



ISSN: 0975-833X

RESEARCH ARTICLE

CULTIVATION OF *AMORPHOPHALLUS PAEONIIFOLIUS* (DENNST.) NICOLSON (ELEPHANT FOOT YAM) IN KOVVUR MANDAL OF WEST GODAVARI DISTRICT, ANDHRAPRADESH INDIA

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ARTICLE INFO

Article History:

Received 18th February, 2015

Received in revised form

06th March, 2015

Accepted 30th April, 2015

Published online 25th May, 2015

Key words:

Amorphophalluspaeoniifolius,

Elephant foot yam,

Traditional cultivation, West Godavari.

ABSTRACT

Edible aroids find an important place in the food basket of many regions of our country as they have critical role in fulfilling the multifaceted needs of the people contributing to nutrition, food security and poverty eradication. *Amorphophalluspaeoniifolius* (Dennst.) Nicolson is known as Elephant foot yam which is considered to be the highest income earner to the cultivator irrespective of the production system and temporal variations. It has both nutritional and medicinal values and is usually consumed as cooked vegetable. The present study focuses on the traditional cultivation in field areas located in west Godavari District of Andhra Pradesh, India.

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INTRODUCTION

Tuber crops, a group of versatile crops cultivated in the tropical and subtropical countries, play a vital role in food security (Ramanandam et al., 2008; Quaye et al., 2009), and are the important staple or subsidiary food for one fifth of the world population. *Amorphophallus paeoniifolius* (Dennst.) Nicolson, commonly known as elephant foot yam (EFY), is a herbaceous, perennial, C3 crop (Ravi et al., 2011) of Southeast Asian origin and due to the indisputable palatability, cooking quality, medical utility and therapeutic values of its tubers, it has been called as “King of tubers” (Suja et al., 2009). *Amorphophallus paeoniifolius* (Dennst) Nicolson belongs to the family Araceae, a tuberous, stout indigenous herb, grown as vegetable is widely available (Anonymous, 2003; Ghani, 1998) and is reported to contain flavonoids (Shilpi et al., 2014). Elephant foot yam, is one of the most extensively cultivated edible aroids of humid tropics and its cultivation is very much dominant in Philippines, India, Malaysia, Indonesia, China, Sri Lanka and many other Southeast Asian countries (Ravi et al., 2009; Sankaran et al., 2011). India is a major producer of this crop, with productivity potential of 30-100 t/ha (Ravi et al., 2011). By attaining the status of cash crop in India it is cultivated in Andhra Pradesh, West Bengal, Gujarat, Kerala, Tamil Nadu, Maharashtra, Uttar Pradesh, and Jharkhand traditionally.

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The net economic return is over 1 lakh rupees per ha. It has a great export potential since its commercial cultivation is not in other countries (Misra and Shivalingaswamy, 1999; Misra et al., 2001). In Andhra Pradesh it is cultivated in East Godavari, West Godavari, and Krishna and Guntur districts. In West Godavari district it is widely cultivated in some villages namely Aurangabad, Chidipi, Ravulapadu, panakanametta, and kumaradevam in Kovvur mandal. Elephant foot yam is a remunerative and profitable stem tuber crop. The crop is gaining popularity due to its shade tolerance, easiness in cultivation, high productivity, less incidence of pests and diseases, steady demand and reasonably good price.

Tubers are mainly used as vegetable after thorough cooking. Tubers contain 18.0% starch, 1-5% protein and up to 2% fat. Leaves contain 2-3% protein, 3% carbohydrates and 4-7% crude fibre. Tubers and leaves are quite acid due to high content of oxalates. Acidity is usually removed by boiling fairly for a long time. The tubers are rich in nutrients. Pickles and many indigenous medicinal preparations are also made using its tubers. The tubers are cheap source of starch, vitamins and minerals (Bradbury and Holloway, 1988). Unlike other tubers, *Amorphophallus* roots have many medicinal uses and are widely prescribed by Ayurveda physicians. *Amorphophallus* corm is a good source of phytoestrogens and is effective alternate of complementary to conventional hormone replacement thereby for symptoms associated with menopause and chronic degenerative diseases in women. *Amorphophallus paeoniifolius* leaf shows anti-

diarrhoeal activity (Purwal *et al.*, 2011). The main objective of the present study was to investigate how elephant foot yams are cultivated in Kovvur mandal of West Godavari District.

Introduction to the plant of *Amorphophallus paeoniifolius* (Dennst.) Nicolson

Scientific classification

Kingdom: *Plantae*
 Division: *Angiosperms*
 Class: *Monocots*
 Order: *Alismatales*
 Family: *Araceae*
 Genus: *Amorphophallus*
 Species: *paeoniifolius*
 Synonyms: *A. campanulatus*.

