

PERFORMANCE OF CABBAGE HYBRIDS UNDER THE PEDOCLIMATIC CONDITIONS OF ÎNSURĂȚEI, BRĂILA COUNTY

Alexandra Violeta LAZIA^{1*}, Gabriela Alina CIOROMELE, (ORCID: 0009-0004-1148-0190)^{1,2,3},
Andreea Raluca CHIRIAC, (ORCID: 0009-0006-0911-9958)^{1,2}, Maria Magdalena TUREK
RAHOVEANU, (ORCID: 0000-0001-5238-5641)^{1,2}

¹ Faculty of Engineering and Agronomy of Brăila, “Dunărea de Jos” University of Galați,
29 Călărășilor Str., 810017 Brăila, România

² Research and Consultancy Center for Agronomy and Environment “Lunca” (CCCAM Lunca),
29 Călărășilor Str., 810017 Brăila, România

³ Brăila Agricultural Research and Development Station, Romania, Km 9 Viziru St., Brăila, Romania

*Corresponding author: alexandra.lazia@ugal.ro

Abstract. At both global and national levels, vegetable production has a significant impact on ensuring food security. In this context, white cabbage (*Brassica oleracea* var. *capitata*) stands out due to its economic and nutritional value, efficient use of agricultural resources, and its adaptability to diverse pedoclimatic conditions. This study aims to provide a comparative analysis of yield performance and adaptability of two hybrids (Gloria F1 and Victoria F1) and a traditional white cabbage variety (Buzău White Cabbage) under the specific conditions of the Bărăgan Plain, namely the Însurăței area, Brăila County. The soil in this region is characterized by high fertility, good structure, and physicochemical properties suitable for this type of crop. Seedlings were monitored for morphological parameters such as plant height, stem diameter, and number of leaves, while mature plants were evaluated based on plant size, head circumference, and head weight. The results showed that at the seedling stage, the Victoria F1 hybrid exhibited faster growth, while Gloria F1 achieved the best performance at maturity, with a yield of approximately 33.9 t/ha. The Buzău variety showed intermediate results, whereas Victoria F1 produced smaller and lighter heads. In conclusion, this study highlights the good adaptability of the Gloria F1 hybrid to local conditions. The use of biostimulants, proper irrigation, and appropriate treatment schemes have a direct effect on maximizing cabbage yield.

Keywords: yield capacity; varietal adaptability; morphological traits; soil fertility; crop management.

INTRODUCTION

White cabbage (*Brassica oleracea* var. *capitata*) is an important vegetable crop due to its nutritional and economic value, as well as its multiple uses. Cabbage heads are consumed fresh, used in traditional dishes and preserved by pickling, which maintains the importance of this crop both in households and in commercial vegetable farms (CIOFU, 2004).

Obtaining a high yield in autumn cabbage depends on several factors, including cultivar selection, soil fertility, water availability, fertilization, crop maintenance works and phytosanitary protection. Soil has an essential role, as it supports the plant, provides water to the root system and supplies the nutrients required for growth (CIOFU, 2004; VOICU, 2023). At the same time, research on cabbage crops shows that irrigation and fertilization can influence head weight and final yield (ERKEN and YILDIRIM, 2019; ŠTURM et al., 2010; TEREFA, 2021).

The Însurăței area, Brăila County, is located in the Bărăgan Plain, where fertile soils can support cabbage cultivation. However, the temperate-continental climate, characterized by hot summers and periods of water deficit, requires irrigation during the sensitive stages of

vegetation (RAUMPLAN DESIGN S.R.L., n.d.; VOICU, 2023). This aspect is important because cabbage has high water requirements, especially during the period of intensive growth and head formation (AECTRA, n.d.). In this context, the choice of biological material becomes important. The study compared the Buzău White Cabbage variety with the Victoria F1 and Gloria F1 hybrids, in order to identify the variant that better uses the local pedoclimatic conditions (AECTRA, n.d.). Varieties and hybrids may behave differently under the same crop conditions, including plant development and yield performance (KACJAN-MARŠIĆ and OSVALD, 2004).

The aim of the research was to evaluate the behavior of several white cabbage cultivars under the pedoclimatic conditions of the Însurăței area, Brăila County. The study followed seedling growth, morphological traits at maturity, head size and weight, and estimated yield per hectare.

