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Favourability of pedo-climatic conditions in strawberry cultivation in Giarmata (Timiș). Case study

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Abstract
The commune of Giarmata (Timiș County), located on the last branches of the Vinga Plain and in the Bega River basin, presents a pedological mosaic dominated by vertic chernozems, vertosols and gleiosols with tendencies of gleyization/salinization in depth, along with alluviosols and eutricambosols on smaller areas. The temperate-continental climate with sub-Mediterranean influences (precipitation of 600–650 mm/year; sunshine duration of 2,200–2,300 hours/year; hot summers and relatively mild winters) confers a notable agricultural potential for strawberry cultivation, a species with moderate heat requirements, sensitive to excess water, salts and compaction. In the paper, the properties of local soils (fine texture, shrinkage/swelling, poor internal drainage, high local water table, risks of salinity/alkalinity) were correlated with the requirements of strawberry cultivation and technological recommendations were made: land modeling (raised beds), drainage and mulching, drip irrigation with EC monitoring, chemical corrections (gypsum on alkaline soils), organic matter supply and early cold rain protection systems. Under favorable pedo-climatic conditions (well-drained chernozem/eutricambosol, pH 5.5–6.5, EC<1 dS/m), the production potential in open field is 15–25 t/ha, and in intensive system with foil/solariums 25–40 t/ha, with fruit qualities (TSS, firmness) competitive for the local market. The integration of water conservation practices and salinity control is essential in years with irregular rainfall and episodes of drought/excessive rain. In conclusion, the soils of Giarmata are suitable for strawberry on surfaces not affected by excess humidity/salinity, provided that a rigorous pedo-hydric management and a technology adapted to local soil types are implemented.

Keywords: Giarmata; *Fragaria* × *ananassa*; vertic chernozem; vertosol; salinity; drainage; pedo-climatic favourability; fruit quality

Introduction

The strawberry crop (*Fragaria* × *ananassa* Duch.) is a species of great economic and food interest in Central-Eastern Europe, with well-defined agro-ecological requirements: well-drained soils, medium texture, slightly acidic soil reaction (pH 5.5–6.5), controlled water intake and a moderate climate, without excess salts or prolonged water stagnation in the root zone (ICDP, 2020; Allen et al., 1998). In western Romania (Banat), the temperate-continental climate regime with sub-Mediterranean influences generally offers a favorable window for strawberries: warm summers, relatively mild winters, rainfall maxima in May–June and a secondary autumn maximum, but with inter-annual variability that requires careful water and technological calendar management (ANM, 2020–2024; ANM, July 2022; meteoblue, modeled climate data).

The commune of Giarmata (Timiș county) is located on the last branches of the Vinga Plain (in the Bega basin), an area of high plain and alluvial meadow, with microdepressions susceptible to excess humidity. Regional climate data for Timișoara show approx. 600–650 mm of precipitation/year and over 2,000–2,300 h/year of sunshine—values compatible with achieving both commercial production and quality parameters (°Brix, firmness), provided that the water regime is rigorously controlled (ANM, 2020–2024; meteoblue). At the same time, the frequency of NW–W winds in the warm season can amplify evapotranspiration, increasing the risk of water stress on poorly drained soils—an additional argument for drip irrigation, mulching, and land modeling in “raised beds” (Allen et al., 1998).

The local pedological mosaic includes chernozems (including vertic), vertosols, eutricambosols, alluviosols, gleiosols and soils with deep salinization/sodicization (pelosol and solonet) (Ianoș et al., 2019; Mihuț et al., 2024). These features are decisive for strawberry, a species sensitive to excess water, compaction and salts.

Reference literature on salinity tolerance indicates the existence of a crop threshold (threshold) above which production decreases almost linearly; in strawberry, negative effects usually become visible above EC ~1–2 dS m^{-1}, even if °Brix sometimes increases, but at the cost of size and yield (Maas & Hoffman, 1977; Denaxa et al., 2022; Medrano-Macías et al., 2021; Liu et al., 2024). Consequently, on subunits with glaciation or deep salinization, drainage, EC monitoring, chemical corrections (e.g., gypsum on sodic soils) and, where risks cannot be controlled, culture on substrate in protected spaces are mandatory (ICDP, 2020; FAO-56; Denaxa et al., 2022, Liang et al., 2025).