Botany

Cultivated species *A. paeoniifolius* is a robust herbaceous plant 1.0 – 1.5 m tall. Large dissected tripartite leaves constitute the luxuriant outspreading crown-like foliage, borne on a fairly thick single upright “stem”. The aerial “pseudostem” which is round with characteristic irregular blotches is botanically a leaf petiole (Figure 1).



Figure 1. Showing plant of *Amorphophallus paeoniifolius*

Though crop is perennial due to underground stem, it is treated as an annual with duration of 8-9 months. It is usually harvested when top becomes yellow and withers (8-9 months after planting). It flowers once in 1-3 years. Inflorescence consists of a bell-shaped spathe surrounding a central yellow spadix and is borne on a very short stalk. It appears almost at ground level. Although wild species flower and set seeds profusely, cultivated species fail to set seeds under normal condition due to extreme protogyny coupled with delay in opening of spathe. It contains numerous local names based on the local language which are given in the Table 1.

Table 1. Local names of Plant (Anuradha Singh, Neeraj Wadhwa 2014)

Language	Names
English	Elephant foot yam, Whitespot Giant Arum, Sweet Yam, Telinga Potato
Hindi	Suranakanda, Zimikanda
Bengali	ole
Fijian	Suran
Japanese	Koniaku, Konjac, Konnyaku
Thai	Buk Khan
Tamil	Kizhangu.
Kannada	Suvarna gedde.
Oriya	Oluo.
Telugu	Kanda gadda.

MATERIALS AND METHODS

Study area

West Godavari District is one of the 13 districts, in the Coastal Andhra region of Andhra Pradesh, India. The region has a tropical climate similar to the rest of the Coastal Andhra region.



Figure 2. Showing map of Andhra Pradesh



Figure 3. Showing mandals of west Godavari district

The summers (March–June) are very hot and dry while the winters are fairly pleasant. The temperatures in the summers often rise over 50°C during the day. The rainy season (July–December) is often the best time for tourist visits, as fields are brilliantly green with paddy crops, rivers flowing with monsoon water, and a relatively cool climate. The region has long been home to the Indian nobles due to its climate and fertile soil, and several zamindari large mansions are scattered around the Godavari area. Kovvur is a town, municipality and mandal in West Godavari district, in the state of Andhra Pradesh, India. It is situated adjacent to the west bank of the Godavari River. Kovvur is an important town in West Godavari District due to its location on the sacred banks of River Godavari. Kovvur is located at 17.0167°N 81.7333°E. It has an average elevation of 11 Metres (36 Feet) (Figure 2&3).

Field study

Field survey was carried out during July 2013- January 2014 to collect information on the traditional cultivation of elephant foot yam crop in villages of Kovvur mandal, West Godavari district, Andhra Pradesh. We select some of the villages namely Aurangabad, Chidipi, Ravulapadu, Panakanametta, Kumaradevam of Kovvur mandal. In these villages the cultivation of elephant foot yam was very high that's why we chose these villages among Kovvur Mandalas study site. At each study site we interviewed farmers about the cultivation practices.

RESULTS AND DISCUSSION

Climate and soil: *Amorphophallus* is a tropical / subtropical crop and hence flourishes well under warm humid climate with a mean annual temperature of 30-35°C and a well distributed rain of 1000-1500 mm spread over a period of 6-8 months, is helpful for good crop growth and tuber yield. Humid climate supports in the initial stages of crop growth where as dry climates assist tuber bulking. It grows well on a variety of soils. Well drained, fertile, sandy-loam, black soil is ideal for elephant foot yam cultivation (Nedunchezhiyan *et al.*, 2006).

Soil should be rich in organic matter with suitable amount of available plant nutrients.

Varieties: Common varieties for cultivation are Sree Padma which was developed at CTCRI, Thiruvananthapuram, another variety Gajendra which was developed at APAU, Hyderabad. But in the present study, this area farmers called varieties as Bihar and Vijayawada as they import seed material from those places and they believe that climate and soil are most suitable for above said seeds and the tubers grow better to give good yield.

Propagation: *Amorphophallus* is propagated through corm. Accessibility of quality seed material is the major constraint in elephant foot yam cultivation. Whole corm size of 500-750 g was recommended for commercial cultivation. However, due to non-availability of the recommended size, farmers cut corms into pieces. The big size corm of 2-3 kg is cut into 4- 6 pieces vertically while retaining the part of the apical bud. (Seed Corn Production Techniques in Elephant Foot Yam M. Nedunchezhiyan 2008)

Cultivation practices: The land was prepared by thorough ploughing in different directions. The land was levelled after removing the weed twigs and rocks. Ridges and furrows were made at 73 cm apart. The tubers were sown 63cm apart in the furrows, immediately the land was irrigated through the furrows. As a result of this, there will be 73cm apart from row to row and 58cm plant to plant. Before planting, the corms are air dried for about 40-45 days, when they are placed in field areas, after drying period the corms are vertically cut into pieces (approximate size– 750-100g) and each piece bears apical bud. Elephant foot yam corm is having central bud situated on the top of the corms. Due to apical dominance it sprouts first and earliest, other buds remain dormant, retaining the portion of the central buds vertical cut, is essential for higher percentage of sprouting. Corm set of 100g sizes could be prepared from whole tubers by cutting vertically. Thus obtained tuber pieces were drying in shade for 24 hours. Afterwards planting material is buried vertically in the furrows (Figure 4-11).