MATERIALS AND METHODS

The research was carried out in Însurăței, Brăila County, on an experimental area of 1000 m². The biological material was represented by three white cabbage cultivars: Buzău White Cabbage variety, Victoria F1 hybrid and Gloria F1 hybrid. The experimental variants are presented in Table 1.

Table 1

Variant	Analyzed cultivar	Type of biological material	Company / origin
V1	Buzău White Cabbage	traditional variety	Agrosel
V2	Victoria F1	hybrid	Hektar
V3	Gloria F1	hybrid	Syngenta

The experimental field is represented by cambic chernozem. The soil within the experiment is a cambic chernozem, with a slightly alkaline reaction (pH 8.0), high organic matter content, high potassium and magnesium values, very high calcium values, and a low value of mobile phosphorus (VOICU, 2023). These characteristics provided favorable conditions for cabbage cultivation, but the water regime of the area required irrigation. Considering the high water and nutrient requirements of cabbage, irrigation and fertilization were considered important works for maintaining normal plant development (CIOFU, 2004).

The experiment was organized into three variants: V1 – Buzău White Cabbage, V2 – Victoria F1 and V3 – Gloria F1. Each variant was represented by 10 rows, resulting in a total of 30 rows on the entire experimental area. The organization of the experiment into variants allowed the behavior of each cultivar to be observed under the same soil, irrigation and fertilization conditions. This type of comparison is useful because varieties and hybrids can react differently to the same technological conditions (KACJAN-MARŠIĆ and OSVALD, 2004). The main elements regarding the organization of the experiment are presented in Table 2.

Sowing for seedling production was carried out on May 15, in trays with 70 cells, using KEKKILA DSM3W peat, with pH adjusted to 5.5–5.9 and starter fertilization NPK 14-16-18 + microelements. After emergence, at the stage of 1–2 true leaves, a preventive treatment with Previcur, at a concentration of 0.15%, was applied to prevent seedling damping-off and downy mildew (MARCOSER, n.d.). Obtaining uniform seedlings is important for starting the crop in good conditions, because differences occurring in the first stages of vegetation can influence the further development of plants (BUTE et al., 2024).

Table 2

Elements regarding the organization of the experiment

Experimental element	Data used in the experiment
Location	Însurăței, Brăila County
Experimental area	1000 m ²
Number of variants	3
Experimental variants	V1, V2, V3
Number of rows/variant	10
Total number of rows	30
Seedling age at transplanting	40 days
Distance between rows	70 cm
Distance between plants	30–35 cm
Irrigation interval	10–12 days

The seedlings were manually transplanted in the field at the age of 40 days, at a spacing of 70 cm between rows and 30–35 cm between plants per row. Irrigation was applied at intervals of 10–12 days, with water rates of approximately 200–250 m³/ha in the first vegetation stages and 300–400 m³/ha during the period of intensive growth and head formation (CIOFU, 2004). Irrigation scheduling according to the vegetation stage is important in cabbage, because water demand increases during the head formation period (PATRA et al., 2024; TEREFA, 2021)

Recent studies show that irrigation frequency and fertilization level can influence cabbage growth and productivity (PATRA et al., 2024). Fertilization included products aimed at stimulating rooting and vegetative growth, such as Blackjak, Terra-Sorb Radicular, Terra-Sorb Foliar, Atonik and Calcig Ca-Mg (AECTRA, n.d.). These products were applied to support plant development after transplanting and to favor the formation of an adequate vegetative mass. Fertilization applied during vegetation has a role in supporting plant growth, and studies on cabbage crops have shown that fertilization and fertigation can influence head yield and quality (AYAS, 2021; KACJAN-MARŠIĆ and OSVALD, 2004; WU et al., 2020). Nitrogen and other nutrients contribute to the development of vegetative mass and yield formation, but their effect also depends on the water level available to plants (PADEM and ALAN, 2014; TEREFA, 2021)

During the vegetation period, maintenance works were carried out, such as weed control, soil loosening, irrigation, and preventive and curative phytosanitary treatments, depending on disease and pest pressure (MARCOSER, n.d.). Maintaining the crop in good phytosanitary condition and applying maintenance works help plants make better use of available water and nutrients. In addition, organic or mineral fertilization can contribute to improving plant development and yield, depending on crop conditions (IBRAHEEM and ALLELA, 2021; KAVALIAUSKAITĖ et al., 2023; TURATBEKOVA et al., 2024). The determinations focused on plant height, stem diameter, number of leaves, plant size at maturity, head circumference, head weight and estimated yield. The main determinations are presented in Table 3.

