Performance of ZZ (*Zamioculcas zamiifolia*) cultivars on different organic potting mixture

ABSTRACT

An experiment was carried out at the research cum instructional farm, Department of Horticulture, School of Agricultural Sciences, Nagaland University, Medziphema, India (2022-2023). The experiment was laid out in completely randomized design (CRD) with 14 treatments and 3 replications. The treatments consisted of organic substrates (T1: FYM, T2: Vermicompost, T3: Used tea leaves, T4: Forest litter, T5: Cocopeat, T6: Perlite and T7: Rice husk) and 2 cultivars (C1: Super Nova and C2: Black Raven).The rooted plants of ZZ cultivars were planted in different organic substrates along with garden soil and sand in the ratio of 1:1:1. Among the cultivars, C_1 (Super Nova) was found to be significantly better than Black Raven. Amongst the organic substrates, T5 (Garden soil + sand + cocopeat) was found to be statistically superior in all observed parameters except for plant height which was found to be in maximum in T_4 (Garden soil + sand + forest litter). The same treatment of T5 exhibited the highest profit (Rs. 12250) and benefit cost ratio (1.89) on ZZ cultivar Black Raven.

Keywords: ZZ (*Zamioculcas zamiifolia*), potting mixture, cocopeat, forest litter

INTRODUCTION

Zamioculcas zamiifolia, also called Zanziber Gem, ZZ plant, ZuZu plant, Aroid palm and Eternity plant is an ornamental plant grown for its attractive glossy foliage. Zamioculcas is a member of the family of Araceae (Bentham and Hooker,1883; Engler and Prantl, 1889) and originates from South Africa. *Zamioculcas zamiifolia* is the only known species of the Zamioculcas genus so far (Chen *et al*., 2002). The aesthetic utility of ZZ plant is due to its special appearance, potential to flourish in low light conditions and its tolerance to drought conditions. The potential of the plant to resist drought and low light conditions has promoted its horticultural significance at international level (Chen and Henny, 2003). ZZ plant has noknown pest or disease incidences under interior conditions and has utmost tolerance to lesslight and drought conditions (Chen *et al*., 2002). Therefore, it serves as a great house plant. It is drought tolerant due to the succulent rhizome that stores water until favourable conditions resumes. In drought condition, the above ground portion of the plant (leaflets and rachis) usually falls and leaves only the reserved swollen petiole base, like the pseudobulbs in orchids to aid the plant until the next irrigation or rain (Brown, 2000).

ZZ Super Nova has a green tinted young leaves that turn dark as they mature (Bisht,2023). It is known for its attractive, exotic looking foliage. Young leaves are bright green while mature leaves are dark (Wyman, 2022). ZZ Black Raven have dark-purpled colored leaves and compact plant are the results of the plants stout robust constitution. This cultivar has a glossy and dark leaves. The new growth initially appears in a stunningly lime green hue which slowly darkens as it ages (Bisht, 2023). It is a slow growing cultivar and grows to a height of about 30 inches tall (Wyman, 2022). The main ornamental interest of ZZ cultivars lies in its glossy foliage and its adaptability to different environmental conditions, robust defense mechanisms against pathogens and resistance to climatic changes (Seneviratne *et al*., 2020).

Its high market value is attributed to its slow growth rate. The propagation of zamiofolia has been inhibited by its inherent characteristics of a slow growth rate. (Seneviratne *et al*., 2013; Sayadi Nejad and Sadeghi, 2019).

Soil is the pool of nutrients for plants thereby making it the most important factor for plant growth.Mixing of organic substances increases effectiveness compared to the use of its ingredients separately. Use of organic matter improves the soil health by improving the soil aeration, buffering capacity, faster release of nutrients, better water and nutrient supply capacity and also increases the activity of beneficial soil microorganisms. Growing media has different origins and they take the place of soil and serve as a means of anchorage for the root system, supply water and nutrients for the plants and aerify the root area (Gruda *et al*., 2006). A good media provides enough anchorage or prop the plant, provide water and nutrients, aid in oxygen diffusion to the plant roots and allow gaseous exchange between the roots and the atmosphere outside the root substratum (Argo 1998 and Abad *et al*., 2002). The production and quality of potted ornamentals is highly affected by the growing media prepared in different compositions (Gheorghe and Monica., 2015).

