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EFFECT OF SHADING LEVELS ON THE GROWTH AND DEVELOPMENT, YIELD AND QUALITY OF RHIZOME OF BLACK MUSLI (*CURCULIGO ORCHIOIDES* GAERTN.) PLANTED IN SUOI HAI COMMUNE, HANOI CITY

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Summary

A two-year field experiment was conducted from January 2022 to December 2023 in Suoi Hai Commune, Hanoi City, to evaluate the effect of different shading levels on the growth and development, yield, and quality of black musli (*Curculigo orchioides* Gaertn.). The experiment was conducted using a completely randomized block design with four shading treatments and three replications, using a planting density of 20 x 25 cm. The results showed that shading significantly affected the ongrowth and development, yield, and quality of *C. orchioides*. Moderate shading at 30% and 50% resulted in markedly improved growth and survival, with plant survival rate exceeding 93% after three months compared with 79% under full sunlight. Rhizome yields were also substantially enhanced, reaching 1.177 and 1.234 tons per hectare under 50% and 30% shade, respectively, nearly double the yield of the unshaded control (0.629 tons per hectare). The highest concentrations of orcinol glucoside (0.63 – 0.67%) and curculigoside (0.16 – 0.17%) were achieved at the shading levels of 30% and 50% at harvest in November 2023. These findings demonstrate that shading plays an important role in improving both productivity and quality of *C. orchioides*. Shading levels between 30% and 50% are recommended for the cultivation of black musli in Suoi Hai commune, Hanoi city.

Keywords: *Black musli;* Curculigo orchioides; *Curculigoside; Orcinol glucoside; Shading.*

1. Introduction

Black musli (*Curculigo orchioides* Gaertn.) belongs to the family Hypoxidaceae, a valuable and precious medicinal plant, which is widely used in Vietnamese traditional medicine and other countries around the world. Black musli is distributed in many countries such as India, Nepal, South China, Japan, Thailand, Laos, Cambodia, Malaysia, Philippines, Vietnam, and Australia [1],[2]. The rhizome contains bioactive compounds such as glycosides, flavonoids, and steroidal saponins, which have been reported to support kidney function and exhibit therapeutic potential against haemorrhoids, jaundice, asthma, physical fatigue, and male reproductive disorders. These compounds also demonstrate immunomodulatory, anti-oxidant, anticancer, hepatoprotective, anti-diabetic, and anti-inflammatory activities [1],[2],[3],[4],[5]. Recently, the alcoholic extract of rhizome has been reported to exhibit antidepressant effects, indicating its potential for drug development [6].

C. orchioides naturally grows in the plains, midlands, and mountains, where the soil is fertile and moist, with a lot of humus, under shade and high humidity [7]. However, excessive harvesting is reducing the population of *C. orchioides* in the wild. As a result, *C. orchioides* has been classified in Vietnam as a medicinal plant species facing a high risk of extinction [8], and similar concerns have been reported in other countries [9]. This urgently requires the development of cultivation. *C. orchioides* is native to Vietnam, distributed in mountainous areas from the North to the South. The terrain and climate of Hanoi, which include mountainous, hilly, and plain areas, provide suitable ecological conditions for a wide range of plant species, including *C. orchioides*. Among the various agronomic measures used to improve cultivation, shading is considered as an important factor that strongly affects plant growth, yield, and quality of *C. orchioides*.

2. Research Materials and Methods

2.1. Research materials

The seedlings used in the experiment were propagated by cuttings originating from Lao Cai province and met the nursery plant quality standards, including a height of 15 – 20 cm, 3 – 5 leaves, a stem diameter of 0.6 – 1.0 cm, and healthy green foliage which is free from pests and diseases. Song Giang organic microbial fertilizer, superphosphate, potassium chloride, urea, and lime powder were also applied in the present study.

2.2. Research method

Experimental design: The experiment was designed as a single-factor randomized complete block design (RCBD) according to the experimental design method of Nguyen Thi Lan and Pham Tien Dung (2005) [10]. Four shading treatments were evaluated, including CT1 (unshading (Control)), CT2 (30% shading), CT3 (50% shading), and CT4 (70% shading). Each treatment consisted of three replicates with an experimental plot size of 10 m^2. The total experimental area was 120 m^2.

