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SEASONAL VARIATION IN THE NUMBER OF HERBACEOUS PLANT SPECIES IN THE GRASSED STRIPS OF AN ORGANIC APPLE ORCHARD

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ABSTRACT

The study aimed to assess species richness and the seasonal dynamics of herbaceous vegetation in the grassed strips of an organic apple orchard located in Turceni, Gorj County, Romania. The research was conducted in 2025, with observations carried out in three different seasons. A total of 42 plant species belonging to 15 botanical families were identified, with Asteraceae (29 %) and Fabaceae (22 %) being the most represented families. Species richness progressively declined from spring to summer and autumn. The high proportion of accidental species (64–72 %) highlighted the spatial heterogeneity of the vegetation, while similarity indices revealed substantial seasonal changes in floristic composition.

INTRODUCTION

Soil management practices in fruit orchards vary considerably depending on the species grown and the production region. Weed control remains a major challenge in orchard management, as weeds compete with fruit trees for essential resources, affecting both yield and fruit quality (Dudic et al. 2020). At the same time, the fruit-growing sector faces increasing pressure to meet higher fruit quality standards while remaining competitive in the global market and maintaining high production levels (Demestihas et al., 2017). These demands have encouraged the intensification of orchard production systems, including the widespread use of pesticides. Managing plant diversity within orchards offers an important means of reducing pesticide use, conserving biodiversity, and supporting beneficial organisms involved in biological pest control, thereby contributing to more sustainable and ecologically balanced fruit production systems (Simon et al. 2010). Fruit orchards have considerable potential to provide ecosystem services. Sustainable management practices, such as maintaining ground vegetation and increasing plant diversity, can help conserve biodiversity, improve soil fertility, regulate soil water availability, and support biological pest control. Ecological processes such as soil stabilization, nutrient cycling, and carbon sequestration also contribute to ecosystem functioning and resilience. These benefits highlight the importance of sustainable vegetation management in maintaining ecological balance and supporting

ecosystem services (Cosmulescu, 2026a). In addition to the limited biodiversity often associated with conventional orchards, pest pressure remains an important concern. Grassed strips may help address both issues and are among the most widely established semi-natural habitats under agri-environment schemes (Cosmulescu et al. 2025, 2026b). They contribute to biodiversity conservation by providing food resources for various vertebrate and invertebrate species (Dong et al. 2021). Vegetated strips also play a role in reducing soil erosion, retaining nutrients, regulating water flows, and sequestering carbon, thereby improving ecosystem services in agricultural landscapes. However, further research is needed to assess their long-term effects, particularly on pest populations and crop productivity (Haddaway et al. 2018). Strip width is another important factor, as wider uncultivated strips generally make a greater contribution to biodiversity conservation and reduce the negative effects of management practices in adjacent crops (Szigeti et al. 2022). Despite growing interest in agroecological approaches, the relationship between agroecological principles and their practical application is still not fully understood. Scientific evidence, together with practical experience, can therefore support the design and management of more diversified agricultural systems and landscapes (Dong et al. 2021). Herbaceous plant diversity contributes to ecosystem services, while spontaneous flora may also provide species with ornamental value and useful agrobiological characteristics, including ecological plasticity and high resistance to environmental stress. Their different adaptive strategies and capacity for self-organization make these species potentially valuable for cost-effective ecosystem restoration (Cosmulescu et al. 2025). Recognizing the ecological importance of spontaneous vegetation, the European Union has promoted policies aimed at increasing the presence of wild plants in agricultural landscapes (Lisek 2023). Vegetation management strongly influences plant species diversity. Frequent mowing is one of the main factors limiting species richness, whereas reducing mowing frequency may allow more species to establish through natural succession (Sehrt et al. 2020). Species richness can also contribute to the stability of community biomass production under variable climatic conditions, including drought and exceptionally wet years (Schnabel et al. 2021). This is particularly relevant because biodiversity loss associated with human-induced global environmental change threatens ecosystem functioning and the services provided by natural and managed ecosystems (Prommer et al. 2020). Under changing climatic and land-use conditions, the stability of ecological communities is essential for sustainable resource management because of its influence on key ecosystem services. Biodiversity is thought to enhance community stability through compensatory effects among species. Such compensatory dynamics are associated with low species synchrony, which describes the extent to which species populations fluctuate in the same direction over time (Valencia et al. 2020). The aim of this study was to assess herbaceous plant species richness and its seasonal variation in the grassed strips of an organically managed apple orchard.

