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# COMPARISON OF GROWTH, BULBS YIELD AND NUTRIENT CONTENT OF *EUCOMIS AUTUMNALIS* (MILL.) CHITT., *E. BICOLOR* BAKER AND *E. COMOSA* (HOUTT.) WEHRH. GROWN IN A GREENHOUSE AS POT PLANTS

# PORÓWNANIE WZROSTU, PLONU CEBUL I ZAWARTOŚCI SKŁADNIKÓW U *EUCOMIS AUTUMNALIS* (MILL.) CHITT., *E. BICOLOR* BAKER I *E. COMOSA* (HOUTT.) WEHRH., UPRAWIANYCH W SZKLARNI JAKO ROŚLINY DONICZKOWE

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**Streszczenie.** Gatunki z rodzaju *Eucomis* należą do perspektywicznych roślin doniczkowych. Celem badań było porównanie wzrostu, kwitnienia, plonu cebul i zawartości makroskładników u trzech gatunków: *Eucomis autumnalis*, *E. bicolor* i *E. comosa*. Badania przeprowadzono w 2013 i 2014 roku w szklarni. Cebule posadzono w doniczkach o średnicy 18 cm, wypełnionych substratem torfowym z dodatkiem nawozu Hydrocomplex. Spośród badanych gatunków *E. autumnalis* miał najmniejszą liczbę liści, najwcześniej zakwitał oraz tworzył najwięcej cebul przybyszowych. *E. bicolor* miał najwięcej liści, dłuższe i szersze kwiatostany oraz tworzył najmniej cebul przybyszowych, w porównaniu z dwoma pozostałymi gatunkami. *E. comosa* cechował się największą średnicą cebul przybyszowych i najwyższą zawartością potasu w liściach. Analiza zawartości makroskładników u wszystkich gatunków wykazała, że liście zawierały więcej azotu, fosforu, potasu, magnezu i wapnia niż cebule.

**Key words:** flowering, geophytes, macronutrients, Pineapple lily, Pineapple Flower.
**Słowa kluczowe:** geofity, koronówka, kwitnienie, makroskładniki, warkocznica.

## INTRODUCTION

*Eucomis* L'Hér., commonly known as pineapple lily, is a genus in the *Asparagaceae* family containing 10 geophytic species indigenous to southern Africa (Masondo et al. 2014). The bulbs produces a rosette of smooth leaves and decorative raceme-type inflorescence consisting of numerous star-shaped flowers (De Hertogh and Le Nard 1993). Flower colour varies from white to yellowish green, pink, purple or burgundy, with or without margins varying from pale to dark purple. The scent of flowers from pleasant to disagreeable depending on the species (Carlson and Dole 2011). When the flowers have been pollinated and fertilized, the flowers turn green or brown fruits, making the inflorescence still decorative. *Eucomis* genus show great potential for use in garden, as cut flower and as potted plants for indoor display (Clark et al. 2010; Filios and Miller 2013; Carlson and Dole 2014). In African traditional medicine, *Eucomis* species are utilized as a remedy against various ailments (Koorbanally et al. 2006). The demand for *Eucomis* as a product for the floricultural market has been increasing steadily.

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Minimal research on cultivation of *Eucomis* species in pots under cover has been published. Moreover, the available literature offers no information about the critical nutrient levels for *Eucomis*. Therefore, the present study aims to assess the growth, flowering, the bulbs yield and nutrient content of three *Eucomis* species grown in the greenhouse as pot plants.