The determinations regarding plant height, number of leaves, head size and head weight were chosen because these traits reflect both vegetative development and the productive potential of the analyzed cultivars (BUTE et al., 2024).

Table 3

Main determinations carried out in the experiment

Moment of determination	Observed indicators	Instrument / method
Seedling stage	Plant height	Ruler
Seedling stage	Stem diameter	Caliper
Seedling stage	Number of leaves	Direct counting
Maturity	Plant height	Ruler
Maturity	Head circumference	Measuring tape
Maturity	Head weight	Weighing
Harvesting	Estimated yield	kg/ha calculation

RESULTS AND DISCUSSIONS

The results showed differences between the three analyzed variants, both at the seedling stage and at plant maturity. The differences observed at the seedling stage show that the biological material can have a different growth rate, even when the variants are cultivated under the same conditions (KACJAN-MARŠIĆ and OSVALD, 2004). At the seedling stage, the Victoria F1 hybrid (V2) had the fastest growth rate in height, while the Buzău White Cabbage variety (V1) recorded the lowest growth rate. Gloria F1 (V3) had intermediate values. The evolution of seedling growth is presented in Figure 1.

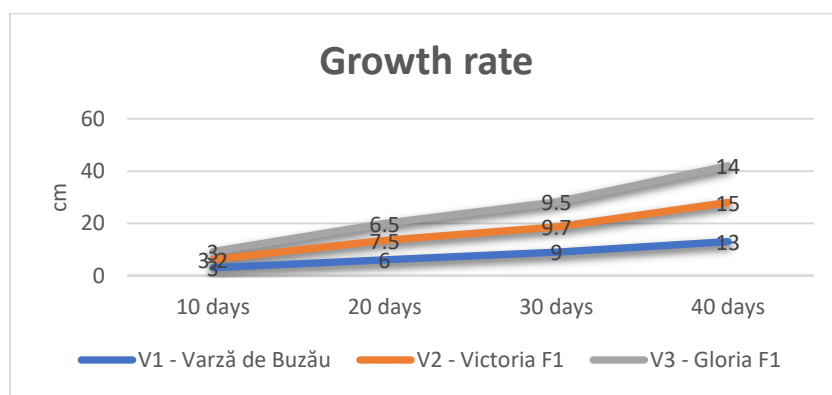


Figure 1. Growth rate of cabbage seedlings during the first 40 days

At the age of 40 days, the height of the aerial part varied between 16 and 19 cm. Victoria F1 recorded 19 cm and 6 leaves, Gloria F1 recorded 18 cm and 5.5 leaves, while Buzău White Cabbage recorded 16 cm and 3.5 leaves. These data show that the hybrids developed faster at the seedling stage compared to the traditional variety. The differences recorded at the seedling stage can be explained by the genetic characteristics of each cultivar, because varieties and hybrids may react differently even when cultivated under the same conditions (KACJAN-MARŠIĆ and OSVALD, 2004).

At maturity, the ranking of the variants changed. Gloria F1 recorded the highest plant height, with 43 cm, followed by Buzău White Cabbage, with 39 cm, and Victoria F1, with 35

cm. Plant height at maturity is presented in Figure 2. This result shows that Gloria F1 made better use of the vegetation period, even though it was not the variant with the fastest initial growth at the seedling stage.

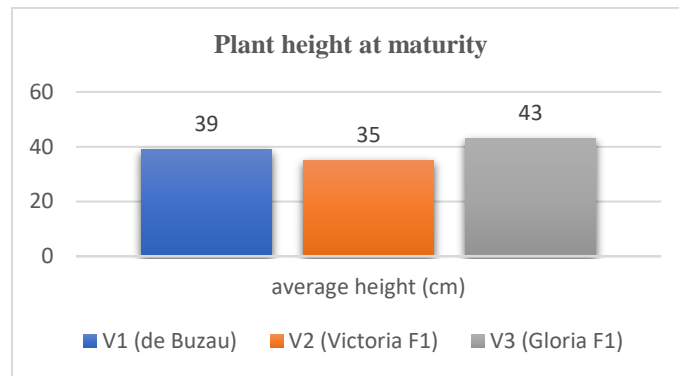


Figure 2. Plant height at maturity

The number of mature leaves varied between 8 and 12, with the highest values observed in Gloria F1. This was also reflected in head development. The total circumference of the cabbage heads varied between 54 cm and 75 cm, with the highest values recorded in Gloria F1, followed by Buzău White Cabbage. Victoria F1 had the lowest values of head circumference, as shown in Figure 3.

