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SUSTAINABLE AGRICULTURAL SOLUTIONS APPLIED TO BUCKWHEAT COVER CROP IN 2024

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Abstract

In the context of the climate challenges of 2025, characterized by prolonged drought, buckwheat stands out as a sustainable solution for agriculture in Stupina Cornetu in Ilfov County, Romania. This plant, used as a cover crop, offers multiple benefits, including improving soil quality, reducing water loss and supporting biodiversity, while also being a valuable source of pollen for bees. Buckwheat sowing was carried out in June, in drought conditions, by using seeds of an adapted variety (Fagopyrum esculentum L. 'Zita'), characterized by a short vegetation period and high tolerance to water deficit. The cultivation scheme included the use of technological links of minimal soil preparation in order to conserve moisture. The results obtained contributed to the creation of a sustainable agricultural ecosystem through the cultivation of buckwheat plants. This culture can thus become a key component in adapting to climate change and supporting a sustainable agriculture in Romania.

Key words*: cover-crop plants, climate change, agricultural ecosystem, honey base, sustainable agriculture.*

INTRODUCTION

Buckwheat has proven a high melliferous potential, providing a constant source of pollen and nectar for bees, during the essential period in the context of climate change. The current study explores the mellifer potential values of the buckwheat plant grown in Stupina Cornetu and its contribution to a sustainable agricultural ecosystem.

Buckwheat plants (*Fagopyrum esculentum* L.) of the 'Zita' variety, represent a promising agricultural solution in areas affected by prolonged drought, having importance both for improving the soil and for beekeeping, according to previous studies (Drăgan et al., 2022; 2023).

At present, several studies have highlighted the benefits of using cover crops in agricultural production, often focusing on the soil's physical, chemical, or biological properties (Păceşilă et al., 2022; Adetunji et al., 2020; Saleem et al., 2020).

The outlook of research conducted on buckwheat cultivation (https://agrolifejournal.usamv.ro/index.php/agrolife/article) has been shaped by variations in domestication conditions and the limited advancements in improving modern varieties. Trotsenko et al. (2020) primarily aimed to examine a buckwheat collection to identify suitable samples for summer sowing in the Northern Forest-Steppe region of Ukraine.

At the same time, Saleem et al. (2020) concluded from their research that additional growth of cover crop roots can provide benefits to the soil, including increasing soil organic carbon content, available nutrients, as well as soil aggregation. In addition, cover crops have been shown to improve nutrient cycling, soil physicochemical and biological properties, as well as soil pest management and weed suppression.

According to Sharma et al. (2018), cover crops help to reduce soil water evaporation, thus preserving soil moisture for the next crop. Although this has been observed in some environments (Basche et al., 2018), under water-limited conditions without irrigation, cover crops have frequently been found to limit soil

moisture for subsequent crops (Nielsen et al., 2020; 2015).

Between June and October 2024, Ilfov County, along with other regions in southern Romania, was severely affected by severe drought, combined with record hot temperatures. During this period, the average temperature was 2-3.5°C above normal, according to data from the EU's MARS System, marking the summer of 2024 as one of the warmest on record. The soil showed an extreme lack of moisture, with very severe pedological drought, which seriously compromised agricultural crops and affected extensive areas, including in Ilfov, where the main economic spring crops suffered significant losses, sometimes 100% (https://joint-research-centre.ec.europa.eu/monitoring-agricultural-resources-mars_en).

In Figure 1, an estimate of the average annual temperature for the Cornetu region is graphically represented. The dotted blue line represents the linear trend of climate change. The trend line is upward from left to right, the temperature trend is positive warming in Cornetu due to climate change.

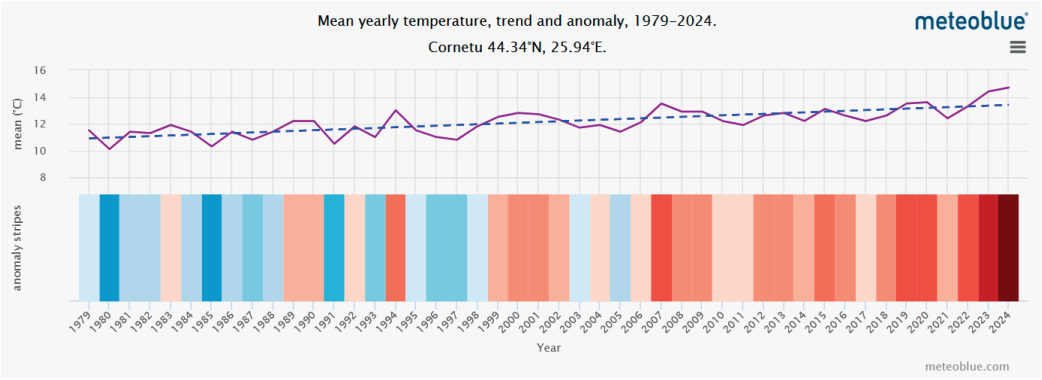

Figure 1. Estimation of the average annual temperature for the Cornetu region, Ilfov county.
Legend: https://www.meteoblue.com/en/climate-change/cornetu_romania_680754

