Int. J. Agricult. Stat. Sci. Vol. 14, Supplement 1, pp. 163-167, 2018 *ISSN : 0973-1903*

ORIGINAL ARTICLE

CULTIVATION AND ECONOMICS OF *EURYALE FEROX* SALISB. FOR SUBSISTENCE AND COMMERCIALIZATION

Helen Soibam and Victor Singh Ayam*

College of Horticulture and Forestry, Central Agricultural University, Pasighat - 791 102, India.
*Department of Botany, Rajiv Gandhi University, Rono Hills, Doimukh - 791 112, India.
E-mail : victor_ayamsingh@yahoo.com

Abstract : *Euryale ferox* is one of the aquatic horticultural crops considered indigenous by Meiteis of Manipur, India. The plant has been considered as a famine food by several workers and has been assigned the "Least Concerned (LC)" category under the IUCN Red List data. Cultivation and market survey of the plant was conducted in Imphal West, Manipur, India during Jan.-Dec. 2016. The study reveals that *E. ferox* are easy in cultivation and helps in income generation. The survey on ethnomedicinal aspects of the plant provides information on the use of this plant in the remedy to a number of diseases. *E. ferox* also adds variety to the diet. Therefore, encouraging cultivation of the plant not only gives benefit to man but also will help in its conservation.

Key words : Cultivation, Conservation, Market survey, Income generation, Least concerned.

1. Introduction

Euryale, meaning "far-roaming" (Greek) was the second eldest of the three Gorgons sisters (hair of living, venomous snakes), according to Greek mythology. The genus *Euryale* (family *Nymphaeaceae*) has 7 scientific names at species level of which *Euryale ferox* Salisb. is the only accepted name with 2 synonyms (*Anneslea spinose* Andrews and *Euryale indica* Planch). They are distributed in tropical and subtropical regions of south-east and east Asia and variously known as *fox nut*, *gorgon nut*, *onibasu* (Japanese), *gasiyeon* (Korean). In India, it is richly distributed in northeast especially in Manipur (*Thangjing* in Manipuri), followed by Assam (*nikori* in Assamese). Also, cultivated in Bihar (*makhana* in Hindi & Punjabi). *Euryale* was often placed under the distinct family Euryalaceae because unlike other water lilies, their pollen grains possess three nuclei [Cronquist (1981)]. They are shallow, aquatic, cash crop, often found in the ponds, ditches and lakes of the plains of Manipur (Fig. 1). Young and tender plant parts, petiole, rhizomes, placenta (immature and mature), perisperm and endosperm eaten and are used as cuisines in indigenous recipes like "*eronba*, *ametpa*, *singju*, *kangsoy*, *chamthong*, *kanghou* and *saag*". Billions of people are under hunger, the current food crisis is certainly massive and destructive [Holt-Giménez (2008)]. According to Mark Joseph Stern the causes of famine is due to human error [Stern (2014)].

Climate change due to global warming leads to irregularity in rainfall, disruption of the water cycle, flood, soil erosion, habitat destruction, followed by drought, incidence and spread of pathogens, which in turn can have a profound effect on the survival [World Bank (2001)]. Hunger and scarcity of food will then become the most important factor leading to poverty, job instability, discrimination, inequality, conflicts, wars and global insecurity [DeFeo (2017)]. The root cause of the crisis is a global food system that is highly vulnerable to economic and environmental shock. This vulnerability springs from the risks, inequities and externalities inherent in food systems that are dominated by a global industrial agri-foods complex. For solving the world food crisis call for more of the same policies that caused the crisis in the first place: *e.g.*, more subsidies, greater reliance on food aid, more free trade, and more Green

***Author for correspondence** **Received** March 10, 2018 **Revised** August 29, 2018 **Accepted** September 12, 2018*

Revolutions [Holt-Giménez (2008)]. The early warning system of famine helps in preparation however, it can be easily mitigated or prevented if the humanitarian response had been timely and more effective [Seal and Bailey (2013)]. Catastrophic food crisis can occur that results in widespread acute malnutrition and mass mortality which is a process, rather than an event, with a beginning, a middle and an end", which is referred as famine [USAID (2002)]. The World Food Program says a famine occurs when a serious food crisis is made worse by "governments' failure to deal with the situation" [WFP (2005)]. According to the international famine center (www.ucc.ie) famine may be due to "the regional failure of food production or distribution systems, leading to sharply increased mortality due to starvation and associated disease" [WIT (2008)]. According to Wikipedia, famine is usually accompanied by regional malnutrition, starvation, epidemic and increased mortality, which is due to a widespread shortage of food that may apply to any faunal species (https://en.wikipedia.org/wiki/Famine). *Euryale ferox* is included in the list of "Famine Foods" by Bob Freedman (1998). Wild food plants, therefore, could be one of the best alternative to cure famine, with the increasing cultivation of the food plants the problem of the food crises could be solved to an appreciable level [Walsh (2009)]. The seeds show low sugar and protein content with higher starch, fat, phenol, and dry matter [Singh and Singh (2011)]. Traditional healers "*maibas* and *maibis*" uses seeds and rhizomes as stimulants and in the treatment of the diseases. Often the demand surpasses the production. Cultivation, nutritional advantages, medicinal application and economic output and marketability is studied in this paper.