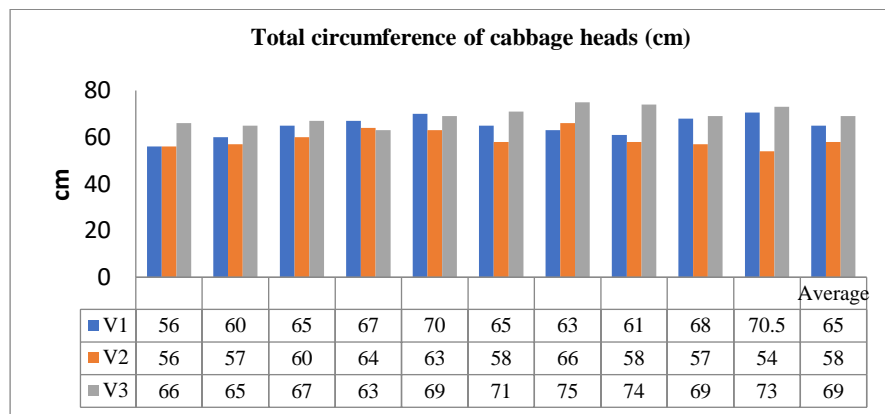


Figure 3. Total circumference of cabbage heads

Head weight varied between 2.0 and 4.0 kg. The highest values were recorded in Gloria F1, while the lowest values were recorded in Victoria F1. The Buzău White Cabbage variety showed good performance, close to Gloria F1 in some determinations. The evolution of head weight is presented in Figure 4. Head weight is an important yield indicator, and research on cabbage crops shows that it can be influenced by irrigation regime and fertilization (PATRA et al., 2024).

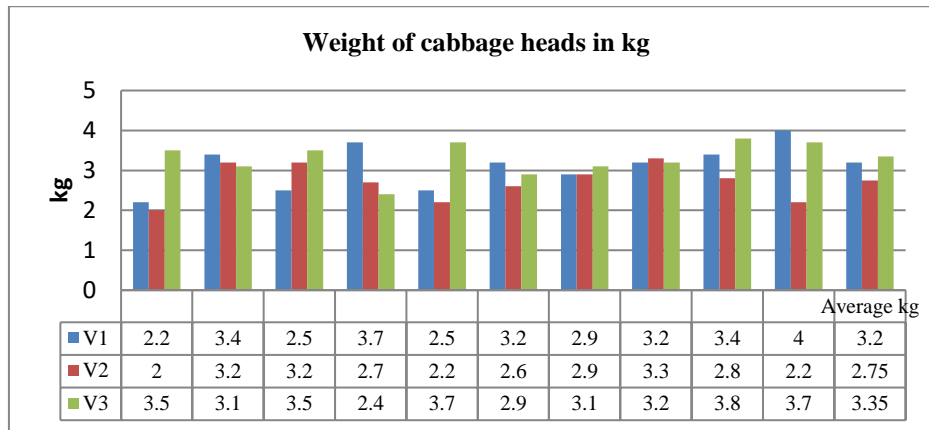


Figure 4. Weight of cabbage heads

The estimated yield per hectare varied between 25,000 kg/ha and 33,900 kg/ha. The highest yield was obtained in Gloria F1, indicating a better adaptability of this hybrid to the pedoclimatic conditions of the Însurăței area. The Buzău White Cabbage variety had an intermediate yield, while Victoria F1 recorded lower yields. The estimated yield is presented in Figure 5. The results confirm that cultivar choice has an important role in obtaining high yield, because biological material can use the same soil, water and fertilization conditions differently (KACJAN-MARŠIĆ and OSVALD, 2004).