Soil preparation, planting, and plant care techniques: The wild weeds were removed from the soil ground, then plowed and harrowed thoroughly. Planting Beds were made with 120 cm wide, 25 - 30 cm high. Trenches were 40-50 cm wide. Holes were made in rows at a distance of 20 x 25 cm. Song Gianh organic microbial fertilizer and superphosphate were mixed well, applied as base fertilizer into the hole, and then filled with soil 1-2 cm thick. Place the seedling upright in the middle of the hole, fill in the soil around the base, and gently press around the base. The seedlings were planted purely on March 15, 2022, under HDPE black shade net (30%, 50%, 70% types) made in Taiwan.

Fertilizer amount for 1 hectare: 5 tons of Song Gianh organic fertilizer + 120 kg N + 80 kg P_2O_5 + 120 kg K_2O + 500 kg lime powder. Equivalent to: 5 tons of Song Gianh organic fertilizer + 260 kg Urea + 500 kg Superphosphate + 200 kg Potassium Chloride + 500 kg lime powder. They were applied as follows:

Basal fertilizer: Apply 100% of Song Gianh organic fertilizer, lime powder, and 50% superphosphate. First Fertilization: 80 kg urea + 50 kg potassium chloride 2 months after planting. Second fertilization: Apply 80 kg urea + 50 kg potassium chloride 4 months after planting. Third fertilization: Apply 50 kg urea + 250 kg superphosphate + 50 kg potassium chloride (May 15, 2023). Fourth fertilization: Apply 50 kg urea + 50 kg potassium chloride (July 15, 2023).

Soil moisture was maintained after planting by watering. Replace dead plants and replant fresh plants after 1 month of planting. Wild weeds were removed monthly.

Rhizome quality analysis method: Rhizomes were harvested in November 15, 2023, after 20 months of planting. Preliminary processing and drying according to Vietnam Pharmacopoeia V (2018) [11]. Orcinol glucoside and curculigoside compounds in rhizome were quantified by HPLC technique at the National Institute of Medicinal Materials [12].

Monitoring parameters: time from planting to rooting (days), time from planting to greening recovery (days), time from planting to new leaf appearance (days), time from planting to harvest (days), survival plant rate (%). Number of leaves/plant (leaves), leaf length (cm), leaf width (cm); rhizome length (cm), rhizome diameter (cm), fresh individual yield (g/plant), fresh/dry rhizome weight rate (folds), dry rhizome yield (ton/ha), orcinol glucoside and curculigoside content (%).

Data collection and processing method: Data were collected from 20 plants/experiment using the 5-point diagonal method and processed using Microsoft Excel ver. 2010 and the IRRISTAT 5.0 software.

2.3. Research Location and Date

The research was conducted in Suoi Hai commune, Hanoi city. Implementation duration: from January 2022 to December 2023.

3. Research Results and Discussion

3.1. Effects of shading levels on growth stages and survival rate of C. orchioises plant

Table 1. Effect of shade levels on the growth period and survival plant rate

Formulas	Time from planting to……(days)			Survival plant rate (%)
	Greening recovery	Rooting	New leaves appear	
CT1 (control)	15	22	29	79.0
CT2	10	15	22	93.3
CT3	10	15	22	94.4
CT4	12	17	27	81.2
LSD 0.05				**7.9**
CV %				**4.6**

Notes: CT1: unshade; CT2: 30% shade; CT3: 50% shade; CT4: 70% shade.