In genetic and technological terms, the selection of varieties and planting material (refrigerated stolons) must be correlated with thermal windows and the risk of late frost/cold rain, and the culture architecture (black/biodegradable foil, raised beds, adapted densities) plays an essential role in the stability of production and quality (ICDP, 2020; Not Bot. Horti., 2017; 2023). Romanian and regional horticultural studies confirm that water management (drip irrigation, staged fertigation) and water quality (low EC) are determinants for strawberry performance in the pedo-climatic conditions of Banat (ICDP, 2020; MADR, 2011). In this context, the present work integrates local pedo-climatic data from Giarmata with the requirements of the species, in order to establish the favourability by soil type and to formulate technological packages (drainage, mulch, irrigation, amendments) oriented towards stable productions and high quality. Giarmata has a heterogeneous soil mantle, which implies differentiated favourabilities for strawberry and decisively conditions the choice of the crop system (in the field, on raised beds, solariums, culture on substrate).

The objective of the work is to integrate concrete pedo-climatic data from Giarmata with the requirements of strawberry cultivation, to define favourable areas/conditions and to propose technological packages for stable production and good quality, with an emphasis on water and salt management.

Material and Method

Giarmata commune (45°50′ N, 21°19′ E approx.), has an area of 7,150 ha, of which 6,292 ha is agricultural land, in the Bega basin, with a rich network of valleys and streams (Beregsău, Măgheruş, Luchin, Niarad) and microdepressions susceptible to excess humidity. The relief is of high plain and alluvial meadow, alt. 100–178 m.

The soil types were represented by: chernozem, of various subtypes, including vertic, eutricambosol, weakly gleyed mollic alluviosol, stagnant preluvosol, gleyic pelosol with deep salinization, gleyic vertosol with deep salinization, gleiosol.

The main objective of the paper is the qualitative-quantitative evaluation of the pedo-climatic favorability for strawberry, by: matching the agro-ecological requirements of the species (pH, texture, drainage, EC, thermal regime, precipitation, insolation), with the local constraints of soils and climate; formulating technological recommendations (drainage, shaping, irrigation, amendments, mulch, variety choice) and estimating plausible production and quality ranges depending on the pedo-climatic conditions of the studied area.

Results and Discussion

1.Climatic conditions

The studied area is characterized by temperatures that frequently exceed 20°C, with mild winters; in years with late cold episodes (April–May), early plantings must be protected. Local climate data from 2020–2024 confirm a pronounced seasonal variability. This implies a preference for summer planting (refrigerated stolons) for fruiting the following year, or autumn planting with frost protection (Şmuleac et al., 2020).

The duration of sunshine (2,200–2,300 hours/year) supports the quality potential (TSS), but control of fruit load and water regime remain decisive.

Regarding precipitation, maximums were in May–June (risk of puddles/diseases) and in November–December. The wind blows from the NW/W, which causes an increase in evapotranspiration and stress, requiring drip irrigation and mulching.

2. Pedological conditions

Chernozem and/or eutricambosol soils were favourable and very favourable for strawberry cultivation. The condition is that the pH has values of 5.5–7.0, the texture is medium and has good drainage. Raised layers (20–30 cm), the application of manure (30–40 t/ha), drip irrigation and mulching are recommended.

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Vertic chernozem and/or vertosol soils (which have a high clay content, contractile-swelling type and slow internal drainage) were moderately favorable, but dependent on drainage and shaping. On these soils, local subsoiling, limiting traffic to reduce compaction, and low and frequent drip irrigation are recommended.

Soils of the weakly gleyed mollic alluviosol and/or stagnant preluvosol and/or gleiosol type are limited, due to excess water during rainy periods. On these soils, drainage (collection ditches, gutters), layered gutter modeling, mulching and rotation are recommended (Figure 1).

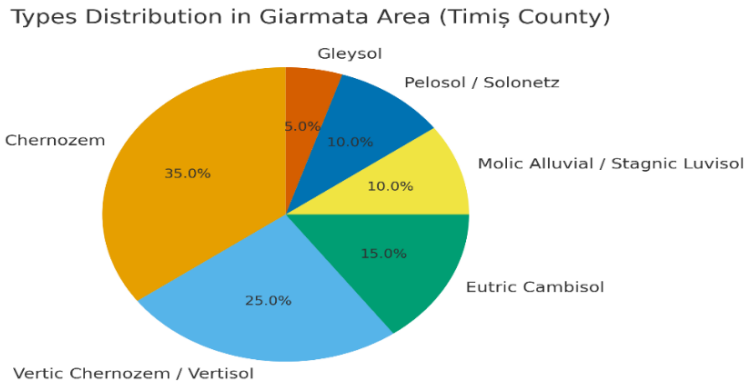

Figure 1. Soil Types Distribution in Giarmata Area (Timiș County)

Pelosol and/or solonet soils, with deep salinization/alkalization processes, are unfavorable soils for strawberries. On these soils, measures are required to check the EC of the water/soil (EC <1 dS/m), apply gypsum to solonets, direct washing where possible, add organic matter and, preferably, use alternative substrates (Figure 2).