## MATERIAL AND METHODS

The study involved *Eucomis autumnalis* (Mill.) Chitt.*, Eucomis bicolor* Baker and *Eucomis comosa* (Houtt.) Wehrh. bulbs with a circumference of 14–16 cm and an average fresh weight of 68.4 ± 11.2 g, obtained from the Netherlands by a horticultural company Ogrodnictwo Wiśniewski Jacek Junior (Poland). The bulbs were treated for 30 min in a suspension of 0.7% (w/v) Topsin M 500 SC and 1% (w/v) Kaptan 50 WP. Twenty bulbs of each species were planted on 14th March 2013 and 18th March 2014 individual in 18 cm diameter pots containing a deacidified peat (pH 6.5), supplemented with 5 g · $dm^{-3}$ of a fertilizer Hydrocomplex, consisting of macro (5% N-$NO_3$, 7% N-$NH_4$, 11% $P_2O_5$, 18% $K_2O$, 2.7% MgO, 8% S) and microelements (0.015% B, 0.2% Fe, 0.02% Mn, and 0.02% Zn). The plants were grown in a greenhouse under natural photoperiod. Day and night air temperature set point values were 20–22ºC and 16–18ºC. The plants were watered twice a week using tap water. The chemical composition of water was as follows (mg · $dm^{-3}$): 1.15 N-$NO_3$, 1.5 P, 6.3 K, 87.9 Ca, 17.6 Mg, 25 Na, 45.8 Cl, 0.62 Cu, 0.3 Zn, 0.9 Fe, 187 $HCO_3$, EC 0.63 mS · $cm^{-1}$, pH 7.7. The number of days from planting to the beginning of flowering (opening of the first floret in the inflorescence) was recorded. After flowering, leaf number per bulb, leaf length (the longest leaf in the rosette), leaf width (measured at the half length of the longest leaf), inflorescences number per plant, inflorescence length (measured from the soil line to the uppermost part of the inflorescences) and inflorescence width (measured at the half length of the inflorescence) were measured. At the end of cultivation, on 7th September 2013 and 10th September 2014, the whole plants were removed from the pots. The bulbs were separated from the leaves, cleaned, counted and weighed. The leaves from the central part of the leaf rosette and mother bulbs were sent to an accredited laboratory at the Chemical and Agricultural Station in Szczecin for determination of macronutrient content according to standard methods (Ostrowska et al. 1991). After plant dry matter mineralization the following assess were performed: total nitrogen by the Kjeldahl method; potassium by flame photometry; phosphorus by spectrophotometry; magnesium and calcium by atomic absorption spectroscopy.

The experiment was conducted as a single factor in a complete randomization system, in four repetitions, 5 plants in each. The results of measurements were statistically verified using a variance analysis model (ANOVA).

## RESULTS AND DISCUSSION

Identification of *Eucomis* taxa is sometimes difficult because the flowers are morphologically similar. Therefore, an additional features allows for better differentiation between species (Masondo et al. 2014). In the current study, differences between the three *Eucomis* species were found for all morphological parameters measured, excepting for

number of inflorescences per plant (Table 1). Among the evaluated species, the highest number of leaves per plant was in *E. bicolor*. The leaves of that species characterized by the widest leaf blades, as compared to the other two species. *E. autumnalis* had the least number of leaves, whereas *E. comosa* had the narrowest leaves. The leaves of *Eucomis* can be used for vegetative propagation by means of taking leaf cuttings (Nndwambi et al. 2013). The long and strappy leaves of few cultivars can also be used as attractive cut foliage (Carlson and Dole 2011).

Table 1. The growth and flowering of three *Eucomis* species grown in a greenhouse. Mean for years 2013–2014
Tabela 1. Wzrost i kwitnienie trzech gatunków *Eucomis* uprawianych w szklarni. Średnia dla lat 2013–2014

| Traits<br>Cechy | Species<br>Gatunek | | |
|---|---|---|---|
| | *Eucomis autumnalis* | *Eucomis bicolor* | *Eucomis comosa* |
| Leaf number<br>Liczba liści | 7.1 c | 8.8 a | 7.8 b |
| Leaf length<br>Długość liścia [cm] | 33 b | 45 ab | 47 a |
| Leaf width<br>Szerokość liścia [cm] | 7.6 b | 9.5 a | 4.7 c |
| Days to flowering<br>Wczesność kwitnienia | 65 c | 80 b | 89 a |
| Number of inflorescences per plant<br>Liczba kwiatostanów z rośliny | 1.0 a | 1.0 a | 1.0 a |
| Inflorescence length<br>Długość kwiatostanu [cm] | 41 b | 57 a | 39 b |
| Inflorescence width<br>Szerokość kwiatostanu [cm] | 4.5 b | 9.0 a | 4.3 b |