In the lower part of the graph, the heating streaks are highlighted. Each colored band represents the average temperature for a year - blue for colder years and red for warmer years (https://www.meteoblue.com/ro/climate-change/cornetu_romania_680754).

Since 2019, the temperature warming situation in the Cornetu region, Ilfov county (Figure 2) has become worrying, this situation has highlighted the urgency of adopting sustainable measures in agriculture, such as the buckwheat plant (cover-crop plant) following the research carried out by Drăgan et al. (2024), for its resistance to water stress and for the ability to conserve soil moisture. Such an approach can help reduce the impact of climate change on agriculture.

Islam et al. (2021) as well as Gutema et al. (2023), demonstrated that management practices that integrate soil conservation works with cover crops could help recover, preserve and build soil quality (SQ) to address food security issues. The study in this paper is based on the conclusion of some objectives pursued, during the years 2021-2024, for the implementation of the project financed by the Agency for the Financing of Rural Investments - Romania, and the Regional Center for the Financing of Rural Investments 8 Bucharest - Ilfov, Project code: CRFIR-BUCURESTI-ILFOV, with the acronym AGROAPIS (https://agroapis.polenizare.ro/).

In collaboration with the Faculty of Biotechnologies of the University of Agronomic Sciences and Veterinary Medicine in Bucharest, with the main objective of identifying some ground cover plants and their valorization in order to sustainably develop honeydew crops and incorporate the plant mass through mechanical plowing in the field after the flowering period in November 2023.

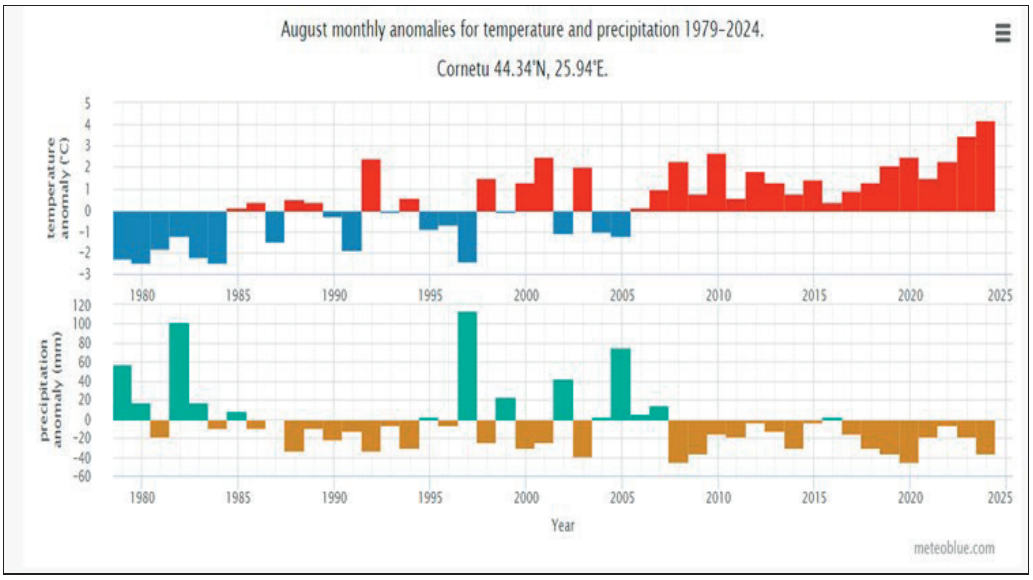

Figure 2. Climate changes – in the town of Cornetu; Temperature and precipitation anomaly in August 2024
Legend: www.meteoblue.com

Consequently, the work integrates the proposals and development objectives proposed to the parties involved in the project in the apiary of Cornetu, county Ilfov - Romania in order to ensure the territorial balance.