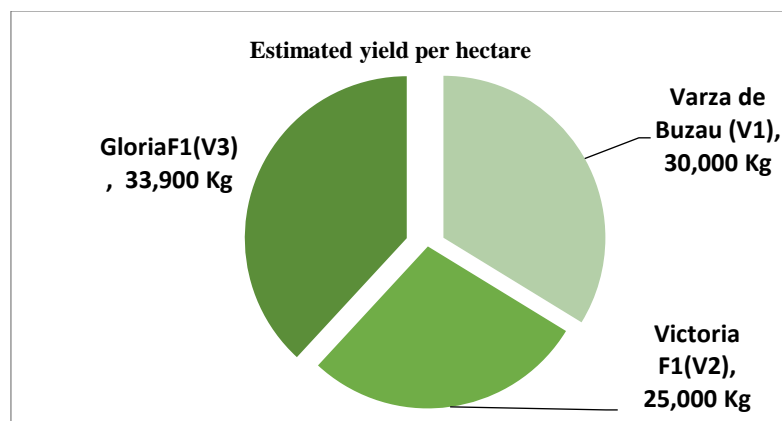


Figure 5. Estimated yield per hectare

The data obtained show that the initial vigor of seedlings does not always guarantee final yield. Victoria F1 had the fastest growth at the seedling stage, but Gloria F1 formed more vigorous plants at maturity, larger heads and the highest estimated yield. This evolution shows that the evaluation of a cultivar must be made throughout the entire vegetation period, not only in the first growth stages.

The application of irrigation, fertilization and phytosanitary treatments contributed to maintaining the crop and to using the productive potential of the analyzed variants. Under the

conditions of the Însurăței area, where periods of water deficit may occur, irrigation had an important role especially during the period of intensive growth and head formation. Studies show that irrigation scheduling can influence cabbage yield and quality, especially under water deficit conditions (BUTE et al., 2021; PATRA et al., 2024; TEREFA, 2021). Maintaining an adequate water regime is important because both water deficit and excess water can affect the development of cabbage plants (HUD et al., 2023). In addition to yield, crop conditions can also influence the nutritional quality of cabbage heads (CITAK and SONMEZ, 2010).

CONCLUSIONS

The study highlighted clear differences between the three analyzed cultivars under the pedoclimatic conditions of the Însurăței area, Brăila County. At the seedling stage, the Victoria F1 hybrid had the fastest growth rate, recording the highest values for plant height and number of leaves. However, this initial advantage was not maintained until maturity in terms of productivity.

At maturity, the Gloria F1 hybrid obtained the best results regarding plant height, number of leaves, head circumference, head weight and estimated yield. The yield varied between 25,000 kg/ha and 33,900 kg/ha, with the maximum value obtained in Gloria F1. The Buzău White Cabbage variety showed good and relatively stable performance, confirming its adaptability to local conditions. Compared to the other variants, Victoria F1 had good development at the seedling stage, but at maturity it formed smaller heads and recorded a lower yield. Under the analyzed experimental conditions, Gloria F1 demonstrated the best adaptability and the highest productive potential for autumn cabbage cultivation in the Însurăței area.

The application of irrigation, fertilization and maintenance works had an important role in maintaining the crop and in using the productive potential of the analyzed variants. The results obtained show that the choice of biological material should be made according to local soil and climate conditions, not only based on the vigor observed in the first growth stages.

BIBLIOGRAPHY

- AECTRA, n.d. – Varza. Aectra, România.
- AYAS, S., 2021 – Effect of irrigation and fertigation levels on cabbage (*Brassicaceae oleracea* var. *capitata* L. Grandslam F1). Turkish Journal of Agriculture-Food Science and Technology, Turcia.
- BUTE, A., IOSOB, G. A., BREZEANU, C., 2021 – The most suitable irrigation methods in cabbage crops (*Brassica oleracea* L. var. *capitata*): a review. Scientific Papers. Series B. Horticulture, LXV (1): 399-405, România.
- BUTE, A., BREZEANU, C., AMBĂRUȘ, S., ANTAL-TREMURICI A., BREZEANU, P.M., MUNTEANU, N., 2024 – Analyses of morphological dynamics into the vegetative phase of white cabbage (*Brassica oleracea* var. *capitata* f. *alba*) across diverse planting schedules. Scientific Papers. Series B. Horticulture, LXVIII (1): 422-430, România.
- CIOFU, R., 2004 – Tratat de legumicultură. Capitolul 14: Plante legumicole din grupa verzei. Varza albă de căpățână. Editura Ceres, București, România.
- CITAK, S., SONMEZ, S., 2010 – Influence of organic and conventional growing conditions on the nutrient contents of white head cabbage (*Brassica oleracea* var. *capitata*) during two successive seasons. Journal of Agricultural and Food Chemistry, SUA.
- ERKEN, O., YILDIRIM, M., 2019 – Yield and quality compounds of white cabbage (*Brassica oleracea* L. cv. *Capitata*) under different irrigation levels. Journal of Agricultural Science and Technology, Turcia.

