The Pharma Innovation Journal 2021; 10(12): 1662-1666

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(12): 1662-1666

www.thepharmajournal.com
Received: 13-10-2021
Accepted: 29-11-2021

Sanjay Kumar
M.Sc. (Floriculture) Scholar, Department of FLA, COA, IGKV, Raipur, Chhattisgarh, India

Deo Shankar
Sr. Scientist & Dean, College of Agriculture and Research Station, Kanker, Chhattisgarh, India

SK Tamrakar
Assistant Professor (Floriculture), Department of FLA, COA, IGKV, Raipur, Chhattisgarh, India

Vijaya Choudhary
M. Sc. (Floriculture) Scholar, Department of FLA, COA, IGKV, Raipur, Chhattisgarh, India

Amar Prakash
M. Sc. (Floriculture) Scholar, Department of FLA, COA, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Sanjay Kumar
M. Sc. (Floriculture) Scholar, Department of FLA, COA, IGKV, Raipur, Chhattisgarh, India

Effect of different size of pots on growth and flowering of *Costus speciosus* (Koenig) Sm.

Sanjay Kumar, Deo Shankar, SK Tamrakar, Vijaya Choudhary and Amar Prakash

Abstract
The present investigation was conducted at Horticultural Research Cum Instructional Farm, College of Agriculture, IGKV, Raipur, Chhattisgarh, during Kharif season of 2020-21. The experiment was laid out in Completely Randomized Design with three replication having 10 treatment combinations of different size of pots with six pots per treatments. The treatments consisted of ten different sizes of pots *viz*., 15 cm, 17 cm, 19 cm, 21 cm, 23 cm, 25 cm, 27 cm, 29 cm, 31 cm and 33 cm diameter pots. The results of the study indicated that growth parameters *viz*., plant height (128.67 cm), leaf length (29.53 cm), leaf breadth (11.00 cm), stem girth (2.70 cm) were obtained significantly maximum in treatment T_{10} (33 cm diameter pots). Whereas, Flower parameters *viz*., days to flower bud emergence (69.17 days), days to opening of flower (82.17 days) was recorded significantly minimum with treatment T_{10} (33 cm diameter pots). Similarly, the significantly maximum flower blooming period (22.42 days), number of flower plant^{-1} (45.83), length of flower (6.63 cm), diameter of flower (5.42 cm), length of inflorescence (12.42 cm), width of inflorescence (7.43 cm), flower stalk length (25.87 cm), flowering duration (42.33 days) was recorded in treatment T_{10} (33 cm diameter pots). Number of tillers plant^{-1} (4.00) and number of leaves plant^{-1} (55.00) was recorded significant in treatment T_6 (25 cm diameter pots), number of leaves tillers^{-1} (20.14) was recorded significant in treatment T_5 (23 cm diameter pots), leaf area index (4.90) was recorded minimum in treatment T_4 (21 cm diameter pots). Therefore, among all the treatment T_{10} (33 cm diameter pots) was found significantly superior in all over the treatments.

Keywords: *Costus speciosus*, Pot size, growth and flowering

Introduction
Costus speciosus (Koenig) Sm. Is a robust perennial rhizomatous succulent flowering plant with tuberous rhizomes that produces pinkish white flower in reddish bracts. It belongs to the Costaceae (Zingiberaceae) family and is a medicinal and ornamental plant in the genus Cheilocostus. It is also known as spiral ginger, cane reed, crepe ginger, wild ginger, malay ginger, costus spiral flag and variegated ginger. "*Cheilocostus speciosus*" the genus name of spiral ginger is derived from the Greek term Cheilo, which means "lip" referring to the plant's huge labellum. It's very common on the Greater sunda islands of Indonesia. Central India's Vindhya and Satpura hills, as well as the western ghats of maharastra, Karnataka and Kerala (Sarin *et al*.1974) [8]. It is common in hilly and forested areas of Chhattisgarh, particularly in the Baster and Bilaspur divisions.