MATERIALS AND METHODS

Buckwheat (*Fagopyrum esculentum* L.) the 'Zita' variety selected for its high tolerance to drought was sown on 01.06.2024 in the apiary in Cornetu, the soil being prepared by light tillage.

The increase or decrease of the water deficit (drought) in the soil depends on the duration of the drought in the atmosphere and on the concrete properties of the soil: texture; structure; compaction (porosity; organic matter content, etc.). Through various agrotechnical, agrochemical and phytotechnical actions, it is possible to make the plants use the available water reserves from the soil as efficiently as possible, first of all, the easily accessible ones and to increase the volume of agricultural production.

In the case of buckwheat cultivation, this methodology makes it an attractive crop for water-scarce areas, at the same time offering multiple ecological benefits, including pollinator support and soil regeneration (Drăgan et al., 2024).

The experiment was carried out on the buckwheat culture in the town of Cornetu, on August 5, 2024.

The following technological links were applied for the establishment of the culture.

Sowing depth: Buckwheat seeds were sown at a depth of 2-3 cm, enough to keep optimal contact with the soil and retain the moisture necessary for germination.

Minimal fertilization: For this purpose, modern technologies of embedding the plant mass in the soil were used in order to obtain a sustainable ecological agriculture of increasing the quality of soil humus in the Cornetu apiary by cultivating honeydew cover crops (Drăgan et al., 2024).

After the end of the flowering period, all these crops were incorporated into the soil by mechanized plowing in order to increase the amount of humus, thus ensuring an ecological method of sustainability through cover crops. (Figure 3).

The determinations regarding the secretion of nectar (mg), the content in soluble carbohydrates and the carbohydrate index (mg/flower) were performed by the capillary method (Drăgan et al., 2023; Ion et al., 2007) in 3 series of 10 samples each (30 repetitions) from the buckwheat culture (*Fagopyrum esculentum* L.) variety 'Zita'.

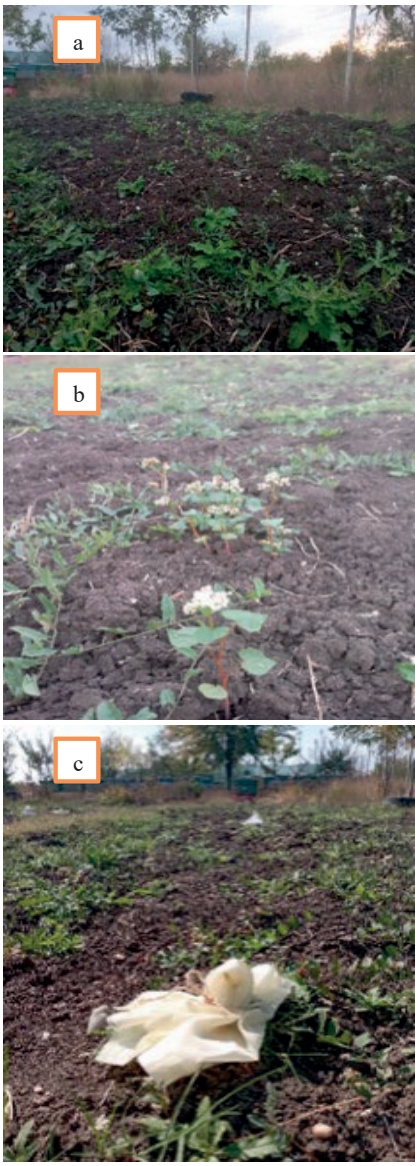

Figure 3. Buckwheat cover-crop culture established at the Cornetu apiary in 2024: a) sprouted buckwheat plants in the furrow; b) buckwheat plants at the beginning of flowering; c) buckwheat flowers isolated with gauze during 24 hours in order to monitor the nectar

The evaluation methodology of the productive parameters referred to those of the mellifer potential determined during the flowering period of the buckwheat plants (Figure 4).

Thus, data were collected regarding the carbohydrate index (mg/flower), the daily honeydew potential (kg/ha/day) and the honeydew potential per crop (kg/ha) at three time intervals (9:00, 12:30, 16:30) using the method of Ion et al. (2007).

Figure 4. Evaluation of honeydew potential determined during the flowering period of buckwheat plants: a) nectar collection by the capillary method; b) overview of the buckwheat plant at 9 o'clock in the Cornetu apiary

The carbohydrate analysis was carried out by standardized methods, and the honey values were calculated based on the available nectar quantities.