2. Materials and Methods

Cultivation practices of *E. ferox*

Field preparation and sowing

Mature seeds were used for the propagation of *E. ferox*. The plant can grow in any wetland or prepared pond occupied all the time with water. For the study, a pond was prepared, selecting a clayey and slightly loamy soil and pH was maintained around 5.5 to 6.5 using lime and sand during the month of February at Nambol, Manipur. The mature seeds were soaked in water for 2 days and kept covered with gunny bags with the frequent sprinkling of water for 2 weeks for proper softening of the seed coats. The seeds were then sown in the prepared pond spacing 2 × 2 sq. m. apart, during early April. The water level was maintained around 4 cm and within 2 weeks' time sprouting occurs and in the next week, reddish/purplish sagittate to cordate leaves arise. The level of water was then increased depending on the pace of growth maintain only not to suffocate the growing seedling. Within 2-3 months from showing the plants become matured, the leaves become circular, dark green with purple veins, spines all over the stems and leaves and purple flowers were produced. During June, fruits were produced. Selecting the mature fruits with the blunt spines were harvested. Survey on medicinal use of the plant was also carried out in the form of spot interview using questionnaire and targeting informants of age above 30 years to elderly people in Manipur and the application/uses of the plants, parts used and mode of preparation were conducted.

3. Results and Discussion

Harvesting

The immature fruits with sharp spines were collected in rotation giving a gap of 4 to 5 days. Harvesting was continued from November. Around 25 to 30 plants were yielded per plant. Since around 2500 plants can be planted per hectare with the spacing of 2×2 sq. m. A rough estimate of 62,500 to 75,000 fruits can be harvested annually. The harvested fruits of various stages were sold in the market (Fig. 2). After a survey on some of the main markets/ bazaars (Imphal and Nambol Bazars/market), the Cost of a matured fruit was @ Rs. 30 ± 5, during the ending of the harvesting season, December 2017. Therefore, the average earnings per hectare per year was Rs. 2,062,500. The price of the fruits increase with maturity however, overripe ones get busted and opened (Fig. 3). The fruits if burst, due over-ripening while in water, then the seeds that get dispersed will propagate and maintain continuity of their life cycle.

Medicinal application

During the survey, it was reported to use for various medicinal purposes (Table 1). The rhizome of the plant is used as a diuretic, in dropsy, jaundice and gonorrhea, beriberi, dysentery, debility and as a general health tonic. It improves fertility. The rhizomes after boiling with a piece of alum are effectively used for the treatment of scabies. Ripe seeds are used in the treatment of chronic diarrhoea due to dyspepsia and urorrhoea, spermatorrhoea (https://www.bimbima.com/herbs/makhana-health-benefits/80/). Three compounds were

Fig. 1 : The growth of *Euryale ferox* in a pond habitat.

Fig. 2 : Fruits of different stages of *Euryale ferox* sold in the market.

Fig. 3 : Overripe fruit of *Euryale ferox* getting opened sowing inside seeds.

isolated from the extract of *E. ferox* seed coat and identified as 5,7-dihydroxy-2-(3,4,5-trihydroxyphenyl)-chroman-4-one, 5,7,4-trihydroxyflavanone and buddlenol E., suggesting that the extract of *E. ferox* is a promising source of natural antioxidants and anti-fatigue material for use in functional foods and medicines [Wu *et al.* (2013)].

4. Conclusion

The above study is concluded with the clear outcome that the fox-nut cultivation can be easily carried out without many technical operations in any wetland areas. The fruitfulness period also attains in a very short time, starting from 4-5 months onwards and giving fruits up to 9-10 months thereby acting as a source of continuous income to the growers on the expense of minimal energy and time. The plant not only provides variety in the food habit but also help in curing several diseases. The ability of the plant in acting as an antiobesity agent as well as against the erectile dysfunction also encourages the demand and consumption among the consumers. Apart from all the applications, the plant has cultural values as religious offerings are done with this plant adding its importance. However, this crop according to the IUCN Red List is under the *Least Concerned* (LC)

Table 1 : Uses of *Euryale ferox* in Manipur.