Costus speciosus differs from common ginger in that it has only one row of spirally arranged leaves 15 to 30 cm long with a pointed tip, short stalks, and a lower surface covered with soft hairs. Flowers can be found in a variety of habitats, spikes, dense and solitary Rhizomes were used to propagate the species vegetatively. Birds scatter seeds when they consume the fruits. It is used as a medicinal plant in India and as a decorative in other countries. *Costus speciosus* has been introduced in some locations and has become an invasive species. It is commonly used as an ornamental plant (Mity Thambi and Mohamed, P. Shafi, 2015) [7].

Material and Methods
The present investigations entitled, "Effect of different size of pots on growth and flowering of *Costus speciosus* (Koenig) Sm." executed in Horticultural Research Cum Instructional Farm, College of Agriculture, IGKV, Raipur (C.G.), inception during Kharif 2020-21. The experiment was laid out in Completely Randomized Design with three replication having 10 treatment combinations of different size of pots with six pots per treatments. The treatments consisted of ten different sizes of pots *viz*., 15 cm, 17 cm, 19 cm, 21 cm, 23 cm, 25 cm, 27 cm,

29 cm, 31 cm and 33 cm diameter pots. Observations were recorded on each plant for various growth, flowering and rhizome parameters in *Costus speciosus*.

Result and Discussion

Effect of different size of pots on growth parameters

Plant height (cm): Plant height was increased significantly influenced by increase in pot size. Maximum plant height (128.67 cm) was recorded in treatment T_{10} (33 cm diameter pots) at 120 DAP, while minimum plant height (32.17 cm) was observed in treatment T_1 (15 cm diameter pots size) at 40 DAP. This could be because a larger pot size could have accommodated more potting mixture, which has been helpful in providing sufficient nutrients and space for growth of an adequate root system, resulting in better growth of the plant, which in turn grows longer. The current findings are consistent with those of gupta and dilta (2015) [5] in primula malacoides France and Dilta *et al*. (2019) [3] in azaleas.

Number of tillers plant^{-1}

There were no significant differences on number of tillers plant^{-1} due to the effect of different size of pots. The data recorded on number of tillers plant^{-1} at different growth stages are presented in the Table 1. The maximum number of tillers plant^{-1} (4.00) at 120 DAP was observed in treatment T_6 (25 cm diameter pots). The minimum number of tillers plant^{-1} (1.93) was recorded in treatment T_1 (15 cm diameter pots). Increased pot sizes resulted in proportionately increased number of tillers plant^{-1}. A similar result was found in Joseph, E. J. (1983) [6] in *Costus speciosus*.

Number of leaves tillers^{-1}

The effect of different size of pots showed non significant effect on number of leaves tillers^{-1} at 120 DAP. The maximum number of leaves tillers^{-1} (20.14) was recorded in treatment T_5 (25 cm daimeter pots), but it was statistically at par with treatments T_3, T_6 T_7 and T_8 respectively. Whereas, the minimum number of leaves tillers^{-1} (14.33) was recorded in treatment T_2 (17 cm diameter pots). Joseph, E. J. (1983) [6] also stated that the number of leaves tillers^{-1} in *Costus speciosus.*

Number of leaves plant^{-1}

The Maximum number of leaves plant^{-1} (55.00) was recorded in Treatment T_6 (25 cm diameter pots) and minimum number of leaves plant^{-1} (7.50) was observed in treatment T_2 (17 cm diameter pots). This might be due to large sized pots developed very effectual root system hence produced taller plants with maximum leaf number. This characteristic was affected negatively as the pot size decreased. They complete for essential resources, increased root mass and decreased rooting space that leads to competition for available oxygen. These results corroborate the previous findings of Alhajhoj (2017) [1] in Gladiolus.

Leaf length (cm)

The data recorded on leaf length (cm) at growth stages are presented in the Table 1. It is observed from the table that leaf lengths varied significantly among the treatment in the observation noted at 120 DAP. The maximum leaf length (29.53 cm) was recorded in treatment T_{10} (33 cm diameter pots). The minimum leaf length (20.00 cm) was recorded in treatment T_1 (15 cm diameter pots).

