Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.14, No.1, 2024

Determination of Some Agricultural Characteristics and Glucomannan Contents of Some Orchid Species under Southeastern Anatolian Conditions

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Abstract
This study, which was conducted to determine the morphological, phenological and agricultural characteristics and active ingredient contents of some salep orchids, was carried out in 3 replications according to the Randomized Blocks trial design under the conditions of the Southeastern Anatolia Region of Turkey between 2015 and 2017. Four wild orchid species were used as materials in the study [*Ophrys apifera* Huds., *Serapias vomeracea* (Burm.f.) Briq., *Anacamptis pyramidalis* (L.) Rich., *Anacamptis sancta* (L.) R.M.Bateman, Pridgeon & M.W.Chase]. In the research, in addition to phenological observations such as sprouting date, flowering date, flowering period, vegetation period; parameters such as plant height (31.27-33.13 cm), number of leaves (5.40-6.93 number per plant^{-1}), leaf lenght (6.60-13.57 cm), leaf width (1.23-2.23 cm), new tuber number per plant^{-1} (1.93-2.08 number per plant^{-1}), tuber yield (145-357 kg/da^{-1}), glucomannan ratio (15.76- 42.74%) were examined. Based on the results of this research, it is not possible to say that these orchid species can be grown economically under field conditions. It is obvious that much more work needs to be done to grow these species under field conditions. In future studies, priority should be given to selection breeding of individuals of the same species collected from different locations.
Keywords: Salep, Orcid, Yield, Tuber, Serapias, Anacamptis, Glucomannan
DOI: 10.7176/JBAH/14-1-02
Publication date: January 31st 2024

1. Introduction

The Orchidaceae family is one of the most widely distributed families on earth, with nearly twenty thousand species (Sezik, 1984). When orchid is mentioned, an expensive, showy and exotic flower grown in tropical climates comes to mind. In addition to the orchid species known as ornamental plants, there are also species used in salep production that are naturally distributed in Turkey. Salep is a drug that has been recorded in medical books since the time of Dioscorides (Sezik, 1984). They have been used as healing extracts, perfumes and food additives in many different cultures such as Oriental, European, American, Australian and African communities for centuries (Bulpitt, 2005). Tubers of about 26 orchid species belonging to *Anacamptis, Barlia, Dactylorhiza, Himantoglossum, Ophrys, Orchis* and *Serapias* genera are used to produce hot drink salep in Turkey. Salep is a very popular and traditional nutritious hot-drink in the Asia-Minor and Arabic countries. Salep has been obtained from the tubers of orchids naturally distributed in Turkey for centuries and has been used both domestically and exported. Salep orchids do not contain endosperm and are one of the smallest seeded plants in the world. Moreover, the mother tuber which produces 1-2 offspring every year, dies at the end of the year. Turkish orchids are in danger of extinction because they are collected from nature. For this reason, salep orchids need to be grown under field conditions. This can only be achieved by determining the cultivation techniques of salep orchids. In this research, it was aimed to determine the possibility of growing some salep orcid species under field conditions and some of its agricultural characteristics.

2. Materials and Methods

The tubers used as material in this research were collected from the rural area of Germencik District of Aydın Province of Turkey. Tubers with a circumference of 10-12 cm belonging to 4 orchid species [*Ophrys apifera* Huds., *Serapias vomeracea* (Burm.f.) Briq., *Anacamptis pyramidalis* (L.) Rich., *Anacamptis sancta* (L.) R.M.Bateman, Pridgeon & M.W.Chase] were used in the study. The research was conducted according to the randomized complete block trial design with 3 replications under Southeastern Anatolia Turkey (Mardin) conditions for two years (2015-2017). Tubers were stored in a temperature-controlled warehouse environment at 16 ℃ until October.

The tuberss were sprayed with a mixed solution of 4% Prochloraz and 2% Iprodione, and then they were dried by laying them in 10 cm thick piles in a place out of sunlight before planting. The bulbs were planted by hand in 6 rows in the plots on October 16 in both years. Each plot was arranged in 3 m length and 10×10 cm density. Additionally, 1 ton/da of burnt sheep-goat manure was thrown into the area and deep ploughing was carried out. 30 kg/da of 15.15.15 compound fertilizer was applied to the soil before planting. Irrigation and manual weed control were carried out when necessary. Şen's method was used to determine the glucomannan content (Şen, 2016). The data obtained from the research; variance analysis was performed through MSTAT-C and grouping was carried out by comparing the statistically significant average results according to the LSD (5%) test.

3. Results and Discussion

3.1 Phenological Observations

Table 1 shows the phenological observation results determined in the study carried out to determine cultivation possibilities of some salep orchid species.

