Agro Techniques of *Costus speciosus* : An Important Endangered Medicinal Plant

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Introduction

Costus speciosus Koen ex. Retz belongs to the Zingiberaceae family. It is known as 'Chanda' or 'Kushtha' in Sanskrit and 'Kebu' or 'Keyu' in Hindi. The botanical name is derived from the Sanskrit terminology. A number of plants are known to contain *Diosgenin* and steroidal sapogenins but none of them satisfy all the criteria of such a substitute. Its distribution is restricted to few localities in northwest Himalayas and has witnessed poor response to domestication. In Uttar Pradesh, it is generally found in Dudhi and Lalitpur Forest Divisions. It is on the verge of extinction in these areas. Harvesting of this plant from its natural habitat has led to depletion of plant resources. Therefore, cultivation of this plant becomes necessary to ensure conservation of this valuable genotype.

Materials and method

Description: A taxonomic rank controversy regarding *Costus* was pointed out by Gideon in 1991. The taxonomic position of the natural group comprising of *Costus*, *DimeroCostus*, *MonoCostus* and *Tapeinochilos* has been reviewed by him. An explanation has also been given for the preferred taxonomic rank for the *Costus* group (Rastogi & Mehrotra, 1991).

Costus is an erect plant found to grow up to a height of 2.7 meters. The root stock is tuberous and the stem is sub woody at the base. Its leaves are large, 15-30 × 5.7-7.5 cm in size, dorsally silky and are sub sessile, oblong and spirally arranged. The plant is reported to have shell shaped flowers which open during night (Moosad, 1983). The white flowers are clustered in very dense spikes with a short corolla tube and are characterized by large and shiny brown or red bracts. The single stamen present is perfect, lip large with incurved margins. The fruits of C. speciosus are globose or ovoid capsules with obovoid or sub globose seeds (Khanna *et al.*, 1977). The botanical description is also given by Gamble, 1987, Kirtiker & Basu, 1987 and Sivarajan & Balachandran, 1994.

Some of the later authors have equated this plant with kebuka or kemuka (Kirtikar & Basu, 1987, Chunekar, 1982 and Sharma, 1983). But kebuka has been mentioned among the bitter vegetables in the classical literature and therefore is treated as a different drug (Moos, 1984 b).

Active Constituents: Tubers and roots contain diosgenin, sitosterol, dioscin, prosapogenins A and B of diosceins, gracillin, and quinines. Various saponins, many new aliphatic esters and acids are reported from its rhizomes, seeds and roots. Rhizomes yield diosgenin (2.12%) and tigogenin. Essential oil from rhizome show anti microbial activity (Asolkar *et al.*, 1992).

Uses: The rhizomes of *Costus* can be used as purgative, depurative, febrifuge, expectorant, and anathematic and as tonic (Khanna et al., 1977,

Rathore & Khanna, 1978 and Rastogi & Mehrotra, 1996). The tuberous root stock is the officinal part. It is bitter, astringent, cooling, digestive, stimulant and good to heart. It cures kapha and pitta disorders, dyspepsia, fever, cough and other respiratory diseases, diabetes, oedema, blood diseases; leprosy and other skin ailments (Chunekar, 1982 and Sharma, 1983). Rhizomes are an alternative source of Diosgenin (Chopra *et al.*, 1956 and Dasgupta, 1970). The tuber is cooked and made into syrup or preserve which is considered to be very wholesome (Nadkarni, 1998). It also finds its use in treating leprosy, burning sensation, constipation, worm infection, skin disease, fever, asthma, bronchitis, inflammation and anemia and also in the making of sexual hormones and contraceptives (Prakash & Mehrotra 1996 and Warrier *et al.*, 1995). The plant is often cultivated as ornamental. Juice of boiled plant is used in earache.

Flowering : August- October.

Fruiting : Fruits ripen from mid November

Soil and Climate: This plant can be grown from sea level to about 1500 m elevation. But the areas at elevation between 400 to 600 m above mean sea level, having a sub tropical climate with an annual rainfall ranging between 1000 to 1500 mm produce good quality material. A good alluvial soil with a pH ranging from 5.7-7.5 is considered ideal for cultivation of *C. speciosus*. A well marked dry period between monsoon precipitation results in higher Diosgenin content in naturally occurring plantation. Coastal regions and regions with high annual rainfall and humidity throughout the year bear poor quality material, in terms of Diosgenin content.

Cultivation technique

(i) **Land Preparation:** The land is ploughed 2-3 times and the soil is brought to a fine tilth. FYM @15 t/ha is applied and mixed well with the soil and furrows are made 50 cm apart.

(ii) **Propagation:** Although the plant can be propagated from seeds, stem cutting and rhizomes; commercially, it is being propagated only through rhizome cuttings. The selection of rhizomes for planting is however important. The rhizomes have a number of buds most of them being concentrated around the stem scars and the tips. The formation of buds on the rhizome is poor during April. The cuttings of rhizome pieces for propagation should have at least 2 viable buds. Rhizome pieces weighing around 40 g should be selected. About 2000-2400 kg of fresh rhizomes are required for planting one hectare of land.

(iii) **Planting:** The rhizome pieces are placed at a depth of 8-10 cm taking care to place the eye buds facing upwards, horizontally in rows 50 cm apart and covered with soil. The crop is irrigated immediately after planting. The thick sized pieces sprout slowly only after 40 - 45 days of planting. This is due to the eye buds being dormant on these rhizome pieces which take a longer time to develop, especially in the case of the crop planted in April. After 70-75 days, about 90-95% sprouting is obtained.