Leaf breadth (cm)

The data recorded on leaf breadth (cm) at growth stages are presented in the Table 1. It is observed from the table that significant difference in leaf breadth has been noted among the treatments at 120 DAP. The maximum leaf breadth (11.00 cm) was observed in treatment T_{10} (33 cm diameter pots). The minimum leaf breadth (6.63 cm) was recorded in treatment T_1 (15 cm diameter pots).

Stem girth (cm)

There were no significant differences on stem girth due to the effect of different size of pots. At 120 DAP, the maximum stem girth (2.70 cm), was observed in treatment T_{10} (33 cm diameter pots), which was significantly superior over all treatments. The minimum stem girth (1.63 cm), was recorded in treatment T_5 (25 cm diameter pots). Increased pot sizes resulted in proportionately increased stem girth.

Leaf area index

The data recorded on leaf area index at growth stages are presented in the Table 1. At 120 DAP, the maximum leaf area index (4.90) was recorded in treatment T_4 pot size of 21 cm diameter but it was at par with treatment T_7. The minimum leaf area index (3.10) was recorded in treatment T_8 (29 cm diameter pots).

Effect of different size of pots on flowering parameters

Days to flower bud emergence: It is clear from the table 2. Days to flower bud emergence varied significantly among the treatments. Interaction of different size pots showed significant effect on days to flower bud emergence in *costus speciosus*. The earliest flower bud emergence (69.17 days) was recorded in treatment T_{10} (33 cm diameter pots), which was followed by treatment T_9. The maximum days to flower bud emergence (101.33 days) was observed in treatment T_1 (15 cm diameter pots).

Days to opening of flower: The minimum days to opening of flower (82.17 days) was observed in treatment T_{10} (33 cm diameter pots) which was significantly superior over treatments but it was statistically at par with treatment T_9. The maximum days to opening of flower (114.17 days) was recorded in treatment T_1 (15 cm diameter pots). The early flower opening might be due to possible role of larger pot sizes through better avaibality of space and nutrients for vegetative growth development which might have resulted in opening of flower earlier. Similar findings of results were also reported by Schenk and Brundert (1979) [9], Gupta (2013) in *primula malacoides* Franch.

Flower blooming period (days)

Observations recorded on the effect of different size of pots on flower blooming period (days) of *costus speciosus* in per pots on one tillers are presented in Table 2. Interaction of different size of pots resulted in significant effect on flower blooming period in *costus speciosus.* The maximum flower blooming period (22.42 days) was observed in treatment T_{10} (33 cm diameter pots), which was significantly superior over all the treatments. The minimum flower blooming period (2.91 days) was recorded in treatment T_1 (15 cm diameter pots). These results got support from the earlier work of Vernieri *et al*. (2003) in sunflower, Carvalho *et al*. (2008) [2], and Gupta (2013) in *primula malacoides* Franch. The

implementation of different size of pots on flower blooming period (days) was found to be significant.

Number of flower plant^{-1}

Higher number of flower plant^{-1} (45.83) was observed in treatment T_{10} (33 cm diameter pots), which was significantly superior over all the treatments. The minimum number of flower plant^{-1} (5.67) was recorded in treatment T_1 (15 cm diameter pots). These findings could be attributed to the capacity of pots to accommodate potting mixture and assuring of space for root growth and development besides providing the nutrients to the growing plants. It is a well proven fact that there is a linear relationship between pot size and growth of plants. As the size of the pots increases, there is corresponding increase in the growth and flowering attributes of plants. Similar findings of results were also reported by Thapa (2015) in Azalea, Gupta (2013) in *primula malacoides* Franch.

Length of flower (cm)

The data reported showed that length of flower was significantly varied among the treatments. The maximum length of flower (6.63 cm) was observed in treatment T_{10} (33 cm diameter pots), which was statistically at par with treatment T_3, T_4 and T_8. However it showed significant difference with rest of the other treatments. The minimum length of flower (3.78 cm) was obtained in treatment T_1 (15 cm diameter pots).