Mean values ($n$ = 40) in the same row followed by the same lower-case letter were not significantly different at $P \leq 0.05$ according to Duncan's multiple range test – Wartości średnie ($n$ = 40) w poszczególnych wierszach oznaczone tą samą literą nie różnią się istotnie przy $p \leq 0{,}05$, według wielokrotnego testu rozstępu Duncana.

According to the results shown in Table 1, the species evaluated in the experiment differed in the earliness of flowering. *E. autumnalis* bloomed earliest, that is 15 days earlier than *E. bicolor* and 24 days earlier than *E. comosa*. No differences were found in the number of inflorescences per bulb of *E. autumnalis*, *E. bicolor* and *E. comosa*. The plants of *O. bicolor* were characterized by significantly longer and wider inflorescences as compared to *E. autumnalis* and *E. comosa*. The present results also showed that inflorescences of *Eucomis* species were very tall (39–57 cm). Problem arise when tall stems bend during production, especially under low light (De Hertogh and Le Nard 1993). The use of plant growth regulators such as flurprimidol, paclobutrazol and uniconazole may help reduce excessive growth of pineapple lily cultivation in pots (Filios and Miller 2013; Carlson et al. 2015).

The evaluate the reproduction potential of *Eucomis* species grown in the greenhouse was also analyzed (Table 2). Diameter of mother and daughter bulbs differed among species. *E. bicolor* had a larger diameter of mother bulbs as compared to *E. autumnalis* and *E. comosa*. The largest diameter of daughter bulbs was found in *E. comosa* while *E. bicolor* presented the smallest diameter daughter bulbs. According to the results, the greatest of the total weight bulbs per plant had *E. comosa*, followed by *E. bicolor*, and finally *E. autumnalis*. Contrary, the highest number of daughter bulbs obtained in *E. autumnalis*. The least daughter bulbs number were recorded in *E. bicolor.* Nndwambi et al. (2013) evaluated the

yield of bulblets of *E*. *bicolor*, *E. van der merwii*, *E. '*Playa Blanca*'* and *E. comosa* propagated by leaf cuttings. It was found that *E. bicolor* produced the least number of bulblets than that in the other taxa.

Table 2. The yield of bulbs of three *Eucomis* species grown in a greenhouse. Mean for years 2013–2014
Tabela 2. Plon cebul trzech gatunków *Eucomis* uprawianych w szklarni. Średnia dla lat 2013–2014

| Traits<br>Cechy | Species<br>Gatunek | | |
|---|---|---|---|
| | *Eucomis autumnalis* | *Eucomis bicolor* | *Eucomis comosa* |
| Diameter of mother bulb<br>Średnica cebuli matecznej [cm] | 6.0 b | 7.3 a | 5.6 b |
| Diameter of daughter bulb<br>Średnica cebuli przybyszowej [cm] | 2.3 b | 1.4 c | 3.2 a |
| Number of bulbs per plant<br>Liczba cebul z rośliny | 8.5 a | 1.2 c | 5.0 b |
| Total weight of bulbs per plant<br>Masa cebul ogółem z rośliny [g] | 174 c | 208 b | 266 a |

Mean values ($n$ = 40) in the same row followed by the same lower-case letter were not significantly different at $P \leq 0.05$ according to Duncan's multiple range test – Wartości średnie ($n$ = 40) w poszczególnych wierszach oznaczone tą samą literą nie różnią się istotnie przy $p \leq 0,05$, według wielokrotnego testu rozstępu Duncana.