When the sprouting dates of some orchid species are examined, it appears that the species significantly affects sprouting dates. It has been determined that among the species, *Anacamptis pyramidalis* sprouted the earliest and *Serapias vomeracea* sprouted the latest in both years. The values obtained in the study belong to later dates than the values reported by Ertaş et al. (2019). It can be said that this difference is due to the variation that occurs because these species are wild plants collected from nature.

Considering the time required for sprouting in Table 1, it is seen that *Anacamptis pyramidalis* emerges much earlier than other species in both years. It can be thought that this situation is due to the request of other species to stratification. The study found that the other three species showed similar ecological requests for sprouting. The values obtained in the study are lower than the values reported by Ertaş et al. (49 days for *Serapias vomeracea* and 51 days for *Anacamptis sancta*). It is thought that this difference is due to the cultivation techniques, genotypic difference, the different circumference of the tubers used as seeds and the difference in planting dates.

When the flowering date values of different orchid species were investigated, it was determined that there was no difference between flowering dates in both years (Table 1). The data obtained in our study were similar to Ertaş et al. (2019), but occurred earlier than Şavşatlı & Akça (2023). It can be said that this difference is due to the different tuber sizes used in the research and the difference in ecological conditions.

Considering the times required for flowering in Table 1, it can be seen that *Anacamptis pyramidalis* blooms in a much longer time than other species in both years. It can be thought that this situation is due to the request of this species to vernalisation. The data obtained in our study are lower than those reported by Ertaş et al. (183 days for *Serapias vomeracea* and 197 days for *Anacamptis sancta*). It can be said that the difference between the values obtained from the two studies is due to climatic factors and the difference in the place where the tubers are collected.

In the study, flowering time values varied between 60-67 days and no significant differences were detected between species. The data obtained in our study are higher than those reported by Ertaş et al. (30 days for *Serapias vomeracea* and 32 days for *Anacamptis sancta*) and Şavşatlı & Akça (28 days for *Serapias vomeracea*). Özel et al. (2017) report that as corm diameter increases, flowering period also increases. It can be said that the difference in flowering periods is due to the different sizes of tubers used in these researches (Beşirli et al., 1999).

When Table 1 was investigated, it was determined that the longest vegetation period occurred in *Anacamptis pyramidalis* (224 and 220 days respectively according to years) and the shortest vegetation period occurred in *Serapias vomeracea* (170 and 172 days respectively according to years). It can be said that the difference in vegetation periods between species is due to the earlier sprouting of *Anacamptis* tubers. The data obtained in our study are lower than those reported by Ertaş et al. (218 days for *Serapias vomeracea* and 233 days for *Anacamptis sancta*). It can be said that the difference between the datas of these studies arises from the difference in the planting time and the ecology in which the tubers used as seeds are collected.

Table 1. Some phenological observations of some orchid species

Species	Sprouting Date	Days to Sprouting (day)	Flowering Date	Days to Flowering (day)	Flowering Period (day)	Vegetation Period (day)
2015-2016						
Ophrys apifera	20.12.2015	66	09.04.2016	112	62	174
Serapias vomer.	24.12.2015	70	07.04.2016	106	64	170
Anacamptis pyr.	01.11.2015	17	09.04.2016	161	62	224
Anacamptis sanc.	18.12.2015	64	05.04.2016	105	66	176
2016-2017						
Ophrys apifera	21.12.2016	67	09.04.2017	111	60	180
Serapias vomer.	23.12.2016	69	06.04.2017	106	60	172
Anacamptis pyr.	03.11.2016	19	10.04.2017	160	63	220
Anacamptis sanc.	17.12.2016	63	06.04.2017	107	67	174

3.2 Plant Characteristics

3.2.1 Plant Height

Plant heights was not significantly affected by different species in both growing seasons. In the research; the plant height values obtained from different species of salep Orchids varied between 31.27-33.13 cm according to the combined values of two years (Table 2). The shortest plant height was found in *Anacamptis sancta* and the highest plant height was found in *Anacamptis pyramidalis.* The data obtained in our study are higher than those reported by Ertaş et al. (24.33 cm for *Serapias vomeracea* and 22.23 cm for *Anacamptis sancta*) and Şavşatlı & Akça (13.42-16.46 cm for *Serapias vomeracea*). It can be said that this difference arises from the different sizes of tubers used in the researchs and collection of tubers from different locations.

3.2.2 Leaf Lenght

In this study on some orchid species, leaf length values varied between 6.60-13.57 cm. The lowest leaf length was detected in *Ophrys apifera* and the highest leaf length was detected in *Serapias vomeracea*. The data obtained in our study are higher than those reported by Ertaş et al. (9.34 cm for *Serapias vomeracea* and 5.49 cm for *Anacamptis sancta*) and similar to Şavşatlı & Akça (7.39-7.92 cm for *Serapias vomeracea*). It is thought that this difference is due to the cultivation technique, genotypic difference, the different circumference of the tubers used as seeds and the difference in planting dates.