Diameter of flower (cm)

The data reported showed that diameter of flower was significantly varied among the treatments. The maximum diameter of flower (5.42 cm) was observed in treatment T_{10} (33 cm diameter pots), which was significantly superior over treatments but it was statistically at par with treatment T_9 (5.15 cm). However it showed significant difference with rest of the other treatments. The minimum length of flower (3.45 cm) was obtained in treatment T_1 (15 cm diameter pots). Similar results have been reported by Carvalho *et al*. (2008) [2].

Length of inflorescence (cm)

It is revealed from the data that average length of inflorescence was significantly influenced by various treatments under investigation. The maximum length of inflorescence (12.42 cm) was observed in treatment T_{10} (33 cm diameter pots), which was significantly superior over all the treatments. The minimum length of inflorescence (3.90 cm) was recorded in treatment T_1 (15 cm diameter pots).

Width of inflorescence (cm)

The data clearly indicated that the maximum width of inflorescence (7.43 cm) was observed in treatment T_{10} (33 cm diameter pots), which was significantly superior over all the treatments. The minimum width of inflorescence (2.40 cm) was recorded in treatment T_1 (15 cm diameter pots). The results shows different sizes of pots have significant effect on width of inflorescence.

Flower stalk length (cm)

There was a significant difference on flower stalk length among the treatments. Maximum number of flower stalk length (25.87 cm) was observed in treatment T_{10} (33 cm diameter pots), which was significantly superior over all the treatments. The minimum number of flower stalk length (9.15 cm) was recorded in treatment T_1 (15 cm diameter pots).

Flowering duration (days)

Implementation of different size of pots resulted in significant difference on flowering duration in *costus speciosus*. The maximum duration of flowering (43.67 days) was observed in treatment T_9 (31 cm diameter pots), which was significantly superior over treatments but it was statistically at par with Treatment T_{10}. The minimum duration of flowering (4.00 days) was recorded in treatment T_1 (15 cm diameter pots).