MATERIAL AND METHODS

An experiment was conducted during 2022-2023 at the Research cum Instructional farm of School of Agricultural Science, Nagaland University, Medziphema located at320 m above mean sea level at a latitude of $27^0$06'00''North and longitude of $93^0$37'12'' East.The climatic condition of Medziphema is sub-tropical with high relative humidity and moderate temperature having medium to high rainfall. The temperature ranges from 25^0C-31^0C during summer and 10^0C-20^0C in winter. During monsoon, the area receives good amount of rainfall of average 3000 mm annum^{-1}.

Table 1: Factors affecting cultivars and organic substrates

Factor I	**Cultivars (C)**
C_1	ZZ Super Nova
C_2	ZZ Black Raven
Factor II	**Organic substrates**
T_1	Garden soil+sand+FYM
T_2	Garden soil +sand + Vermicompost
T_3	Garden soil+sand+Used tea leaves
T_4	Garden soil+sand+Forest litter
T_5	Garden soil+sand+Cocopeat
T_6	Garden soil+sand+Perlite
T_7	Garden soil+sand+ Rice husk

* FYM : Farm yard manure

Before transplanting, polybags of 20 x 15 cm (L X B) dimensions were obtained. Garden soil, sand and various organic substrates, each measuring 500 gm were measured separately, thoroughly mixed together and filled in the polybags. The rooted plants were planted in the centre of the polybags.The first watering was given immediately after transplanting the plant, thereafter irrigation was given on plant demand and the surrounding conditions.Weeding and earthing up was done as when required or deemed necessary. The observations were made on rhizome size at transplanting and 8 months after transplanting, number of days to shoot emergence, number of days to unfurling of leaves, plant height at 3,6 and 8 months aftertransplanting, number of shoots at 3,6 and 8 months after transplanting, rachis girth at 3,6 and 8 months after transplanting, growth rate at 3,6 and 8 months after transplanting and benefit cost ratio. The plants were maintained in a green house with good air circulation and natural light condition.

Formula used

1. Growth rate : (Lt –L0) / Lt X 100
2. Net returns : Gross income –total cost
3. B:C ratio : Gross income / total cost

The recorded data was subjected to analysis of variance method (Gomez and Gomez.,1983) and tested against error mean square using Fisher Snedecor 'F'test at 0.5% level of significance.

RESULTS AND DISCUSSION

Rhizome size at transplanting and rhizome size

Among the cultivars, C_1 (Super Nova) recorded the maximum (2.84 cm and 3.97 cm) rhizome size. Kumar *et al*. (2020) reported that the difference among the cultivars might be attributed to differences in genetic makeup of the cultivars. Among the organic substrates, the maximum (2.83 cm and 3.65 cm) rhizome size were recorded in T_5 (Garden soil+sand +cocopeat), followed by T_6 (Garden soil+sand+perlite) with a rhizome size of 2.74 cm and 3.48 cm at transplanting and 8 months after planting.The minimum (1.78 cm and 2.84 cm) rhizome size were observed in T_3 (Garden soil+sand+used tea leaves) (Table 1). The maximum rhizome size in cocopeat might be due to the fact that although cocopeat has low levels of nitrogen, calcium and magnesium but has high levels of phosphorous and potassium. Phosphorous is good for root growth and development (Gohil *et al.*, 2018).

Days to shoot emergence

Cultivar Super Nova took a minimum of 67.97 days to shooting which might be due to difference in vegetative attributes of different genotypes exhibiting varied growth rate and genetic make up (Thakur *et al*., 2018). Among the substrates, T_5 (Garden soil+sand +cocopeat) took minimum days (62.89) for shoot emergence while maximum (88.61) days to shoot emergence was recorded in T_3 (Garden soil+sand +used tea leaves). The days for ZZ shoot emergence was around 65 days after propagation (Chen and Henny, 2003). Cocopeat as a growing media have higher water holding capacity and moisture supply as well as sufficient porosity which helps in better seedling emergence (Lohani *et al*., 2023).Cocopeat provides a

better texture to the growing media and also prevents compaction (Ghosh *etal*., 2021) which might have contributed to the early shoot emergence.