Dessication of young sprouts has been observed turning the hot summer, necessitating a liberal water supply during this period. The best period of planting is from 3rd week of April to 3rd week of May. Rhizomes planted during June and July complete germination within 60 days, but yields obtained are low as the crop has a shorter growth period in the first year before dormancy sets in. The active vegetative growth period of the crop is from July to mid September and maximum tuberization takes place between September to November. Comparing the effect of planting on ridges versus flat beds indicates that there is no significant difference in yields although slightly higher yield of fresh rhizomes was obtained from the crop planted on ridges.

(iv) **Manure and Fertilizer:** It is a rhizomatous crop and to compensate the biomass production, heavy manuring is required. Trials suggest that the optimum dose for obtaining maximum yield of Diosgenin is 45 Kg N, 30 Kg P_2O_5 and 30 Kg K_2O along with 15 t/ha of FYM. The FYM and a half dose of P and K are applied in two split doses at 20 and 60 days from the time of planting, the remaining half dose of P and K is given along with the second dose of N after the 60th day of planting.

(v) **Irrigation:** The crop requires a liberal apply of water for its successful growth. The crop planted during April and May requires irrigation at least 2-3 times a month till the outbreak of monsoon. As September to November is the period of maximum tuberization, at least 2 irrigations should be given in this period. During the dormancy period (Decemebr-March) if winter rains are scanty there will be a need for irrigation. If moisture conditions are adequate, it has been observed that the crop sprout toward the end of March or early April. With a liberal supply of irrigation during the hot summer months, an excellent crop growth is observed. Thus, for a crop to be harvested after a period of 17-18 months, 14-17 irrigations are required.

(vi) **Weeding and Interculture:** One weeding during the sprouting period of the crop followed by two more keeps the crop fairly free from weeds. During the period of active vegetative growth (July to Sep), most of the weeds are suppressed. If the monsoon is erratic, at least one more weeding is required.

Weeding once or twice during dormant season helps in better sprouting of the crop during the next season. In the second year of the crop, the inter row space between the plants is covered by the canes and only 2-3 weeding are necessary before the crop is harvested in August or September.

(vii) **Pest and Diseases:** There are no major pests which affect the crop. However, the following are some diseases which are observed to affect the crop:

1. **Rhizome rot:** It is caused by *Phytophthora solani* and develops very quickly from July to August in the rhizomes kept in storage after the harvest. Initially, the symptoms start from the tip of the injured portion of the rhizomes. Subsequently, the rhizome becomes light brown and gives off an offensive odour. Properly harvested rhizomes without injuries can be stored for a long time. No chemical control has been worked out.

2. **Pythium Rhizome rot:** It is caused by *Pythium spirosum*. Infection starts from the injured portion of the rhizome and in later stages the rhizomes turn dirty brown, the leaves become yellowish-brown and finally dry off. The prudent selection of rhizomes from the healthy crop and dipping the rhizomes in fungicidal solutions like Benlate, Babistian or Dithane Z-78 has been recommended to control the disease.

3. **Leaf Blight:** It is caused by *Curvularia paradissi*. It is very severe from July to September. The symptoms develop on the leaf laminae as small, spherical to irregular spots, light brown in colour and in the advanced stages they become dark brown. The upward cutting of young leaves is very common. In the advanced stages all the leaves fall off, leaving bare stems in the fields. This pathogen can be effectively controlled by spraying 0.3% Dithane M-45 at fortnight intervals.

(viii) **Harvesting and Yield:** It is observed that the Diosgenin content is maximum when the crop is in an active stage of vegetative growth about 16-17 months old. Two operations *viz.* harvesting

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the aerial shoots and digging out the rhizomes are required to complete the harvesting in *Costus*. After harvesting the aerial shoots, the most satisfactory and economical method to dig out the rhizomes is to run the tractor drawn with water cross-wise twice or thrice over the field and simultaneously collect the uprooted rhizomes manually. A negligible amount of damage is caused to the rhizome during this operation. The harvested rhizomes are spread out for a few days and the mud adhering to the rhizomes is removed or alternatively, the rhizomes are washed under a jet of water from the tubewell discharge pipe, the rhizomes have to be chopped and dried before the Diosgenin can be extracted. Chopping by hand is time consuming and costly, so mechanical means are employed. Several methods have been tried but the ordinary wheat thresher with a little modification is found satisfactory for chopping the fresh rhizomes. Very finely chopped material dries quickly (2-3 days).

A yield of 28 - 30 t/ha of fresh rhizomes may be obtained in the first season's crop (8-9 months) harvested in the dormant season but the Diosgenin yield will be poor on account of low recovery. The crop should therefore be harvested after 17 - 19 months of planting for a better yield of fresh rhizomes and Diosgenin content. From the second season's crop (17 - 19 months), there is a yield of 50 tones of fresh rhizome from which 75 - 125 Kg of crude Diosgenin may be obtained.

Discussion and conclusion

Research and development needs in broadly three areas, viz. raw material, production technology and utilization of *Costus* as a medicinal plant are required. The other issues which need attention are resource collection and their cryopreservation, increasing availability of planting material, intro cropping, and selection of high yielding varieties developing agro techniques for different agro climatic regions. Biotechnology tools can be applied in producing high quality elite planting material through tissue culture technologies to help in mass producing the elite identified clones. Research effort should continue for identifying new and potential source of raw material. For maximum yield, proper agro techniques are essential. Research studies on standardizing nursery practices need to be further strengthened. There is enormous waste and marginal land available and technologies for utilizing then effectively are required to be standardized so as to be grown in various ecosystems. Proper scientific data is essential for planting density, fertilization practices, planting procedures etc.

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