Table 2. Mean values of plant heights (cm), leaf lenghts (cm), leaf widths (cm), leaf number per plant (leaf plant $^{-1}$), tuber number per plant (tuber plant $^{-1}$), tuber yield (kg da $^{-1}$) and Glucomannan ratio (%) of some salep Orchid species

Characteristics	Plant Heights	Leaf Lengths	Leaf Widths	Leaf Number per Plant	Tuber Number per Plant	Glucomannan Ratio	Tuber Yield
Two Years Combined							
Ophrys apifera	31.67	6.60 ^{d}	1.81 ^{b}	6.93 ^{a}	2.03 ^{bc}	20.07 ^{b}	356.60 ^{a}
Serapias vomer.	32.67	13.57 ^{a}	2.23 ^{a}	6.93 ^{a}	2.06 ^{b}	42.74 ^{a}	222.25 ^{b}
Anacamptis pyr.	33.13	11.60 ^{b}	1.23 ^{c}	5.40 ^{b}	1.93 ^{c}	19.75 ^{b}	145.00 ^{c}
Anacamptis sanc.	31.27	7.60 ^{c}	1.40 ^{c}	6.60 ^{a}	2.08 ^{c}	15.77 ^{b}	228.83 ^{d}
Mean	**32.18**	**9.84**	**1.67**	**6,47**	**2.03**	**24.58**	**238.17**
LSD (%5)	**N.S.**	**0.99**	**2.82**	**1.09**	**0.11**	**0.50**	**11.91**

N.S.: Not Significant

3.2.3 Leaf Width

When the leaf widths determined in some orchid species are examined, it is seen that the leaf width values vary between 1.23-2.23 cm. The lowest leaf width was detected in *Anacamptis pyramidalis* and the highest leaf width was detected in *Serapias vomeracea*. The data obtained in our study are higher than those reported by Ertaş et al. (1.78 cm) and Şavşatlı & Akça (1.35-1.40) for *Serapias vomeracea*. It can be said that this difference is due to the variation that occurs because these species are wild plants collected from nature. The data obtained in our study are similar to the data reported by Ertaş et al. (2019) for *Anacamptis sancta*.

3.2.4 Leaf Number per Plant

When the number of leaves determined in some orchid species are examined, the lowest number of leaves comes from *Anacamptis pyramidalis* (5.40 number per plant) and the highest number of leaves comes from *Ophrys apifera* and *Serapias vomeracea* (6.93 number per plant) was found to be obtained (Table 2). The data obtained in our study are higher than those reported by Ertaş et al. (3.50 number per plant for *Serapias vomeracea* and 5.17 number per plant for *Anacamptis sancta*) and Şavşatlı & Akça (4.60-5.47 number per plant for *Serapias vomeracea*). It can be said that this difference is due to the variation that occurs because these species are wild plants collected from nature.

3.2.5 Tuber Number per Plant

The number of tubers per plant determined according to different salep orchid species varied between 1.93-2.08 number per plant, and it was determined that the lowest value was obtained from *Anacamptis pyramidalis* and the highest value was obtained from *Anacamptis sancta*. The data obtained in our study are higher than those reported by Ertaş et al. (1.13 numbers per plant for *Serapias vomeracea* and 1.50 numbers per plant for *Anacamptis sancta*) and Şavşatlı & Akça (1.40-1.63 numbers per plant for *Serapias vomeracea*). Özel & Erden (2008) and Arslan et al. (2007) in their researchs, reported that the number of cormels increased due to the increase in corm diameter. It can be said that this difference is due to the different sizes of tubers and genotypic differences.

3.2.6 Tuber Yield

Tuber yield was significantly affected by orchid species in both growing seasons. Tuber yield values in some orchid species varied between 145.00 and 356.60 kg da^{-1}. The lowest bulb yield was found in *Anacamptis pyramidalis*, and the highest bulb yield was found in *Ophrys apifera*. Since there is no research on the tuber yields of the species subject to our research, no comparison could be made.

3.2.7 Glucomannan Ratio

It was determined that the Glucomannan ratio values detected in some orchid species varied between 15.77-42.74%. The Glucomannan ratio values obtained in this study are lower than the values of Ertaş et al. (59.63% for *Serapias vomeracea* and 29.47% for *Anacamptis sancta*). It can be said that this difference is due to the variation that occurs because these species are wild plants collected from nature.

4. Conclusion

Based on the results of this research, it is not possible to say that these orchid species can be grown economically under field conditions. It is obvious that much more work needs to be done to grow these species under field conditions. In future studies, priority should be given to selection breeding of individuals of the same species collected from different locations. Selection is essential because there can be great variation among different individuals of a wild plant species.

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