Days to unfurling of leaves

The minimum (75.54) days to unfurling of leaves was observed in C_1 (Super Nova). Arora and Khanna (1985) and Rani *etal*. (2007) reported that supremacy of some genotypes over other genotypes is because of the variation in genotypes of different varieties. T_5 (Garden soil+sand +cocopeat) took minimum (71.67) days to unfurl the leaves which was followed by T_6 (Garden soil+sand +perlite) which took 73.00 days. The maximum days (95.00) to unfurling of leaves was recorded in plants grown in T_3 (Garden soil+sand +used tea leaves) (Table 2). Cocopeat has the potential to stock and liberate nutrients to plants for an increased length of time (Swetha *et al*., 2014). Cocopeat has good physical characteristics, high total pore space, elevated water content, low shrinkage, low bulk density and slow biodegradation (Evans *et al*., 1996; Prasad, 1997) which might have contributed to its superiority as compared to other substrates.

Table 2: Effect of potting mixture on rhizome size at transplanting and 8 months after transplanting, days to shoot emergence and days to unfurling of leaves

Cultivars (C)	**Rhizome size (cm)**		**Days to shoot emergence**	**Days to unfurling of leaves**
	At transplanting	**8 months after transplanting**		
C_1	2.84	3.97	67.97	75.54
C_2	1.95	2.63	82.84	87.98
SEm (±)	0.14	0.10	3.71	3.27
CD at 5%	0.40	0.30	10.74	9.47
Organic substrates (T)				
T_1	2.27	3.29	72.56	79.33
T_2	2.29	3.22	83.50	83.50
T3	1.78	2.84	88.61	95.00
T_4	2.38	3.29	79.67	87.22
T_5	2.83	3.65	62.89	71.67
T_6	2.74	3.48	64.78	73.00
T_7	2.50	3.35	75.83	82.61
SEm (±)	0.23	0.20	6.93	6.12
CD at 5 %	0.67	0.57	20.09	17.72
Interaction (C X T)				
SEm (±)	0.37	0.28	9.81	8.65
CD at 5%	NS	NS	NS	NS

* SEm : Standard error of mean
* CD : Critical difference
* NS : Non significant

Plant height at 3, 6 and 8 months after transplanting

The maximum plant height (11.87 cm, 14.28 cm and 16.60 cm) was recorded in C_1 (Super Nova). Kumari and Kumar (2015) reported that differences in plant height amongst hybrids is attributed to the hereditary traits or the existing conditions of the environment of the growing location. Amongst the treatment, T_4 (Garden soil+sand +forest litter) exhibited the maximum height (10.06 cm, 13.30 cm and 14.89 cm), followed by T_7 (Garden soil+sand + rice husk) recording 9.99 cm, 11.28 cm and 12.87 cm at 3,6 and 8 months of planting. The minimum plant height (8.23 cm, 8.69 cm and 10.28 cm) was noted in T_3 (Garden soil+sand +used tea leaves). The maximum plant height in forest litter maybe attributed to the fact that flavonoids which are known to play a role in attracting beneficial microbes such as rhizobia may remain in plant tissue after senescence and affect plant growth by scavenging free radicals and improving stress tolerance (Barazani and Friedman, 2001).

Number of shoots at 3, 6 and 8 months after transplanting

Cultivar C_1 recorded the maximum number of shoots (1.13, 1.41 and 1.93) and treatment T_5 (Garden soil+sand+cocopeat) revealed the maximum number of shoots (1.26, 1.71 and 2.54) while the minimum number of shoots (0.73, 1.06 and 1.31) was observed in T_3 (Garden soil+sand +used tea leaves). The maximum number of shoots was observed in soil +cocopeat medium (Rawat *et al*., 2020.,Singh *et al*.,2021) and Lad *et al*., 2020 also observed the same in media consisting of cocopeat as a growing media. More production of shoots in cocopeat media might be due to an increase in soil porosity, water retention and increase in ion exchange capacity (Devidas, 2012).

Rachis girth at 3, 6 and 8 months after transplanting

The maximum rachis girth (0.17 cm, 0.29 cm and 0.36 cm) was observed in C_1 and T_5 (Garden soil+sand +cocopeat) recording a maximum value of (0.22 cm, 0.29 cm and 0.35cm) on all days of observation. The minimum rachis girth (0.13 cm,0.22 cmand 0.28 cm) was noted in plants grown in T_3 (Garden soil+sand +used tea leaves). The high porosity feature of cocopeat aided to maintain a balanced water retention and aeration for enhanced intake of nutrients in the growth medium confined in a limited and enclosed space (Singh *etal*., 2015) which might have contributed to the good growth of the plant.