Figure 4. Showing *A. paeoniifolius* seed lot; Figure 5. Showing cutting of corms; Figure 6. Showing Air dried seed lot; Figure 7. Showing marking the distance; Figure 8. Showing seed sets of *A. paeoniifolius*; Figure 9. Showing Corm pieces placed on ridges; Figure 10. Showing planting the corm pieces; Figure 11. Showing after planting the corms



Figure 12. Showing Earthing up of the field; Figure 13. Showing sprouting's of the crop; Figure 14. Showing crop of *A.paeoniifolius*; Figure 15. Showing corm of *A.paeoniifolius*

This is followed by digging interspaces and light earthing up, one month later, along with intercultural operations like de-weeding, earthing up. Tubers start sprouting after 2-3 months. The crop matures in 6-8 months after planting indicated by yellowing followed by complete drying of the pseudostem (Figure 12-15).

Water requirement: *Amorphophallus* is mainly grown as a rain fed crop. During periods of late receipt of monsoon, a light irrigation is given during early stages of crop, and subsequent irrigation is needed (20 days intervals) in the dry months before the onset of monsoon. Crop is irrigated first three month at an interval of 10 days and next few months six day interval or twice a week. Crop is susceptible to collar rot when water gets stagnated.

Pests and diseases: *Amorphophallus* is free from major pests and diseases except collar rot caused by *Sclerotium rolfsii*. Water logging, poor drainage and mechanical injury at the collar region favour disease incidence. Another ailment is turning of green colour of leaves into red colour and this may be cured by supplying Zinc to the field.

Harvest and yield: Underground corms are harvested with pick axe or by digging when the top is completely withered and fallen. Crop will be ready for harvest within 7-8 months after planting. However on better market price, tubers can be dug out six month onwards. At present farmers are selling these harvested corms or tubers to primary wholesaler or otherwise they export corms to foreign countries and other states.

Cultivation statistics in India

Based on the data (Table 2), it is clear that West Bengal, Kerala and Andhra Pradesh rank top three positions in the cultivation of elephant foot yam contributing to nearly 70% of the area and production.

24-Paraganas North, Nadia, Midnapore East and West, Howrah and Murshidabad districts in West Bengal; Wayanad, Kollam, Kottayam, Idukki districts in Kerala and East and West Godavari, Krishna, Guntur, Prakasam and Nellore districts in Andhra Pradesh cultivate more than 50% of the cultivated area under the crop in the respective states.

Table 2. Area, Production and yield statistics in major growing states

Name of the state	Area (ha)	Production (Mt)	Yield (tha^{-1})
West Bengal	12142	174520	14.37
Kerala	7897	197425	25.00
Andhra Pradesh	3439	100830	29.32
Chhattisgarh	898	8675	9.66
Tamil Nadu	807	20175	25.00
Bihar	518	23585	45.53
Gujarat	286	5284	18.48
Jharkhand	198	8250	41.67
Karnataka	192	7187	37.43

MT – (Metric Tonne), t/ha^{-1} – (Tonnes per hectare)

Source: Unpublished statistics from Department of Agriculture/Horticulture of various states, 2009-10.

Conclusion

By the above results we conclude that *Amorphophallus paeoniifolius* is a cash crop in West Godavari district due to its shade tolerance and export potential. Hot and humid climate is required at initial stages of the crop for vigorous growth, whereas dry climates facilitate tuber bulking at later stage. Elephant foot yam (*Amorphophallus paeoniifolius*) is one of the most nutritious tuberous vegetable crops in this area. In traditional cultivation the cultivated variety Gajendra used in this area has a non-acrid Character. Farmers in the present study area import Gajendra seeds from Bihar and Vijayawada and the seed cost and transportation cost are so high. After harvesting, corms are marketed through middle men in West Godavari District. Though the yield is high, market value of

the corms is good total profit obtained by selling the corms in this area is not much because the seed cost and transportation cost are more.

Acknowledgement

We are thankful to the Department of Botany, Andhra University, Visakhapatnam, for providing the infrastructure facilities, library facilities etc. for this study.

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