Effects of shading levels on growth stages and survival plant rate were shown in Table 1. In formulas CT2 and CT3, the seedlings recovered greening fastest after 10 days of planting, followed by CT4 (after 12 days) and CT1 unshaded (after 15 days). Similarly, they rooted in formulas CT2 and CT3 after 15 days, faster than in CT4 (17 days) and CT1 (22 days). The seedlings developed new leaves after 22 days in CT2 and CT3, compared to CT4 (27 days) and CT1 (29 days). Thus, seedlings grown in CT2 and CT3 (corresponding to 30% and 50% shade) recovered, developed new roots and new leaves faster than the seedlings grown in CT4 (corresponding to 70% shade) and CT1 (full sunlight) formulas. Also, in CT2 and CT3 formulas, the survival rate of the seedlings was highest after 3 months of planting (93.3-94.4%) compared to the plants in CT4 (81.2%) and CT1 (79.0%) formulas. According to Do Huy Bich et al. (2006), the *C. orchioides* plant is a moisture-loving, light-loving, and slightly shade-tolerant plant, so appropriate and suitable shading level is necessary for plant growth and development [13]. Thus, suitable shading levels of 30% and 50% werebetter than shading level of 70% and unshading. Suitable shading levels reduce air temperature and light intensity, reduce the amount of water vapor lost from the plant, increase humidity under the canopy, helping the plant to grow and develop better than unshaded conditions. However, when the plant is shaded 70%, the survival plant rate drops to 81.2% (CT4), which was lower than in the CT2, CT3 formulas. *C. orchioides* plants were grown under 30% shading level for 2 months shown in Fig. 1.

Fig. 1. *C. orchioides* plants were grown under 30% shading level after 2 months.

3.2. Effect of shading levels on leaf parameters

Plants require a certain amount of light during the growth and development processes. The appropriate shading level varies depending on the type and species of plant. The effects of shading levels on the number of leaves, leaf length, and leaf width of *C. orchioides* plants 20 months after planting (November 15, 2023) are shown in Table 2.

Table 2. Effects of shading levels on leaf parameters

Formulas	Number of leaves /plant (leaves)	Leaf length (cm)	Leaf width (cm)
CT1	8.9	38.9	2.1
CT2	10.6	48.7	2.8
CT3	11.0	47.3	2.9
CT4	8.5	41.7	2.1
LSD $_{0.05}$	**1.4**	**0.33**	**0.33**
CV%	**7.3**	**6.80**	**6.80**

Notes: CT1: unshade; CT2: 30% shade; CT3: 50% shade; CT4: 70% shade.

Number of leaves/plant: The number of leaves produced on the plant varies depending on the level of shading, ranging from 8.5 leaves (CT4), 8.9 leaves (CT1), 10.6 leaves (CT2), to 11.0 leaves (CT3). The shading formulas CT2 and CT3 gave the highest number of leaves compared to the other two formulas, with a statistically significant difference at the 95% confidence level. However, there was no statistically significant difference between the two formulas, CT1 and CT2.

Leaf width, leaf length: under the 70% shading (CT4), there was not enough sunlight for plant photosynthesis. The leaf size was smaller (leaf length and leaf width are small) compared to the leaves in CT2 (30%) and CT3 (50%) and the unshaded control (CT1) formulas. Leaf width and leaf length were highest in formulas CT2 and CT3, with significant differences at the 95% confidence level at 20th months after planting (November 15, 2023). Leaf width of plants in formulas CT1 and CT2 reached 2.8 cm and 2.9 cm, respectively. While leaf length reached 48.7 cm and 47.3 cm, respectively.

Thus, the level of shading affects the parameters such as the number of leaves, leaf length, and leaf width. When plants were shaded by 30% and 50%, the leaf number, leaf length, and leaf width were higher than those at 70% shade and no shading. Therefore, a reasonable shading regime had positively effect on the number of leaves and leaf size. It means an increase in leaf area, helping plants increase their ability to photosynthesize.

3.3. Effect of shading levels on yield components and rhizome yield

The effect of shading levels on rhizome yield of *C. orchioides* is shown in Table 3. The shading levels affected the parameters of rhizome length, rhizome diameter, individual yield, and dried rhizome yield. The length of the rhizome ranged from 62.8 mm (CT1) to 84.5 mm (CT2); the diameter of the rhizome reached 7.2.3 mm (CT1) to 14.85 mm (CT2); the individual yield ranged from 7.09 g (CT1) to 11.75 g (CT2); the rhizome yield reached 0.629 tons/ha (CT1) to 1.234 tons/ha (CT2). At 50% shade level, the plants produced the highest rhizome yield (1.234 tons/ha), followed by 30% shade level (1.134 tons/ha), then 70% (0.972 tons/ha), and unshaded (0.629 tons/ha).