Growth rate at 3, 6 and 8 months after transplanting

Cultivar Super Nova recorded the maximum growth rate (15.97%, 30.31% and 36.86%) amongst both the cultivars. Treatment wise, T_5 (Garden soil+sand +cocopeat),recorded the maximum growth rate (16.52%, 34.47% and 40.72%) followed by T_6 (Garden soil+sand +perlite) which recorded growth rates of 15.10%,31.44% and 37.36% while the minimum growth rate (11.00%, 21.37% and 29.83%) was noted in T_3 (Garden soil+sand +used tea leaves) at 3, 6 and 8 months after transplanting.

Benefit cost ratio

The highest benefit cost ratio (1.94) was recorded in T_5 (Garden soil+sand+cocopeat) with net returns 9700/100. The least benefit cost ratio and the least net returns was recorded in T_3 (Garden soil+sand+ Used tea leaves). The highest net return for T5 can be attributed to the fact that although the plant height was recorded highest in T4 however the other attributes like number of shoots, rachis girth and growth rate was significantly higher in T4 which may have contributed to the plant's aesthetic value thereby increasing its sale.

Table 3: B:C ratio of cultivars Super Nova and Black Raven

Organic substrate	B:C ratio	
	Super Nova	**Black Raven**
T_1	1.85	1.82
T_2	1.79	1.77
T_3	1.68	1.74
T_4	1.86	1.84
T_5	1.94	1.89
T_6	1.89	1.85
T_7	1.76	1.76

Table 4: Effect of potting mixture on plant height, number of shoots, rachis girth and growth rate at 3, 6 and 8 months after transplanting

Cultivars	Plant height (cm)			Number of shoots			Rachis girth (cm)			Growth rate (%)		
	3 months	6 months	8 months	3 months	6 months	8 months	3 months	6 months	8 months	3 months	6 months	8 months
C1	11.87	14.28	16.60	1.13	1.41	1.93	0.17	0.29	0.36	15.97	30.31	36.86
C2	6.02	7.34	8.20	0.77	1.17	1.73	0.16	0.23	0.27	11.11	25.01	32.97
SEm (±)	0.46	1.00	0.54	0.10	0.13	0.16	0.02	0.01	0.01	0.77	1.62	0.94
CD at 5 %	1.32	1.54	1.56	0.28	NS	NS	0.05	0.02	0.02	2.24	4.69	2.71
Organic substrates												
T1	9.36	10.41	12.00	0.88	1.11	1.70	0.15	0.24	0.29	12.39	26.69	34.48
T2	9.75	10.96	12.55	0.82	1.22	1.66	0.17	0.27	0.32	13.40	24.40	23.23
T3	8.23	8.69	10.28	0.73	1.06	1.31	0.13	0.22	0.28	11.00	21.37	29.83
T4	10.06	13.30	14.89	0.96	1.33	1.77	0.15	0.26	0.31	12.35	25.26	34.47
T5	8.55	10.17	11.76	1.26	1.71	2.54	0.22	0.29	0.35	16.52	34.47	40.72
T6	9.65	10.83	12.42	1.07	1.39	2.17	0.18	0.28	0.34	15.10	31.44	37.36
T7	9.99	11.28	12.87	0.93	1.22	1.64	0.16	0.26	0.32	14.04	29.97	35.33
SEm (±)	0.85	1.00	1.01	0.18	0.24	0.30	0.03	0.01	0.01	1.45	3.03	1.75
CD at 5 %	2.47	2.89	2.92	NS	NS	0.42	NS	0.03	0.03	4.19	8.78	5.08
Interaction (C X T)												
SEm (±)	1.21	1.41	1.43	0.25	0.34	0.42	0.05	0.02	0.01	2.05	4.29	2.48
CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

* SEm : Standard error of mean
* CD : Critical difference
* NS : Non significant

CONCLUSION

It is concluded that the growth of Super Nova is faster and superior than Black Raven irrespective of the growing medium. The growth of Super Nova and Black Raven was found to do well in potting mixture consisting of Garden soil+Sand+Cocopeat in terms of rhizome size, shoot emergence, unfurling of leaves, number of shoots, rachis girth and growth rate. The same treatment gave the highest B:C ratio. However for the plant height, the treatment of Garden soil+Sand+Forest litter was found better for both the cultivars. There is no literature available on improved culture media for rapid propagation of ZZ (Seneviratne *etal,* 2013). Therefore, use of garden soil + sand+ cocopeat for growing ZZ plants is recommended.

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