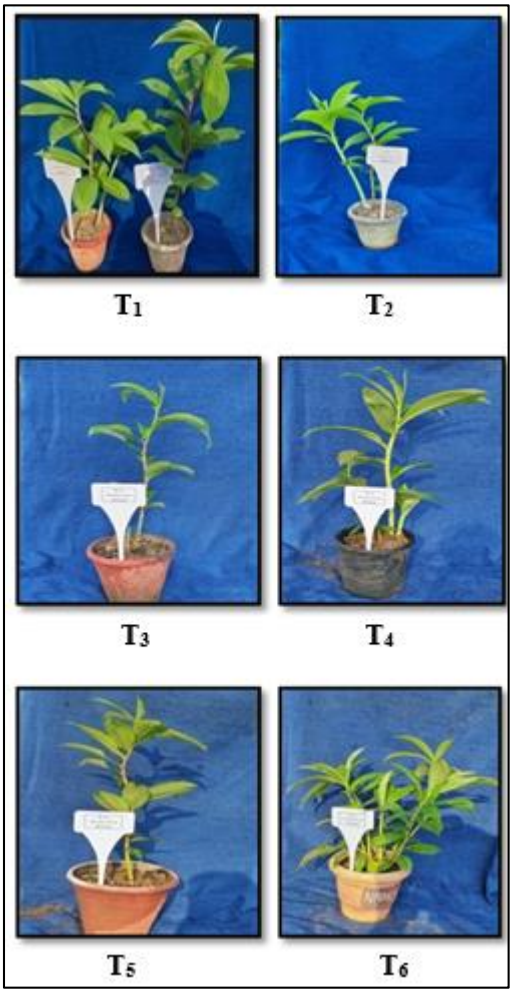

Fig A: Effect of different size of pots on growth stage of *Costus speciosus*

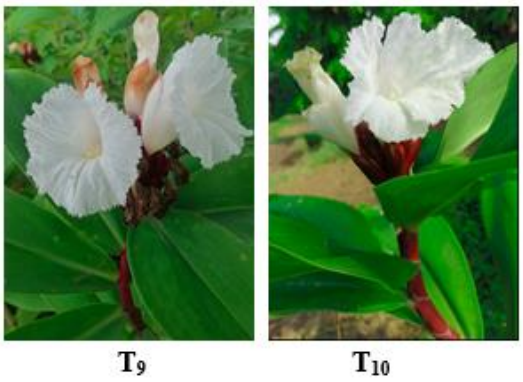

Fig B: Effect of pots on Flower Parameters

Table 1: Effect of different size of pots on growth parameters of *Costus speciosus* (Koenig) Sm.

Notation	Treatment (Pot sizes)	Plant height (cm)	Number of tillers plant^{-1}	Number of leaves tillers^{-1}	Number of leaves plant^{-1}	Leaf length (cm)	Leaf breadth (cm)	Stem girth (cm)	Leaf area index
T1	15 cm diameter	69.50	1.93	16.25	25.33	20.00	6.63	1.72	3.83
T2	17 cm diameter	77.00	2.33	14.33	30.83	20.67	7.00	1.73	3.94
T3	19 cm diameter	81.00	2.50	17.04	36.40	21.50	8.53	1.77	4.03
T4	21 cm diameter	105.00	3.17	50.40	46.00	25.17	9.22	2.03	4.90
T5	23 cm diameter	86.50	2.23	20.14	33.33	21.52	7.82	1.63	3.26
T6	25 cm diameter	92.17	4.00	17.14	55.00	22.22	8.58	1.75	4.03
T7	27 cm diameter	123.33	3.33	18.16	50.67	29.18	10.25	2.37	4.42
T8	29 cm diameter	103.17	2.83	17.03	38.83	23.42	8.92	1.83	3.10
T9	31 cm diameter	114.33	3.53	15.84	47.00	28.20	9.95	2.33	3.64
T10	33 cm diameter	128.67	3.37	16.34	54.17	29.53	11.00	2.70	3.95
S.Em±		4.08	0.23	1.09	2.54	0.88	0.30	0.07	0.14
C.D. at 5%		12.04	0.69	NS	7.51	2.59	0.89	0.23	0.43
C.V.		7.20	13.96	11.46	10.57	6.33	5.97	6.91	6.59

Table 2: Effect of different size of pots on flowering parameters of *Costus speciosus* (Koenig) Sm.

Notation	Treatment (Pot sizes)	Days to flower bud emergence	Days to opening of flower	Flower blooming period (days)	Number of flower plant^{-1}	Length of flower (cm)	Diameter of flower (cm)	Length of inflorescence (cm)	Width of inflorescence (cm)	Flower stalk length (cm)	Flowering duration (days)
T1	15 cm diameter	101.33	114.17	2.91	5.67	3.78	3.45	3.90	2.40	9.15	4.00
T2	17 cm diameter	95.33	108.33	6.42	12.83	4.72	3.78	5.45	3.78	11.77	10.33
T3	19 cm diameter	86.33	97.67	10.00	20.00	5.83	4.38	7.48	4.28	15.13	17.17
T4	21 cm diameter	89.67	102.67	10.50	21.00	5.58	4.22	7.12	4.72	18.23	18.33
T5	23 cm diameter	88.17	102.50	7.75	16.17	5.05	3.82	6.37	3.78	15.20	13.67
T6	25 cm diameter	91.50	102.50	8.08	15.50	5.30	4.08	6.08	4.67	14.63	12.83
T7	27 cm diameter	85.67	99.17	8.83	19.50	5.13	3.59	8.03	5.05	18.75	16.67
T8	29 cm diameter	86.50	100.33	9.42	20.33	5.75	4.15	8.15	5.18	20.50	18.33
T9	31 cm diameter	76.00	88.67	14.50	33.50	6.33	5.15	8.62	5.32	17.97	43.67
T10	33 cm diameter	69.17	82.17	22.42	45.83	6.63	5.42	12.42	7.43	25.87	42.33
S.Em±		2.56	2.38	1.65	2.89	0.38	0.29	0.58	0.31	1.49	3.05
C.D. at 5%		7.58	7.03	4.87	8.54	1.12	0.85	1.73	0.92	4.42	9.00
C.V.		5.11	4.13	28.36	23.85	12.18	11.94	13.86	11.61	15.53	26.79

