ROOTING CHARACTERISTICS AND GROWTH STATISTICS IN *COSTUS PICTUS*

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Abstract : The aim of the present investigation was to compare the methods of propagation using various plant parts of *Costus pictus*, commonly known as insulin plant or spiral flag the medicinal spiral ginger. Effect in rooting initialization using various rooting media was also performed, as it is a promising species for soil reclamation in riverbank as well as in wastelands. Trials using rhizomes of mother plant, aerial shoot cuttings and axillary buds were used as clonal planting material. For the conduction of cultivation trials rhizomes of mother plant, aerial shoot cuttings and axillary bud that arises from older aerial shoots were used as planting material. After gathering the planting material they were repeatedly rinsed in running water and after sizing they were directly planted in equal distance in the nursery bed or in polythene bags with various potting media. Aerial shoot cuttings and rhizome may be the most suitable planting material as there is no much variation in sprouting percentage was observed. Potting media such as Coir pith and vermi compost are suitable for growing purpose other than the standard potting mixture.

***IndexTerms* - *Costus pictus*, propagules, planting material, rooting**

I. INTRODUCTION

Costus pictus D. Don, (*Costus mexicanus* Liebm. *Costus igneus* Nak. *Costus mexicanus* Liebm ex Petersen or *Costus congenitus* Rowle) commonly called as fiery costus, Step ladder or Spiral flag or insulin plant (Hedge et. al., 2014; Jose & Reddy 2010) is an introduced medicinal spiral ginger to Peninsular India. The plant gains more medicinal interest in the present decade due to the knowledge that their leaves have medicinal property of anti-diabetic activity in humans (Dhanabal et. al., 2007; Jayasri et. al., 2008; Gireesh et al., 2009). Various research workers have conducted laborious research to find the active principle and many studies are in fast progress in both animal and human models. However it is doubtful for its traditional use (Elavarasi & Saravanan, 2012) for treating diabetes by the tribal people of Kolli hills of Namakkal district, Tamilnadu, in spite it is well known as a recently introduced species from America (Hedge et. al., 2014). Taxonomic identification of the species is at most important before using in any medicinal purpose. In this contest, knowing the morphologic and anatomic features gains high importance for identifying the plant material in fresh or preserved conditions when it becomes a demanding raw material for wide scale medicinal extractions. However some studies about the species, such as (Sabu, 2006) provides taxonomic key whereas (Nayagam, 2015A) elucidates the morphological characters using specimens collected from different localities.

II. METHODOLOGY

For the present investigation samples were collected from Botanic garden, University of Kerala, Thiruvananthapuram (+ 8º 33' 55.63" N, + 76º 53' 10.98"E) (142ft elevation) and cultivation plots at Kidangoor (+ 10º 11' 34.99" N, + 76º 24' 14.93"E) (83ft elevation).

In order to develop cultivation practice for *Costus pictus* a green house was constructed with a measure of 12.5 x 12.5m^2 and raised standard nursery beds were prepared in which trials using different rooting media was conducted. The nursery is provided with misting system in order to ensure uninterrupted water supply and to maintain an average temperature ranges 25ºC – 35ºC and an average humidity that ranges 70% - 85% throughout the study period.

For conduction of nursery trials rhizomes of mother plant, aerial shoot cuttings and axillary bud that arises from older aerial shoots were used and planting material. After gathering the planting material they were repeatedly rinsed in running water and after sizing they were directly planted in equal distance in the nursery bed or in polythene bags with various potting media (Fig. 1, Fig. 2, Fig. 3 & Fig. 4).

Fig. 1. Polythene bags with potting media Fig. 2. Sized aerial shoot cuttings & rhizomes

Fig. 3. Shoot cuttings planted in Nursery beds

Fig. 4. Propagules for planting

Growth data from different cultivation trials were gathered so that a viable method with sustainable harvest can be suggested.