S. no.	Uses	Plant part use	Mode of use
1.	Thangjingkhayoneronba (food)	Young leaves	Boiled and meshed with other ingredients.
2.	Thanjingsoidoneronba (food)	Mature fruit, seeds	Oiled and meshed with other ingredients.
3.	Thangjing -pan eronba (food)	Mature fruits (seeds, placenta)	Oiled and meshed with other ingredients
4.	Thangjingkanghou (food)	Seed	Boiled and meshed with other ingredients
5.	Singju/Ametpa (food)	Fruits, young leaves and petioles	Fresh as salad with other ingredients
6.	Thanging Maroi Borithongba (food)	Seed	Cooked with the main ingredient Maroi (*Allium hookeri*)
7.	Thangjingkanghou (food)	Ripen seeds	Finely chopped, *Allium odorosum*, cowpea and chopped potatoes are fried in mustard oil along with the seeds of fully rippen *E. ferox. Chillies* and salts are added and are eaten as a delicacy.
8.	Thangjingchamthong (food)	Seed, placenta, petiole	Boiled and cooked with other ingredients and served.
9.	Kangsoi (food)	Petiole, young seeds and placenta	Soup prepared with other ingredients
10.	Heart problems (medicine)	Seed	Cooked in any food formRemark: low fat
11.	Blood pressure (medicine)	Seed	Cooked in any food formRemark: low sodium and high potassium
12.	Diabetes	Seed	Cooked in any food formRemark: Low fat and sodium
13.	Diarrhoea	Seed	Cooked in any food formRemark: high fiber and astringent property
14.	Aphrodisiac	Seed	Cooked in any food form
15.	Scabies	Rhizome	Boil with alum
16.	High Anti-oxidant	Seed	Cooked in any food formRemark: rich in ascorbic acid, phenol
17.	Religious offering	Whole fruit	Along with other items in front of deities
		Popped seed	

Survey report: Imphal Bazar, Nambol Bazar, January – December 2016.

category [Zhuang (2011)]. So, encouraging cultivation practice will help in its conservation. Considering its various uses and ease in cultivation, large-scale commercial cultivation needs to be encouraged in other states of India to help in its conservation. Research on pharmacological aspects can be emphasized for in-depth study of the crop's pharmacological claims.

Acknowledgement

Authors are grateful to the Anonymous reviewer for his fruitful comments for the much improvement in the manuscript.

References

Bob Freedman (1998). Famine foods. 50 E. CalleEncanto Tucson, Arizona 85710. https://www.purdue.edu/hla/sites/famine-foods/ (retrieved on 16th Dec. 2017).

Cronquist, A. (1981). *An Integrated System of Classification of Flowering Plants*. New York: Columbia University Press. p. 111. ISBN 0-231-03880-1.

DeFeo, M. (2017). Food Insecurity and the Threat to Global Stability and Security in the 21st Century. *Inquiries Journal*, **9(12)**. Retrieved from http://www.inquiriesjournal.com/a?id=1712.

Holt-Giménez, E. (2008). Hunger Notes. *The world food crisis: what is behind it and what we can do*. World Hunger Education Service. P.O. Box 29015. Washington, D.C. 20017.

https://en.wikipedia.org/wiki/Famine

Seal, A. and R. Bailey (2013). The 2011 Famine in Somalia: lessons learnt from a failed response. *Conflict and*

Health, **7**, 22. http://doi.org/10.1186/1752-1505-7-22.

Singh, A.V. and P.K. Singh (2011). Nutritional, ethnotheraputics and socio-economic relevance of *Euryale ferox* salisb. in Manipur, India. *Life Sciences Leaflets*, **22**, 1104 – 1115.

Stern, M.J. (2014). What causes famine? It doesn't take a Mao or a Stalin. Slate. *Slate*'s New York office. 15 Metro Tech Center, 8th Floor, Brooklyn, N.Y., 11201.

USAID (2002). Background Paper: Famine. U.S. Agency for International Development Fact Sheet. The United States Agency for International Development. Washington, DC 20523, Press Office. http://www.usaid.gov (202) 712-4320 2002-017.

Walsh, M. (2009). The Use of Wild and Cultivated Plants as famine Foods on Pemba Island, Zanzibar. ÉtudesocéanIndien [Online], 42-43, document 8, Online since 27 January 2012, connection on 30 September 2016. URL: http://oceanindien.revues.org/793; DOI: 10.4000/oceanindien.793.

WFP (2005). How food shortages occur and how we tackle hunger.

WIT (2008). World Ecology Report. *Critical Issues in Health and Environment*, **20**(4), 1-16.

World Bank (2001). A Revised Forestry Strategy for the World Bank Group, in Riesco, L. L. Forest loss and human health: focus on EU policies and practices – FERN Brie ng Note P6.

Wu, C.Y., R. Chen, X.S. Wang, B. Shen, W. Yue and Q. Wu (2013). Antioxidant and Anti-Fatigue Activities of Phenolic Extract from the Seed Coat of Euryale feroxSalisb. and Identification of Three Phenolic Compounds by LC-ESI-MS/MS. *Molecules*, **18**, 11003-11021; doi:10.3390/molecules180911003.

Zhuang, X. (2011). *Euryale ferox*. The IUCN Red List of Threatened Species 2011: e. T168756A6535154. http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T168756A6535154.en.