Table 3. Effect of canopy cover on yield components, rhizome yield

Formulas	The rhizome length (mm)	Rhizome diameter (mm)	Fresh individual yield (g)	Fresh/ dry weight Ratio (folds)	Dried rhizome yield (tons/ha)
CT1	62.8 ± 1.34	7.23 ± 0.84	7.09 ± 0.73	3.73 ± 0.26	0.629
CT2	84.5 ± 2.25	14.79 ± 0.72	11.75 ± 1.35	3.72 ± 0.35	1.234
CT3	83.9 ± 1.32	14.85 ± 0.65	11.21 ± 1.02	3.75 ± 0.43	1.177
CT4	63.4 ± 0.59	8.25 ± 0.38	9.02 ± 1.21	4.05 ± 0.52	0.972
$LSD_{0,05}$					**0.12**
CV %					**6.3**

Notes: CT1: unshade; CT2: 30% shade; CT3: 50% shade; CT4: 70% shade.

3.4. Effect of shading levels on the rhizome quality

The effects of shading levels on the content of orcinol glucoside and curculigoside compounds in the rhizome were shown in Table 4. The content of orcinol glucoside reached 0.34% (CT4), 0.37% (CT1), 0.63% (CT2), and 0.67% (CT3). The content of curculigoside reached 0.11% (CT1), 0.14% (CT4), 0.16% (CT3), and 0.17% (CT2). Thus, rhizomes collected in formula CT2 (shading 30%) and CT3 (50%) tend to have higher content than in CT4 (70%) and CT1 (no shading).

In this study, the *C. orchioides* plant was grown in Suoi Hai commune, Hanoi city under suitable shade levels of 30% and 50%, which helped the plant grow and develop better than at a level of 70% and control (unshading). Here, we recommend using in practice planting *C. orchioides* plant under the canopy of 50% shade in the first 2-3 months after planting, then reducing the shade to 30% for the plant to grow and develop well. *C. orchioides* is a precious and native medicinal plant with high medical value in Vietnam. Normally, plants grow and develop from

April to November, dormant from December to March every year. It is a medicinal plant that has an obligatory dormant phenomenon in the dry season, or winter, when the cold northeast monsoon appears. It grows and develops with a new cycle starting when the weather is warm, and the air humidity is high. In nature, *C. orchioides* is a shade-tolerant plant, preferring shade and humid environment [7]. The plant often grows under the canopy of trees in forests, in crevices in rocks, and mixed with other plants in bushes. Appropriate shading has a positive effect on plant growth and development [9]. Appropriate shading level helps the plant avoid leaf burn due to strong sunlight, especially during the hottest hours of the day, keeping the soil moist better, helping the leaves photosynthesize more effectively. However, when it was shaded too much, the plant does not receive enough light, reducing the plant's ability to photosynthesize, affecting its growth, development, yield, and quality of rhizome.

Table 4. Effect of canopy cover on the content of active compounds in rhizome

Formulas	Orcinol glucoside content (%)	Curculigosid content (%)
CT1	0.37 ± 0.01	0.11 ± 0.01
CT2	0.67 ± 0.02	0.17 ± 0.020
CT3	0.63 ± 0.02	0.16 ± 0.01
CT4	0.34 ± 0.01	0.14 ± 0.01

Notes: CT1: no shade; CT2: 30% shade; CT3: 50% shade; CT4: 70% shade.

