precipitation levels were close to the multiannual average. The year 2022 recorded a drier spring and a moderate water deficit in may–june. In 2023, rainfall was below average during the tuber formation period, likely reducing vegetative uniformity. The 2024 season was marked by severe pedological drought, with total precipitation estimated below 350 mm. Relative humidity frequently dropped below 60% in the summer months, while prevailing easterly winds accelerated soil moisture loss.

Although not presented in a dedicated table or figure, these insights are drawn from local meteorological monitoring and field notes. Future versions of this study will aim to include structured climatic data to better illustrate these interactions. The crop was established in an intensive irrigated system on flat, well-prepared land, with mechanized operations. Harvesting was carried out mechanically between late August and early September, depending on cultivar earliness. Laboratory analyses included average hill weight, number of tubers per hill, and average tuber weight.
One of the key vegetative parameters analyzed was the number of aerial stems per plant, a morphological indicator associated with initial vigor, biomass density, and tuberization capacity. Measurements were taken on four replications per cultivar at phenological stage BBCH 30–32, corresponding to the onset of stem elongation and full leaf development.

The four-year average results showed clear differences between cultivars. Arizona had the highest mean value (8.3 ± 0.48 stems/plant), followed by Evolution (7.5 ± 0.50) and Queen Anne (6.8 ± 0.42). Riviera (6.1 ± 0.39) and Labella (5.9 ± 0.47) recorded significantly lower values. One-way ANOVA confirmed highly significant statistical differences between cultivars ($F = 33.37$; $p = 2.64 \times 10^{-7}$), indicating real genetic variability in aerial stem development capacity.

These differences suggest differentiated adaptability to thermal and water stress and have direct implications for cultivar selection. The distribution of average stem number per plant is shown in figure 1, highlighting the varietal hierarchy in terms of initial vegetative vigor.

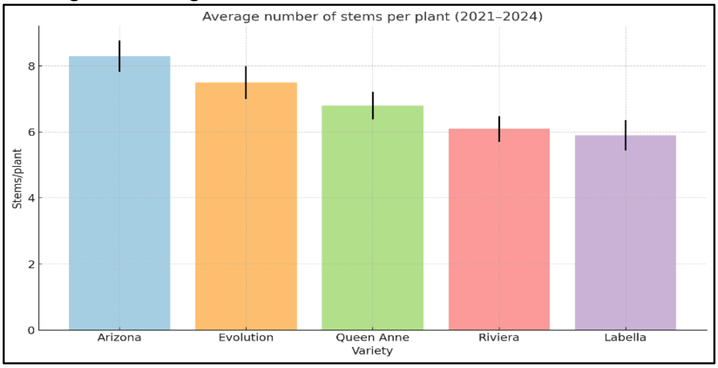

Figure 1. The distribution of the average number of stems per plant for each cultivar

During the analyzed period, the number of tubers formed per hill varied significantly among the five studied potato cultivars, reflecting genetic differences and the specific tuberization capacity under the pedoclimatic conditions of the Poiana area. Although it does not directly indicate yield in tons per hectare, this parameter is a recognized agromorphological indicator used to evaluate tuber-setting potential and distinguish genotypes.

The cultivar Arizona recorded the highest tuberization capacity, with an average of 12.6 ± 0.75 tubers per hill, followed by Evolution (11.2 ± 0.68) and Queen Anne (10.8 ± 0.62). Lower values were recorded for Riviera (9.3 ± 0.59) and Labella (8.7 ± 0.66), suggesting a growth strategy oriented toward forming fewer but larger commercial-grade tubers. Analysis of variance (ANOVA) revealed statistically significant differences among cultivars ($F = 13.30$; $p = 8.01 \times 10^{-5}$), confirming that the observed variation reflects real genetic potential and is not due to random factors. Arizona confirmed its leading position through a high tuber formation capacity under irrigated conditions, especially in favorable years (2021 and 2022). Evolution and Queen Anne also showed stable and balanced performance, maintaining effective tuberization rates even under moderate water stress. Riviera and Labella, despite having fewer tubers, compensated with superior size and uniformity, as confirmed by laboratory measurements.

These differences are relevant when selecting cultivars according to technological objectives. For farms focused on maximizing quantitative yield, cultivars with higher tuber numbers per hill are preferable. Conversely, in systems targeting uniform, high-quality tubers, cultivars with moderate but stable tuberization may be more advantageous. The distribution of average values is shown in figure 2, highlighting the clear hierarchy among cultivars and the inter-genotypic variation observed in the experiment.