MATERIAL AND METHODS

Study Area. The study was conducted in 2025 in an organic apple orchard located in Turceni (44°40′0″N, 23°23′0″E), Gorj County, Romania. The area has a temperate continental climate, with a mean annual temperature of 11.6 °C and an average annual precipitation of 593.3 mm. The soil is classified as a psammic preluvosol, is slightly alkaline (pH 7.80–8.44), and has a loose structure and good permeability. At the time of the study, the orchard was four years old and covered

an area of 5.6 ha. The apple cultivars grown were ‘Jeronime’, ‘Smeralda’, ‘Devil Gala’, ‘Granny Smith’, and ‘Sinfonia’. Trees were planted at a spacing of 3.5 × 1 m and trained to a spindle system. The orchard was equipped with a tree support system and drip irrigation. Orchard management included fruiting pruning in March, mowing and shredding of spontaneous vegetation in May, after the floristic observations had been completed, and applications of Vermicompost, Biohumussol, and treatments based on Bioprotekt, Neemex, and Etamin.

Data Collection and Plant Species Identification. Floristic surveys were carried out on three occasions, at three-month intervals, in May, August, and November 2025. During each survey, ten randomly located 1 × 1 m quadrats were sampled within the grassed strips of the orchard (Meng et al., 2016), following the method described by Cosmulescu et al. (2025). Herbaceous plant species were identified based on morphological characteristics using standard floristic references (Ciocârlan 2009, Sârbu et al. 2013) and the Euro+Med PlantBase database (https://europlusmed.org/

RESULTS AND DISCUSSIONS

Taxonomic analysis revealed the presence of 15 plant families (Figure 1). Asteraceae was the most represented family, accounting for 29 % of all identified species, followed by Fabaceae (22 %). Together, these two families accounted for more than half (51 %) of the total species richness, highlighting their contribution to the floristic composition of the surveyed plant community. Poaceae and Plantaginaceae each represented 7 % of the recorded species, while Apiaceae, Geraniaceae, Lamiaceae, and Ranunculaceae each accounted for 5 %. Caryophyllaceae represented 3 %, whereas six other families each contributed 2% of the total species richness.

The predominance of Asteraceae and Fabaceae highlights the importance of these two taxonomic groups in the spontaneous vegetation of the studied agroecosystem. Asteraceae, also known as Compositae, is a highly diverse plant family characterized by considerable ecological and morphological variation and effective seed dispersal mechanisms. Many species within this family are well adapted to semi-arid environments and can disperse over long distances (Waheed & Arshad 2024). Fabaceae is also one of the largest and most ecologically important angiosperm families, playing a key role in ecosystems worldwide. Its ecological significance is largely associated with the ability of many species to fix atmospheric nitrogen through symbiotic relationships with bacteria, including those of the genus Rhizobium. This process contributes to soil fertility and supports plant communities (Siddiqui 2025).

Field surveys recorded a total of 42 herbaceous plant species during the study period. Species richness was highest in May, towards the end of spring, when 33 species were identified. A progressive decline was observed over the following sampling periods, with 21 species recorded in August and 14 in November. Thus, the grassed strips supported the greatest number of herbaceous species in spring, followed by a marked reduction in species richness during summer and autumn. The analysis of herbaceous species distribution according to constancy (Figure 2) showed that accidental species predominated in all three sampling periods. In May, accidental species accounted for 70 % of the total species recorded, while accessory and constant species represented 18 % and 12 %, respectively. A similar pattern

was observed in August, when the proportion of accidental species increased slightly to 72 %, whereas accessory and constant species each accounted for 14 %.