III. RESULTS

3.1. Botanical Nomenclature of *Costus pictus* and *Costus speciosus:*

Costus pictus: D. Don, Bot. Mag. T. 1594; Horan. Monogr. 37. 1862; K. Schum. In Engler Pflanzenr. 4(46): 396. 1904.
Synonym: Costus mexicanus Leibm., Bot. Tidsskr 18: 261. t.16. 1892: K. Schum. In Engler, Pflanzenr. 4(46): 397. 1904.
Costus speciosus *(J. Koen)* Smith, Trans. Linn. Soc. London 1: 249.1791; Roxb., Fl. Ind. 1: 58. 1832; Wight, Ic. T. 2014. Baker in 1853; Hook. f. Fl. Brit. India 6:249. 1892; Fischer and Gamble, Fl. Pres. Madras 1490. 1928; Gandhi in Sald. & Nicols., Fl. Hassan Dist. 770. 1976; Matthew & Britto in Matthew, Fl. Tam. Carnatic 3: 1613. 1983; Burtt & Smith in Dassan. & Fosb., Rev. Handb. Fl. Ceylon 4: 491. 1983; Nair & Nayar, Fl. Courtallum 2: 390. 1987; Nicols., Suresh & Manilal, An Interpr. Hort. Malab. 316. 1988; Mohanan & Henry, Fl. Thiruvananthapuram 475. 1994.
Synonyms: Banksea speciosa J. Koen. In Retz., Obs. Bot. 3: 75. 1783.
Tsjana- kua Rheede, Hort. Malab. 11: 15 – 16, t. 8. 1692.

3.2. Regeneration Characteristics of Planting Materials in Various Planting Medium

Effect of sprouting by the different planting materials in raised standard nursery beds and polythene bags with various sprouting medium was performed. Prefilled polythene bags of the size 22 x 17 cm were utilized for this purpose.

3.2.1. Sprouting Characteristics of Planting Material in Standard Nursery Beds

A total of 69.76 per cent sprouting was obtained in nursery bed with rhizome as planting material. Sprouting was initiated in just 20 days and extended up to 31 days for completion. Maximum percent of sprouting was observed on 23rd day with a record of 24.4% sprouting.
87.55% sprouting was obtained in nursery bed when aerial shoot cuttings were used as planting material. Sprouting was initiated in just 18 days and was completed in 39 days. Maximum percent of sprouting was observed on 24th day with a record of 32.7% sprouting.
When propagules directly obtained from aerial shoot was used as planting material in standard nursery bed 70.24% regeneration was obtained. It took 36 days for the first sprouting to occur and was completed in 52 days.

3.2.2. Sprouting Characteristics of Planting Material in Poly Bags with Coir Pith

A total of 66% per cent sprouting was obtained in nursery bed with rhizome as planting material. Sprouting was initiated in just 24 days and extended up to 42 days for completion. Maximum percent of sprouting was observed on 24 day with a record of 14 sprouting.
62% sprouting was obtained in nursery bed when aerial shoot cuttings were used as planting material. Sprouting was initiated in just 21 days and was completed in 34 days. Maximum percent of sprouting was observed on 24th day with a record of 19.23% sprouting.

3.2.3. Sprouting Characteristics of Planting Material in Poly Bags with Vermi compost

A total of 14 per cent sprouting was obtained in nursery bed with rhizome as planting material. Sprouting was initiated in just 24 days and extended up to 30 days for completion. Maximum percent of sprouting was observed on 28th day with a record of 8% sprouting.
40% sprouting was obtained in nursery bed when aerial shoot cuttings were used as planting material. Sprouting was initiated in just 23 days and was completed in 36 days. Maximum percent of sprouting was observed on 26th day with a record of 13.46% sprouting.

3.2.4. Sprouting Characteristics of Planting Material in Poly Bags with Sterilized Potting Media

A total of 31 per cent sprouting was obtained in nursery bed with rhizome as planting material. Sprouting was initiated in just 18 days and extended up to 51 days for completion. Maximum percent of sprouting was observed on 43rd day with a record of 8% sprouting.

38% sprouting was obtained in nursery bed when aerial shoot cuttings were used as planting material. Sprouting was initiated in just 24 days and was completed in 36 days. Maximum percent of sprouting was observed on 30th day with a record of 4% sprouting.

3.2.5. Sprouting Characteristics of Planting Material in Poly Bags with Potting Mixture

A total of 66% per cent sprouting was obtained in nursery bed with rhizome as planting material. Sprouting was initiated in just 16 days and extended up to 30 days for completion. Maximum percent of sprouting was observed on 24th day with a record of 26% sprouting.