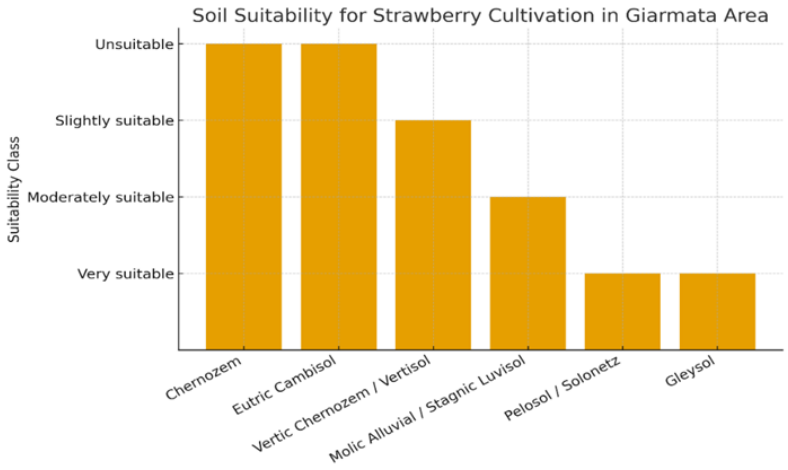

Figure 2. Soil Suitability for Strawberry Cultivation in Giarmata Area

It was thus found that the favorability of the soils at Giarmata is spatially heterogeneous: very good on well-drained chernozems and eutricambosols, moderate on vertosols and unfavorable on gleiosols, pelosols and solonets.

3. Conditioning of fruit quality

Strawberry is a species sensitive to both water deficit and excess and salinity. Drip irrigation with frequent monitoring of humidity and EC in water is essential.

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Studies (FAO/ICDP guidelines) recommend programming according to the soil water balance and phenological stage. Increasing EC to 2–4 dS/m significantly reduces production, and at moderate values sometimes increases TSS/°Brix (sweeter fruits), but at the risk of smaller caliber and salt burn on the leaves. Maintaining EC <1 dS/m during the season, with occasional washing and mulching, provides the best yield–quality (Navarro-Torre, S. et al., 2023).

In the area of Giarmata, strawberries find the best development conditions (high favorability) on chernozem and eutricambosol type soils. To achieve higher yields, it is recommended to cultivate on raised beds, apply drip irrigation, cultivate early varieties and apply manure before planting. At the opposite pole are found gleiosols and solonets, soils that show processes of gleization, alkalization and vertosols present a medium favorability for strawberry cultivation.

4. Technological recommendations for strawberries in the Giarmata area

Detailed soil mapping, at plot level, to separate salinity/gleying areas (including EC/pH measurement, texture, seasonal water table).

Shaping and drainage: 20–30 cm raised beds; digging of collector trenches in micro-depressions; underground drainage on heavy soils (gleiosols and vertosols).

Drip irrigation and application of mulch (black/biodegradable foil) for weed, temperature and evaporation control; EC monitoring (water/drain solution) and washing as needed.

Application of gypsum amendments on sodic and calcareous soils, when pH <5.5 and application of manure (20–30 t/ha).

Planting of cryopreserved stolons of varieties with better tolerance to root diseases; strict rotation (no return to soils with a history of *Phytophthora*).

Integrated phytosanitary protection; avoiding spring puddles that predispose to rot and fruit deformation.

For soils at risk (recurrent salinization/sliming): culture on substrate in protected spaces, use of water with EC <0.8–1 dS/m for irrigation, staged fertigation, drain control.

Selection of strawberry varieties with productive potential in order to study their behavior in the pedoclimatic conditions of Giarmata locality, for example: Albion, San Andreas, Murano, Joly, Gigantella and Elegans (Figure 3).

Albion variety

San Andreas variety

Gigantella variety

Murano variety

Joly variety

Elegance variety

Figure 3. Recommended varieties

Conclusions

Giarmata locality has medium to high suitability for strawberry cultivation on well-drained chernozem and/or eutricambosol surfaces and conditional suitability on vertosols and/or vertic chernozems, where drainage and land shaping are essential.

Soils with deep gleising/salinization are unfavourable in the absence of a complete technological package. In these situations (gleising/salinization processes), the effective solution is to switch to protected systems on the substrate and strict water quality control.

On soils that are favourable to this crop, estimated productions are 15–25 t/ha in the field and 25–40 t/ha in intensive systems, with quality parameters (TSS, firmness) competitive on the regional market.