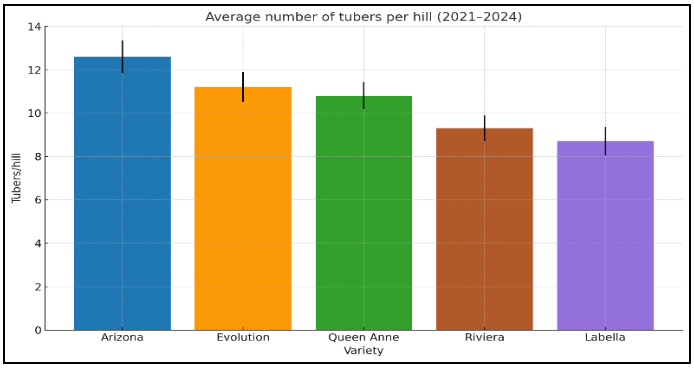

Figure 2. Average number of tubers per hill (2021–2024), for each cultivar

The average weight of tubers per hill is an important agronomic and commercial indicator, reflecting both cultivar productivity and efficiency in biomass allocation. Data from 2021 to 2024 revealed clear differences among the five studied cultivars under the specific conditions of the Poiana area.

Arizona showed the highest average tuber weight per hill (590 ± 35 g), followed by Evolution (545 ± 28 g) and Queen Anne (525 ± 30 g). Riviera and Labella recorded lower values (510 ± 27 g and 498 ± 33 g, respectively), though they maintained consistent performance considering their lower tuber counts, indicating a more efficient biomass distribution per tuber.

Analysis of variance (ANOVA) confirmed statistically significant differences among cultivars ($F = 3.08$; $p = 0.048$), suggesting real variability for this trait. Although the differences were less pronounced than those for tuber number, they remain relevant for commercial grading and uniformity.

Arizona's performance aligns with its high vegetative vigor and tuberization rate. Evolution and Queen Anne also demonstrated solid capacity to accumulate tuber mass, even under partial water stress in 2023 and 2024.

From a practical perspective, this parameter helps guide cultivar selection when uniformity and grading efficiency are important. Figure 3 presents the average weights per hill, illustrating the hierarchy of cultivars by their ability to accumulate marketable biomass.

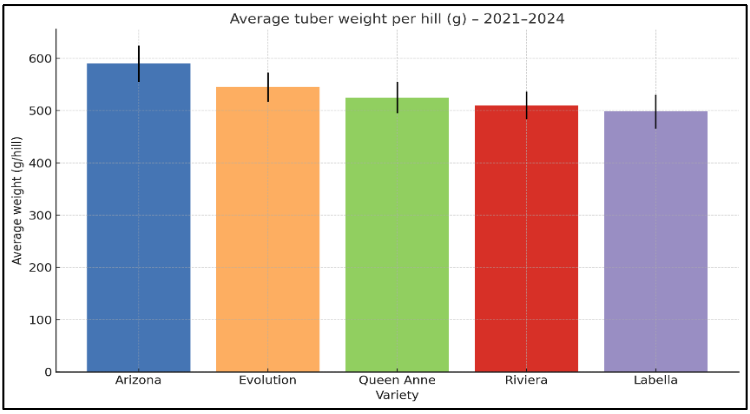

Figure 3. Average tuber weight per hill (g), 2021–2024, for each cultivar

Average tuber yield (t/ha) is a central indicator for assessing the overall agronomic performance of a cultivar, as it integrates genetic potential, environmental adaptability, and technological response. In the trials conducted in Poiana between 2021 and 2024, yield was influenced by both cultivar characteristics and external factors such as soil fertility, irrigation, and climatic variation.

Arizona achieved the highest average yield (42.3 ± 1.8 t/ha), followed by Evolution (38.9 ± 1.5 t/ha) and Queen Anne (37.5 ± 1.4 t/ha). Riviera (35.1 ± 1.3 t/ha) and Labella (34.6 ± 1.6 t/ha) recorded slightly lower but stable yields, maintaining performance even under more challenging weather conditions, particularly in 2023 and 2024.

Analysis of variance (ANOVA) confirmed statistically significant differences among cultivars ($F = 15.72$; $p = 3.04 \times 10^{-5}$), validating the existence of real variability in yield potential.

The results are visually presented in figure 4, which highlights the yield distribution among cultivars and confirms the advantages of those with vigorous growth and adaptability to southeastern Romanian conditions.