24% sprouting was obtained in nursery bed when aerial shoot cuttings were used as planting material. Sprouting was initiated in just 24 days and was completed in 31 days. Maximum percent of sprouting was observed on 24th day with a record of 12% sprouting.

3.2.6. Sprouting Characteristics of Aerial Soot Cuttings in Root – Trainers

Vegetative aerial shoot cuttings were made into suitable size and have been planted in the prefilled root trainers with coir pith compost and soil. Buds arise within 15 – 20 days, which require frequent watering for maintaining the propagules fresh (Fig.5.a & Fig. 5.b). The root trainers were maintained in specially devised glass chambers inside which an average temperature ranges 25ºC – 35ºC and an average humidity that ranges 70% - 85% throughout the study period. The rooted stem cuttings reach an average height of 20cm in 30 days by the time they are ready for out planting. Leaves can also be harvested at this stage as raw drug for medicinal preparations.

Fig. 5.a. Stem cuttings in root trainers Fig.5.b. Rooted cuttings with sprouts

Vegetative aerial shoot cuttings were made into suitable size and have been planted in the prefilled root trainers with coir pith compost and soil. Buds arise within 15 – 20 days, which require frequent watering for maintaining the propagules fresh. The root trainers were maintained in specially devised glass chambers inside which an average temperature ranges 25ºC – 35ºC and an average humidity that ranges 70% - 85% throughout the study period.

3.3. Growth Performance of Propagules in Various Potting Media

3.3.1. Growth Performance of Propagules in raised soil in Nursery

Growth data were gathered at an interval of 15 days. For standardization purpose data were gathered from 25 plants in each sample media. The average height in length, number of leaves, number of nodes and leaf length are given in table 1. Within first 45 days of growth plants attain an average height of 10.5 cm with 7-15 leaves and 6-15 nodes.

Table 1. Growth data of Propagules in raised soil in Nursery

Period of Observation	Average height (cm)	Average No of leaves	Average No of nodes	Average leaf width (cm)	Average leaf length (cm)
Period 1	5.18	4	6	3.3	3.45
Period 2	5.26	4	9	3.43	7.55
Period 3	10.5	12	13	3.4	8.5

3.3.2. Growth performance of Propagules in Poly Bags with Coir Pith

Within first 30 days of growth plants attain an average height of 4.5 cm with 2-8 leaves and 3 - 4 nodes. The data generated are given in table 2.

Table 2. Growth data of Propagules in Poly Bags with Coir Pith

Period of Observation	Average height (cm)	Average No of leaves	Average No of nodes	Average leaf width (cm)	Average leaf length (cm)
Period 1	3.41	3	4	2.72	5.64
Period 2	4.5	4.75	6.17	2.9	5.81

3.3.3. Growth performance of Propagules in Poly Bags with Vermi Compost

Within first 30 days of growth plants attain an average height of 6.4 cm however the maximum height observed was 10.5 cm. with 2-10 leaves and 4 -10 nodes. The data generated are given in table 3.

Table 3. Growth data of Propagules in Poly Bags with Vermi Compost

Period of Observation	Average height (cm)	Average No of leaves	Average No of nodes	Average leaf width (cm)	Average leaf length (cm)
Period 1	3.218	3	5	2.93	4.93
Period 2	6.4	6	8	3.73	8.3

3.3.4. Growth performance of Propagules in with Sterilized Potting Media

In 30 days of growth, plants attain an average height of 9.73 cm with 4 - 8 leaves and 4 - 10 nodes. The data generated are given in table 4.

Table 4. Growth data of Propagules in Poly Bags with Sterilized Potting Media

Period of Observation	Average height (cm)	Average No of leaves	Average No of nodes	Average leaf width (cm)	Average leaf length (cm)
Period 1	3.97	3	5	2.76	5.32
Period 2	9.73	6	7	3.58	7.4

3.3.5. Growth performance of Propagules in with Sterilized Potting Media

In 30 days of growth, plants attain an average height of 3.84 cm with 2 - 6 leaves and 3 - 7 nodes. The average data on different parameters considered are given in table 5.

Table 5. Growth data of Propagules in Poly Bags with Potting Mixture

Period of Observation	Average height (cm)	Average No of leaves	Average No of nodes	Average leaf width (cm)	Average leaf length (cm)
Period 1	2.8	2	4	1.8	4.6
Period 2	3.84	3	4	2.95	5.22

3.3.6. Growth performance of Propagules in Root- trainers

In 30 days of growth, plants attain an average height of 7.1 cm with 3 - 5 leaves and 3 - 7 nodes. The average data on different parameters considered are given in table 6.