Our research results showed that the suitable shade regimes for the growth and development of *C. orchioides* grown in Suoi Hai commune, Hanoi are 30% and 50%. Under these levels, the survival rates of the plants were over 90% after 3 months of planting. The rhizome yield was over 1.0 tons/ha/2 years, and the quality of rhizome met Chinese Pharmacopoeia X (2015) [14] and basic standards [12]. According to Do Huy Bich et al. (2006), *C. orchioides* is a shade-tolerant plant that can be grown indoors as an ornamental plant [13]. Le Van Dung et al. (2018) showed that C. *orchioides* could grow and develop well under the forest canopy in Ben En National Park, Thanh Hoa province [15]. Pham Thanh et al. (2018) found that *C. orchioides* planted under the canopy of ***Eucalyptus*** and ***Acacia*** plantations with a shade level of 30 - 50% grew better than those planted on bare land in the sandy inland fields in Thua Thien Hue province [16]. Nguyen Huu Toan Phan (2021) determined that the suitable shade level for *C. orchioides* in Dak Lak province was 30% to 50% [17]. Vu Thi Anh Dao et al. (2023) showed that black musli developed well in Ha Giang province under 25% shade [18]. Nguyen Van Khiem et al. (2023) indicated that *C. orchioides* grew and developed well under the forest canopy at 25 – 50% shade in Kon Tum province. After more than 2 years of planting, the survival plant rate reached over 80%, and the quality of medicinal materials met the current Pharmacopoeia standards [19]. Bui Thi Xuan et al. (2022) determined that the appropriate shade level for *C. orchioides* grown in Tam Dao, Vinh Phuc was 25% [20]. Tran Thi Trang et al. (2024) evaluated the growth, development, yield, and quality of 7 isolates of *C. orchiodes* that grew on alluvial soil of the Red River. The plants were shaded 50% for 3 months after planting, then shaded at 30% using the banana plant canopy [21]. The plants grew and developed well in the field, the medicinal material met the standards according to the Chinese Pharmacopoeia X (2015) [14], and the Basic Standards for medicinal materials [12].

4. Conclusion

Shade level has a significant impact on the growth, rhizome yield, and quality of *C. orchioides* grown in Suoi Hai commune, Hanoi city. The shade levels of 30 – 50% were determined to be the most suitable for plant performance. At these shade levels, the survival plant rate reached over 93% after 3 months of planting compared to 81.2% under 70% shade, and 79% under unshaded. The yield of rhizomes reached 1.177 – 1.234 tons/ha compared to the control (unshaded) of 0.629 tons/ha. The orcinol glucoside content reached 0.63 – 0.67%

compared with 0.37% in the control, while the curculigoside content reached 0.16 – 0.17% compared with 0.11% in the control. Therefore, it is recommended that *C. orchioides* should be planted under 30 – 50% shade level in Suoi Hai commune, Hanoi city.