Pedo-hydric and salinity management is decisive in years with water variability. In these situations, we recommend EC monitoring, drainage, mulch and rotation, as well as the integration of water conservation practices.

References

[1] Allen, R. G., Pereira, L. S., Raes, D., & Smith, M. (1998), *Crop Evapotranspiration – Guidelines for Computing Crop Water Requirements (FAO Irrigation and Drainage Paper No. 56)*. FAO, Rome. https://www.fao.org/3/x0490e/x0490e00.htm

[2] ANM (2020–2024), *Climatological Data and Agro-meteorological Bulletins for Timiș County*. National Meteorological Administration, Bucharest. https://www.meteoromania.ro

[3] CIULCA, S., CARP, N., MADOŞA, E., CIULCA, A., Șumălan, R. (2017), *Assessment of Combining Ability Effects for Several Yield and Quality Traits in a Complete Diallel Cross of Strawberry (Fragaria × ananassa Duch.).* Not Bot Horti Agrobo, 45(2):517-524. Notulae Botanicae HortiCluj-NapocaAgrobotanici Print ISSN 0255-965X; DOI:10.15835/nbha45210873

[4] Denaxa, N.-K., Nomikou, A., Malamos, N., Liveri, E., Roussos, P. A. și Papasotiropoulos, V. (2022), *The effect of salinity on plant growth parameters and bioactive compounds in the fruit of two strawberry varieties, together with monitoring of environmental conditions*. Agronomy, 12(10), 2279. https://doi.org/10.3390/agronomy12102279

[5] FAO (2015), *World Reference Base for Soil Resources 2015: International Soil Classification System for Naming Soils and Creating Legends for Soil Maps*. FAO, Rome. https://www.fao.org/3/i3794en/I3794en.pdf

[6] FAO (2023), *Irrigation and Drainage Paper 56 Update: Crop Water Productivity and Climate Adaptation*. FAO, Rome. https://www.fao.org

[7] Ianoş, Gh., Goian, M., (1995), Soils of Banat – evolution and agrochemical characteristics, Ed. Mirton, Timişoara, 272 pp.

[8] ICDP Pitești (2020), *Technological Guide for Strawberry Cultivation. Research and Development Institute for Fruit Growing* Pitești-Mărăcineni. http://www.icdp.ro

[9] Liang, K., Zhang, X., McCarty, G.W. et al. (2025), *From basin to golf course: Conservative tillage improves soil health but exacerbates hypoxia.* npj Sustain. Agric. 3, 47 https://doi.org/10.1038/s44264-025-00090-0

[10] Liu, H., Zhang, Y., Zhang, Z., & Wang, W. (2024*), Effects of saline irrigation on strawberry fruit yield and quality.* Agronomy, 14, 202. https://doi.org/10.3390/agronomy14010202

[11] Maas, E. V., & Hoffman, G. J. (1977),. *Crop salt tolerance—Current assessment*. Journal of the Irrigation and Drainage Division, 103(IR2), 115–134. https://doi.org/10.1061/JRCEA4.0001137

[12] Medrano-Macías, J., et al. (2021), *Physiological and biochemical mechanisms of strawberry plants under saline stress.* Horticulturae, 7(8), 214. https://doi.org/10.3390/horticulturae7080214

[13] Meteoblue (2024), *Climate and Agroclimate Data for Timișoara and Giarmata (Romania)*. https://www.meteoblue.com

[14] Mihuț, C., Niță, L., (2018), *Atmospheric Factors used characterize soil resources* https://www.rjas.ro/issue_detail/44, Timișoara, pp. 114 120.

[15] Mihuț, C., Duma, S., & Ilieș, L. (2024), *Pedological characteristics and agricultural suitability of soils in the Banat region, Western Romania*. Research Journal of Agricultural Science, 56(2), 71–84. https://rjas.info/art_article.php?id=427

[16] Navarro-Torre, S., Díaz, M., & Serrano, M. (2023), *Strawberry irrigation management under variable EC conditions: effects on yield and fruit quality*. Plants, 12, 1872. https://doi.org/10.3390/plants12101872

[17] Romanian Ministry of Agriculture and Rural Development (MADR) (2011), *Technological Guide for Strawberry Cultivation in Romania*. Bucharest. https://www.madr.ro

[18] Şmuleac, L., Rujescu, C., Șmuleac, A., Imbrea, F., Radulov, I., Manea, D., Ienciu, A., Adamov, T., Pașcalău, R. (2020), *The impact of climate change in the Banat Plain, western Romania, on water accessibility for crop production in agriculture*. Agriculture. 10(10):437. https://doi.org/10.3390/agriculture10100437