- HUB, A., ŠAMEC, D., SENKO, H., PETEK, M., BRKLJAČIĆ, L., POLE, L., 2023 – Response of white cabbage (*Brassica oleracea* var. *capitata*) to single and repeated short-term waterlogging. *Agronomy*, 13 (1): 200, Elveția.
- İBRAHEEM, F.F.R., ALLELA, W.B.A.M., 2021 – Response of cabbage plant for different types of mineral fertilizer (*Brassica oleracea* var. *capitata*). IOP Conference Series: Earth and Environmental Science, 910: 012101, Regatul Unit.
- KACJAN-MARŠIĆ, N., OSVALD, J., 2004 – The effect of fertigation on yield and quality of four white cabbage (*Brassica oleracea* var. *capitata* L.) cultivars. *Acta Agriculturae Slovenica*, Slovenia.
- KAVALIAUSKAITĖ, D., KARKLELIENĖ, R., JANKAUSKIENĖ J., 2023 – Impact of an organic fertiliser on the yield of white cabbage (*Brassica oleracea* var. *capitata*) and the soil productivity. *Horticultural Science*, Republica Cehă.
- MARCOSE, n.d. – Produse și tehnologii moderne în agricultură: schema de tratamente pentru cultura de varză. *Marcoser*, România.
- PADEM, H., ALAN, R., 2014 – The effects of nitrogen rates and irrigation levels on growth, yield and nutrient contents of cabbage (*Brassica oleracea* L. var. *capitata*). *Atatürk Üniversitesi Ziraat Fakültesi Dergisi*, Turcia.
- PATRA, S. K., PODDAR, R., PANDA, R., SARKAR, A., 2024 – Response of cabbage (*Brassica oleracea* var. *capitata* L.) to different frequencies of irrigation and levels of soil fertilization in a non-saline coastal Typic Endoaquept. *Journal of Coastal Conservation*, Olanda.
- RAUPLAN DESIGN S.R.L., n.d. – Memoriu general Însurăței. *Plan Urbanistic General*, orașul Însurăței, județul Brăila. România.
- ŠTURM, M., KACJAN-MARŠIĆ, N., ZUPANC, V., BRAČIČ-ŽELEZNIK, B., LOJEN, S., PINTAR, M., 2010 – Effect of different fertilisation and irrigation practices on yield, nitrogen uptake and fertiliser use efficiency of white cabbage (*Brassica oleracea* var. *capitata* L.). *Scientia Horticulturae*, 125: 103-109, Olanda.
- TEREFA, F., 2021 – Performance evaluation of cabbage (*Brassica oleracea* L. var. *capitata*) with irrigation scheduling and nitrogen fertilizer. *Journal of Agricultural Research Advances*, India.
- TURATBEKOVA, A., PARMANOVA, N., ABDUKADIROVA, M., KHADZHIEV, A., ARZIKULOV, X., XODJIMATOV M.-B., 2024 – Study on the effect of organic fertilizers for enhancing the yield and quality of the white cabbage (*Brassica oleracea* var. *capitata* f. *alba*). *E3S Web of Conferences*, Franța.
- VOICU, V., 2023 – Pedology course notes. “Dunărea de Jos” University of Galați, Faculty of Engineering and Agronomy, Brăila, România.
- WU, X., BAI, M., LI, Y., DU, T., ZHANG, S., SHI, Y., LIU, Y., 2020 – The effect of fertigation on cabbage (*Brassica oleracea* L. var. *capitata*) grown in a greenhouse. *Water*, 12 (4): 1076, Elveția.