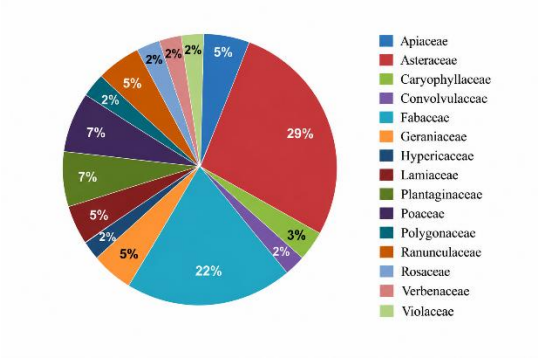


Figure 1. Distribution of taxonomic families according to the number of species

In November, accidental species remained the dominant category (64 %), although the proportion of accessory species increased to 29 %, while that of constant species declined to only 7 %. The predominance of accidental species suggests considerable spatial heterogeneity in the herbaceous vegetation, with many taxa occurring in only a small number of sampling quadrats. In spontaneous orchard vegetation, a high proportion of accidental species, together with variation in species frequency, may reflect the heterogeneous nature of herbaceous plant communities, whereas frequently occurring species form their more stable component. A similar pattern was reported for spontaneous vegetation in orchards in southern Romania (Cosmulescu et al. 2025), where the constancy classes revealed both a core group of frequently occurring species and a large number of taxa with uneven spatial distributions.

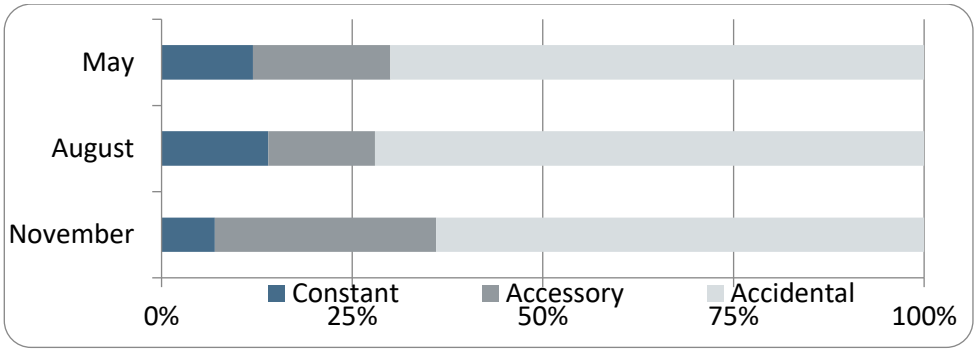


Figure 2. Distribution of herbaceous plant species according to constancy.

The similarity indices (Table 1) revealed clear differences in species composition within the grassed strips across the sampling periods, indicating marked seasonal changes in floristic composition. The highest similarity was recorded between August and November, with a Jaccard index of 66.67 % and a Dice index of 80.00 %, suggesting the presence of a common group of species and a relatively stable floristic composition during this period. In contrast, similarity between May and

August was lower (Jaccard index: 25.58 %; Dice index: 40.74 %), indicating a substantial shift in species composition over the summer. This change was probably associated with the disappearance of some short-lived species and the establishment of more competitive summer-growing species.

The lowest similarity was recorded between May and November, with a Jaccard index of 14.63 % and a Dice index of 25.53 %, reflecting marked differences in vegetation composition between the two transitional seasons. Overall, these results indicate pronounced seasonal changes in the herbaceous flora of the grassed strips between tree rows in the studied orchard. Species composition changed considerably from spring to summer, whereas a substantial proportion of the species recorded in summer persisted into autumn.

Table 1

Analysis of floristic similarity indices between sampling periods

Sampling period 1	Sampling period 2	Jaccard index (%)	Dice index (%)
May	August	25.58	40.74
August	November	66.67	80.00
November	May	14.63	25.53

CONCLUSIONS

The results of this study showed that the organic apple orchard supports a diverse herbaceous flora, with clear seasonal changes in species richness. The predominance of accidental species indicates a heterogeneous spatial distribution of the vegetation, while changes in the proportions of constancy classes throughout the growing season reflect the dynamic nature of the herbaceous plant community. Furthermore, the high representation of Asteraceae and Fabaceae highlights the floristic characteristics of the studied agroecosystem.

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