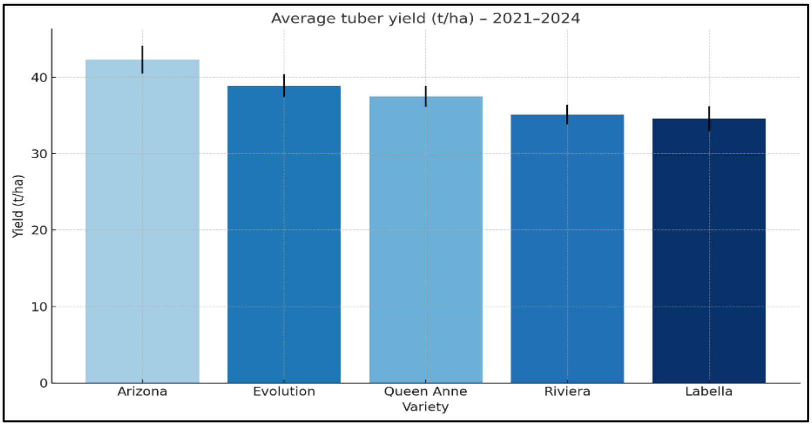

Figure 4. Average tuber yield (t/ha), 2021–2024, for each cultivar

To assess the impact of climatic factors on yield under local conditions in Poiana, a correlation analysis was performed between annual meteorological indicators and the average tuber yield (t/ha), calculated as the mean of all five cultivars for each year from 2021 to 2024.

The results showed a very strong positive correlation between total annual precipitation and yield ($r = 0.96$), confirming that rainfall is the primary climatic factor influencing production in the area. A similarly strong correlation was observed between relative air humidity and yield ($r = 0.97$), indicating that higher humidity supports soil moisture retention and reduces crop water stress. In contrast, average annual temperature had a negligible effect ($r = 0.15$), suggesting good thermal adaptability among the tested cultivars.

As illustrated in figure 5, yield increased proportionally with precipitation up to an optimal threshold near 490 mm (as in 2021). In contrast, years with low rainfall (2023 and 2024, < 370 mm) corresponded with the lowest yields, despite irrigation. To quantify the effect of precipitation on yield, a simple linear regression model was applied, resulting in the equation: Yield (t/ha) = 0.032 × Precipitation (mm) + 22.63. This suggests that for every additional 100 mm of rainfall, yield may increase by approximately 3.2 t/ha under the specific soil and technological conditions of the study area.

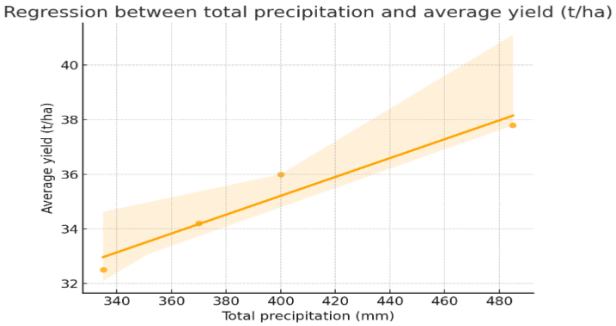

Figure 5. Regression between total precipitation and average yield (t/ha).

CONCLUSIONS

The study conducted over four agricultural years (2021–2024) in the Poiana vegetable-growing area highlighted significant genotypic differences among five potato cultivars grown under irrigated field conditions in southeastern Romania. Statistical analyses confirmed the existence of highly significant variations in key agronomic parameters, including number of stems per plant, tubers per hill, average hill weight, and yield expressed in t/ha.

Among the tested cultivars, Arizona showed superior performance across all indicators, confirming its high production potential under favorable technological conditions. Evolution and Queen Anne demonstrated consistent yields and good adaptability to years with moderate rainfall deficits. Riviera and Labella, although lower yielding, were characterized by uniform tuber shape and relative earliness, traits valuable for short-cycle production and fresh markets.

Correlation and regression analyses identified precipitation (r = 0.96) and air humidity (r = 0.97) as the primary climatic factors influencing yield variability. The average annual temperature had limited impact (r = 0.15), indicating adequate thermal tolerance in all cultivars tested. A simple linear regression model showed that every additional 100 mm of rainfall may result in a yield increase of approximately 3.2 t/ha.

These findings confirm that the combined selection of well-adapted cultivars and appropriate management practices, adjusted to local environmental conditions, is essential for achieving stable and competitive potato yields under climate variability.

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