Conclusion

From the results of the present investigation concluded that the different sizes of pots have significant influence on growth, flower and rhizome parameters. However, Treatment T_{10} (33 cm diameter pots) had a superior result in almost all considerable aspects of study.

The use of 33 cm diameter pots sizes gave better results of the *costus speciosus* in this investigation by providing more space for root growth and hence shoot growth, also amount of substrates in large pot size was more that has been helpful in providing sufficient nutrients and space for growth of root system of the plants.

Acknowledgement

The authors express their sincere gratitude to Dr. S. K. Patil, former Vice Chancellor and present Director of Research IGKV, Raipur and Former Dr. R. K. Bajpai, Former DRS and present DES, IGKV, Raipur for the facilities provided and encouragement for undertaking this programme. The authors express their sincere thanks to Dr. Padmakshi Thakur, Scientist (Hort.) and PI-AICRP on Tuber Crops she was provided planting material of *costus* for experiment. The senior author is indebted to Dr. T. Tirkey, Dr. S. Tamarakar, Dr. Pooja Singh and Dr. L. S. Verma for their valuable suggestions and guidance during the experiment.

References

1. Alhajhoj MR. Effect of Corm Size, planting Time and Pot Size on Plant Development and Flowering of *Gladiolus* × *hybrid.* International journal of Agriculture Innovations and Research 2017;5(5):2319-1473.
2. Carvalho SMP, Almeida J, Eveleens-Clark B, Bakker MJ, Heuvelink E. Modelling visual quality of *kalanchoe blossfeldiana* Influence of cultivar and pot size. Acta Horticulture 2008;801:1069-1076.
3. Dilta BS, Thapa S, Gupta YC, Sharma BP. Growth, flowering and presentability of potted azaleas as influenced by pot size and cultivars. Indian J. Agric. Sciences 2019;89(2):199-205.
4. Edward F Gilman. *Costus speciosus* 'Variegatus' Variegated crepe ginger. Environmental horticulture department, UF/IFAS Extension university of florida Gainesville, FL 32611 1999.
5. Gupta J, Dilta BS. Effect of growing substrate and pot sizes on Growth, flowering and pot presentability of *Primula malacoides* Franch. Int. J. Curr. Res. Aca. Rev. 2015;3(7):174-183.
6. Joseph EJ. Effect of spacing, rhizome weight and time of harvesting on the yield and quality constituents in *Costus speciosus.* M.Sc. Thesis Kerala Agricultural University 1983.
7. Mity, Thambi, Mohamed, P Shafi. Rhizome essential oil composition of Costus speciosus and its antimicrobial properties. International Journal of Pharmaceutical Research & Allied Sciences 2015. ISSN 2277-3657.
8. Sarin YK, Bedi KL, Atal CK. *Costus speciosus* rhizome as a source of diosgenin. Current sci 1974;43(18):569-570.
9. Schenk M, Brundert W. Effect of pot material and size on growth in hydroculture. Deutscher-Gartebau.

1979;33(21):898.
10. Thapa S. Effect of pot size and cultivars on growth, flowering and presentability of potted azaleas. Dr.Y.S. parmar UHF, Nauni, solan (H.P.) 173 230, 2014
11. Vernieri P, Incrocci G, Tognoni F, Serra G. Effect of cultivar, timing, growth retardants, potting type on potted sunflowers production. Acta Horticulturae 2003;614(1):313 318.