No symptoms such as tip burns, chlorosis and necrosis, which are characteristic to some nutrient deficiencies were observed in plants during their growth and flowering in a greenhouse. The analysis of nutrients content in leaves revealed that the species differed in nitrogen, phosphorus and potassium (Table 3). *E. autumnalis* and *E. comosa* were characterized by higher nitrogen content in leaves as compared to *E. bicolor*. The highest potassium content in the leaves was observed in *E. comosa*, and it was significantly lower in *E. bicolor*. The leaves of *E. comosa* had higher phosphorus content than leaves of the other two species. The results showed that the bulbs of *Eucomis* species differences in the content of nitrogen and calcium. The bulbs of *E. bicolor* and *E. comosa* were significantly richer in nitrogen and calcium, and its level was lower in *E. autumnalis* (Table 3).

Table 3. Nutrients content in the leaves and bulbs of three *Eucomis* species grown in a greenhouse. Mean for years 2013–2014
Tabela 3. Zawartość składników pokarmowych w liściach i cebulach u trzech gatunków *Eucomis.* Średnia dla lat 2013–2014

| Plant organ<br>Część rośliny | Nutrients<br>Składniki<br>[% DW] | Species<br>Gatunek | | |
|---|---|---|---|---|
| | | *Eucomis autumnalis* | *Eucomis bicolor* | *Eucomis comosa* |
| Leaves<br>Liście | N | 2.62 a | 1.74 b | 2.36 a |
| | P | 0.21 b | 0.18 b | 0.27 a |
| | K | 2.88 b | 1.60 c | 3.76 a |
| | Ca | 2.62 a | 2.62 a | 2.51 a |
| | Mg | 0.16 a | 0.19 a | 0.16 a |
| Bulbs<br>Cebule | N | 0.45 b | 0.73 a | 0.67 a |
| | P | 0.08 a | 0.10 a | 0.09 a |
| | K | 0.38 a | 0.49 a | 0.50 a |
| | Ca | 0.15 b | 0.19 a | 0.21 a |
| | Mg | 0.04 a | 0.05 a | 0.04 a |

DW – dry weight – sucha masa. Mean values ($n$ = 3) in the same row followed by the same lower-case letter were not significantly different at $P \leq 0.05$ according to Duncan's multiple range test – Wartości średnie ($n$ = 3) w poszczególnych wierszach oznaczone tą samą literą nie różnią się istotnie przy $p \leq 0,05$, według wielokrotnego testu rozstępu Duncana.

An analysis of the macronutrient content in different parts of the plants indicated that the leaves contained more nitrogen, phosphorus, potassium, calcium, and magnesium than the bulbs (Table 3). Similar results were obtained in *E. autumnalis* grown in an unheated plastic tunnel where that the leaves contained significantly more nitrogen, phosphorus, potassium, calcium, magnesium, boron, zinc, manganese, and iron as compared to the bulbs (Salachna and Zawadzińska 2015). Previous studies also showed that the leaves of *E. autumnalis*, *E. bicolor*, *E. comosa*, *E. comosa* 'Sparkling Burgundy', and *E. comosa* 'Twinkle Stars' had higher antioxidant activity (DPPH), higher content of L-ascorbic acid, total carotenoids and chlorophylls than the bulbs, which were characterized by higher concentration of total polyphenols and dry matter (Salachna et al. 2015). The available literature contains no data on the limiting values defining an optimal level of nutrients for *Eucomis* species and cultivars.

## CONCLUSION

In conclusion, the evaluated species have the great potential to be used as potted plants for decorating interiors, balconies, and terraces. Furthermore, a variety of summer-growing *Eucomis* species offered as pot plants is limited and needs to be enriched with underutilized species, such as *E. schijffii E. zambesiaca* and *E. vandermerwei* (Duncan 2013). The results of the analyzes for the plants grown under the same conditions and examined at a similar growth stage may be useful in the development of fertilization schedules for the studied species.