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References

1. Chauhan N. S., Sharma V., Thakur M., Dixit V. K. (2010), *Curculigo orchioides*: the black gold with numerous health benefits. *Journal of Chinese Integrative Medicine*, 8(7), 613-623.
2. Asif M. (2012), A review phytochemical and ethnopharmacological activities of *Curculigo orchioides*. *Malaysian Journal of Pharmaceutical Sciences*, 39(3-4), 1-10.
3. Chauhan N. S., Dixit V. K. (2008), Spermatogenic activity of rhizomes of *Curculigo orchioides* Gaertn in male rats. *International Journal of Applied Research in Natural Products*, 1(2), 26-31.
4. Singh R., Gupta A.K. (2008), Antimicrobial and antitumor activity of the fractionated extracts of Kalimusli (*Curculigo orchioides*). *The International Journal of Green Pharmacy*, 2, 34-6.
5. Thakur M., Dixit V. K. (2007), Effect of some Vajikaran herbs on pendiculation activities and *in vitro* sperm count in male. *Sexuality and Disability*, 25(4), 203-207.
6. Chen B., Liu X., Wang Y., Bai J., Liu X., Xiang G., Liu W., Zhu X., Cheng J., Lu L., Zhang G., Zhang G., Dai Z., Zi S., Yang S., Jiang H. (2023), Production of the antidepressant orcinol glucoside in *Yarrowia lipolytica* with yields over 6,400-fold higher than plant extraction. *PLoS Biology*, 21(6), e3002131.
7. Nagesh K. S. (2008), High Frequency Multiple Shoot Induction of *Curculigo orchioides* Gaertn.: Shoot Tip V/S Rhizome Disc, *Taiwania*, 53(3), 242-247.
8. Nguyen Tap (2019), Red list of medicinal plants in Vietnam, *Journal of Medicinal Materials*, 24(6), 319-328.
9. Metha J., Nama K. S. (2014), A review on ethnomidicines of *Curculigo orchioides* Gaertn: Balck Gold. *International Journal of Pharmacy and Biomedical Research*, 2014, 1(1), 12-16.
10. Nguyen Thi Lan, Pham Tien Dung (2005), Experimental methods textbook. Agricultural Publishing House, Hanoi.
11. Ministry of Health (2018), *Vietnamese Pharmacopoeia V.* Volume 1, Medical Publishing House. Hanoi.
12. Nguyen Van Khiem, Vu Thi Hoai Sam, Nguyen Minh Khoi, Nguyen Thi Huong, Trinh Van Vuong, Nhu Thu Nga, Pham Hong Minh, Phuong Thien Thuong, Pham Thi Nguyet Hang, Tran Thi Lan (2019), Summary report of research results of the Ministry of Health-level project: "Research on chemical composition, biological effects and propagation of black musli (*Curculigo orchioides* Gaertn)", Hanoi. Project ID: 60/HD/K2DT, Registration number 2019-64-0136/KQNC.
13. Do Huy Bich, Dang Quang Chung, Bui Xuan Chuong, Nguyen Thuong Dong, Do Trung Dam, Pham Van Hien, Vu Ngoc Lo, Pham Duy Mai, Pham Kim Man, Doan Thi Nhu, Nguyen Tap, Tran Toan (2006), *Medicinal Plants and Medicinal Animals in Vietnam*, Vol. 2, Science and Technology Publishing House, Hanoi, 693-696.
14. Chinese Pharmacopoeia Commission (2015 Edition), Pharmacopoeia of the People's Republic of China X, Volume 1, Curculiginis Rhizoma. China Medical Science Press.
15. Le Van Dung, Le Dinh Phuong, Tong Van Hoang, Nguyen Quang Sy, Le Van Hai (2018), Summary report of research results of the Provincial-level project: "Research on breeding techniques and building a model for growing *Curculigo orchioides* Gaertn under the forest canopy at Ben En National Park".
16. Pham Thanh, Tran Minh Duc, Nguyen Huy Son (2018), Results of investigation on distribution and experimental planting of *Curculigo orchioides* Gaernt. on sandy soil in the fields in Thua Thien – Hue province. Journal of Agriculture and Rural Development, 22:130-135.
17. Nguyen Huu Toan Phan (2021), Summary report of the national science and technology project: "Research on conservation and development of some key medicinal species of the Central Highlands, creating some high-value products from some key medicinal species, rare indigenous medicinal species of the Central Highlands", code: TN18/C09 (2018-2021).
18. Vu Thi Anh Dao, Tran The Duy, Nguyen Ngoc Quynh, Trieu Van Ve, Mai Tien Bang, Phan Thanh Huong, Nguyen Văn Khiem (2023), Summary report of research results of the provincial-level project: "Research to complete the propagation procedure and development of *Curculigo orchioides* Gaertn in Ha Giang province", code: DTKH.HG-03/20.
19. Nguyen Van Khiem, Tran Thi Trang, Dinh Thi Thu Trang, Nguyen Xuan Nam, Ngo Dinh Dai, Le Van Thoan, Nguyen Thanh Tuan (2023), Results of experimental planting of *Curculigo orchioides* Gaertn. under forest canopy in some ecological sub-regions of Kon Tum province. *Science and Technology Information*, 2, 68-74.
20. Bui Thi, Xuan, Nguyen Van, Tam, Tran Thi Lan, Nguyen Quang Tin (2022), Effect of cultural pratices on growth and quality of black musli (*Curculigo orchioides* Gaertn.) in Tam Đao, Vin Phuc, *Journal of Agriculture and Rural Development*, Issue 1, December, 38-46.
21. Tran Thi Trang, Nhu Thu Nga, Tran Thi Kim Dung, Trinh Van Vuong, Nguyen Duc Manh, Lo Duc Viet, Nguyen Van Khiem (2024), Preliminary Investigation of Growth, Development, Yield and Quality of some Samples of *Curculigo orchioides* Gaertn. in Hanoi. *Journal of Medicinal Materials*, 29,(4), 248-252.