Table 6. Growth data of Propagules in Root - trainers

Period of Observation	Average height (cm)	Average No of leaves	Average No of nodes	Average leaf width (cm)	Average leaf length (cm)
Period 1	4.2	3	5	3.01	4.52
Period 2	7.1	5	7	3.83	7.4

IV. Discussions and Conclusion

From the data obtained it can be inferred that *Costus pictus* plant can be cultivated easily in tropical climatic conditions. Aerial shoot cuttings and rhizome may be the most suitable planting material as there is no much variation in sprouting percentage was observed. Potting media such as Coir pith and vermi compost are suitable for growing purpose other than the standard potting mixture. Tropics are blessed with numerable plants, which are of multifarious use. The combined effect of plant introduction and cultivation has largely accelerated the interest of scientists and industrialists to focus on herbal medicine and other economic products (Nayagam, 2015B). Correct taxonomic identification is most important before proceeding to any analytical procedure and utilization. Comparative approach on morphological and anatomical features provides distinguishable features (Nayagam, 2015A) but most of the reliable distinguishing characters are with respect to reproductive morphology. Morphological features of vegetative parts with qualitative value vary, when samples from different localities with respect to growing regions and cultivars are considered. Since the flowers in the study species are produced seasonally and the economically important part is leaves and vegetative parts a reliable internal character may be useful for raw drug identification. Diagnostic ergastic crystals are present in several plant species (Metcafe, 1960). The presence of characteristic cuboidal ergastic crystal in the leaves of several plant species including *Costus speciosus* has been reported (Wallis, 2005; Kokate, 2010; Nayagam, 2015A).

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REFERENCES

[1] Dhanabal SP, Kumar A, Chandrasekar R, John S, Joseph S, James M (2007) Hypoglycemic and antioxidant activities of *Costus mexicans* (Costaceae) Aryavaidyan 21:53–8.

[2] Elavarasi S, Saravanan K(2012) Ethnobotanical study of plants used to treat diabetes by tribal people of Kolli Hills, Namakkal District, Tamilnadu, Southern India. International Journal of Pharmaceutical Technology 4:404–11.

[3] Gireesh G, Thomas SK, Joseph B, Paulose CS (2009) Antihyperglycemic and insulin secretory activity of*Costus pictus* leaf extract in streptozotocin induced diabetic rats and in *in vitro* pancreatic islet culture. Journal of Ethnopharmacology 123:470–4.

[4] Hedge, prokash K., Harini A Rao, Prasanna N. Rao. (2014). A review on insulin plant (Costus igneus Nak). Pharmacognosy Reviews. Jan-Jun; 8(15): 67-72.

[5] Jayasri MA, Gunasekaran S, Radha A, Mathew TL (2008) Anti-diabetic effect of *Costus pictus* leaves in normal and streptozotocin-induced diabetic rats. International Journal of Diabetes and Metabolism 16:117–22.

[6] Jose B, Reddy LJ. (2010) Analysis of the essential oils of the stems, leaves and rhizomes of the medicinal plant *Costus pictus* from southern India. International Journal Pharmacy and Pharmaceutical Sciences 2 (Suppl 2):100–1.

[7] Kokate, CK, Purohit, AP, Gokhale, SB (2010) Pharmacognosy Edition 46, Vol. I & II, Nirali Prakashan publishers, Shivaji Nagar, Pune.

[8] Metcalfe, CR, (1960) Anatomy of Monocotyledons I Gramineae. Clarendon Press, Oxford.

[9] Nayagam, JR (2015 A). Compendium on *Costus pictus*: A medicinal spiral ginger. Lambert Academic Publishers, Germany.

[10] Nayagam, JR (2015 B). Plantation technology for seven tropical tree species. Lambert Academic Publishers, Germany.

[11] Sabu, M (2006) Zingiberaceae and Costaceae of South India. Indian Association of Angiosperm taxonomy, Calicut, India.

[12] Wallis, TE (2005) Text book of Pharmacognosy 5th ed. CBS publishers, New Delhi, India 566-570.