RESULTS AND DISCUSSIONS

According to the collected data which are represented in Table 1, the following results were obtained for the following analyzed parameters:

The carbohydrate index varied between 0.0016 mg/flower (at 16:30) and 0.003 mg/flower (at 9:00), with an average value of 0.0022 mg/flower. These values demonstrate a constant availability of carbohydrates, essential for bees.

Daily honeydew potential was highest at 9:00 AM (1.75 kg/ha/day), gradually decreasing to 0.94 kg/ha/day at 4:30 PM. This variation can be correlated with air temperature and humidity.

The honeydew potential/per crop reached an average of 33.26 kg/ha, highlighting the importance of the buckwheat plant as a honeydew base in drought conditions (Table 1). These results suggest that buckwheat is an adaptable crop that supports biodiversity and contributes to the resilience of local beekeeping.

Table 1. The values recorded at the level of the samples collected from the conventional buckwheat culture for the evaluation of the mellifer potential, evaluation date August 5, 2024, at Cornetu apiary (Ilfov county, in S-E Romania)

SERIES	Average number (flowers /ha)	Glycemic index (mg/ flower)	The entire flowering period (number of days)	Daily honeydew potential (kg/ha/days)	Honeybee buckwheat potential (kg/ha)
SERIES 1 9:00 a.m.	475.200.000	0.0030000	26	1.75	45.56
SERIES 2 12:30 p.m.	475.200.000	0.0020000	26	1.15	29.83
SERIES 3 16:30 p.m.	475.200.000	0.0016000	26	0.94	24.41
Average values	**475.200.000**	**0.0022000**	**26**	**1.28**	**33.26**

(*with variation limits between 230.400.000 and 720.000.000)

The high values of honeydew potential prove that it is a viable solution for diversifying pollinators' food resources (Figure 5), especially in the early part of the day when atmospheric moisture contributes to the nectar secretion of plants.

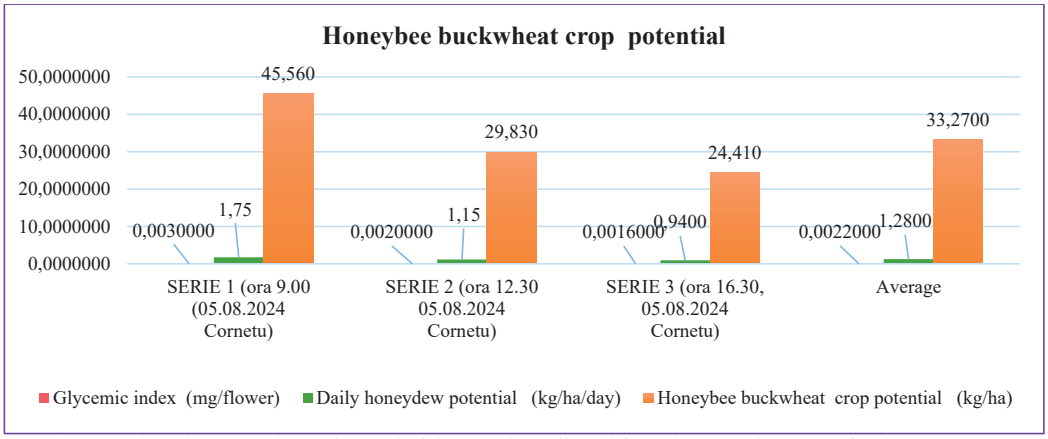

Figure 5. The values recorded at the level of the samples collected from the buckwheat crop, for the assessment of honeydew potential - assessment date August 5, 2024, SERIES 3 - 9 am - 12.30 pm - 4.30 pm, at Cornetu apiary (Ilfov county, in S-E Romania)

CONCLUSIONS

Buckwheat is proving to be an essential crop for maintaining the health of agricultural ecosystems and supporting beekeeping, especially in drought conditions.

The high values of honeydew potential underline the importance of using this plant in sustainable regenerative agriculture strategies.

The high temperatures of 2024 negatively influenced nectar secretion during the day, at the level of buckwheat flowers.

Thus, the results obtained in 2024 confirmed the fact that the flowers of the buckwheat plants of the studied variety 'Zita' accumulated the best honey activity in the first part of the day (morning), and as a result the bees were active during that period, in order to maximize honey production.

The parameters of honey potential values were within the optimal parameters, but their decrease occurred in the afternoon, which proves a clear indicator of thermal stress on the culture.

To optimize the results, it is recommended to expand the areas cultivated with buckwheat and continue studies on its adaptation to various climatic conditions.

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