## REFERENCES

**Carlson A.S., Dole J.M.** 2011. Eucomis for specialty cut flower production. Greenhouse Prod. News, May, 18–22.

**Carlson A.S., Dole J.M.** 2014. Postharvest handling recommendations for cut pineapple lily. Hort. Technol. 24(6), 731–735.

**Carlson A.S., Dole J.M., Whipker B.E.** 2015. Plant growth regulator drenches suppress foliage and inflorescence height of 'Leia' pineapple lily. Hort. Technol. 25(1), 105–109.

**Clark E.M.R., Dole J.M., Carlson A.S., Moody E.P., McCall I.F., Fanelli F.L., Fonteno W.C.** 2010. Vase life of new cut flower cultivars. Hort. Technol. 20(6), 1016–1025.

**De Hertogh A., Le Nard M.** 1993. The physiology of flower bulbs. Amsterdam, Elsevier, The Netherlands, 752–753.

**Duncan G.D**. 2013. Geophyte research and production in South Africa. In: Ornamental geophytes: From basic science to sustainable production. Eds. R. Kamenetsky, H. Okubo. Boca Raton, Taylor and Francis Group LLC, 487.

**Filios P.M., Miller W.B.** 2013. Effects of flurprimidol, paclobutrazol and uniconazole drenches on *Eucomis comosa* growth. Acta Hort. 1002, 439–443.

**Koorbanally C., Crouch N.R., Mulholland D.A**. 2006. The phytochemistry and ethnobotany of the southern African genus *Eucomis* (Hyacinthaceae: Hyacinthoideae), in: Phytochemistry: Advances in research. Ed. F. Imperato. Trivandrum, India, Research Signpost, 69–85.

**Masondo N.A., Finnie J.F., Van Staden J.** 2014. Pharmacological potential and conservation prospect of the genus *Eucomis* (*Hyacinthaceae*) endemic to southern Africa. J. Ethnopharmacol. 151(1), 44–53.

**Nndwambi D., Matsiliza-Mlathi B., Kleynhans R.** 2013. Optimizing *in vivo* bulblet formation on leaf cuttings in *Eucomis* spp. S. Afr. J. Bot. 86, 179.

**Ostrowska A., Gawliński S., Szczubiałka Z.** 1991. Metody analizy i oceny właściwości gleb i roślin. Warszawa, Instyt. Ochr. Środ. [in Polish]

**Salachna P., Grzeszczuk M., Wilas J.** 2015. Total phenolic content, photosynthetic pigment concentration and antioxidant activity of leaves and bulbs of selected *Eucomis* L'Hér. taxa. Fresen. Environ. Bull. 24(11c), 4220–4225.

**Salachna P., Zawadzinska A.** 2015. Comparison of morphological traits and mineral content in *Eucomis autumnalis* (Mill.) Chitt. plants obtained from bulbs treated with fungicides and coated with natural polysaccharides. J. Ecol. Eng. 16(2), 136–142.

**Abstract.** *Eucomis* species are a relatively new pot plants with potential for expansion. The aim of the study was to compare the growth, flowering, bulbs yield and macronutrients content of three species: *Eucomis autumnalis, E. bicolor* and *E. comosa*. The experiment was conducted in 2013 and 2014 in a greenhouse. The bulbs were planted in 18 cm diameter pots containing a deacidified peat, supplemented with a fertilizer Hydrocomplex. Of all the species tested, *E. autumnalis* had the least leaves, flowered earliest and produced the highest number of adventitious bulbs. *E. bicolor* had the highest number of leaves, produced longer and wider inflorescences and the least number of adventitious bulbs as compared to the other two species. *E. comosa* was characterized by the largest diameter of adventitious bulbs and the highest potassium content in the leaves. The analysis of the macronutrient composition of three *Eucomis* species showed that the leaves contained more nitrogen, phosphorus, potassium, magnesium and calcium than the bulbs.