Eco. Env. & Cons. 30 (August Suppl. Issue) : 2024; pp. (S221-S226)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i05s.034

Exploration and Collection of Root and Tuber Crop Germplasm in Southern Districts of Assam, India

P. Arun Kumar[1], G.D. Harish[2], M.N. Sheela[3] and A.K. Misra[4]

[1]Department of Horticulture, Agricultural College, PJTSAU, Jagtial, Telangana, India
[2]ICAR-NBPGR New Delhi, India
[3]Division of Crop Improvement, ICAR-CTCRI, Thiruvananthapuram, Kerela, India
[4]ICAR-NBPGR ICAR-NBPGR New Delhi, India

(Received 11 February, 2024; Accepted 15 April, 2024)

ABSTRACT

An exploration was conducted in Southern districts of Assam comprising of Karbiyanglong, Dima Hansao, Hailakandi and Karimgunj regions. With diverse agro climate coupled with varied soil and rainfall pattern, these regions are best suited for cultivating tuber crops and play significant role in food security of tribals inhabited. In hilly areas, tuber crops were grown mainly in *jhums* and in homestead farming, while in plains they are grown in small pockets under mixed cropping. Of the four districts explored, diversity in yam and taro were maximum in Karbianglong and Dima Hasao offering good scope for taxonomic studies. Farmers Interviewed during exploration reported a declining trend in the production and the number of local varieties maintained in individual farms since the past decade. The factors include displacement by other crops, little research attention, drought, short shelf life, shortage and non availability of planting material, limited knowledge among youth and susceptablity to new pests and diseases. In the present mission, a total of eighty nine (89) tuber crop species comprising of thirty five (35) yam, twenty eight (28) taro, eight (8) sweet potato, six (6) xanthosoma, five (5) tapioca, four (4) arrow root, two (2) elephant yam and one species of Stemona were collected. The study revealed that there is ample scope for multi-crop explorations combining crop wild relatives and landraces diversity.

Key words: *Assam, Exploration, Collection, Germplasm, Root and Tuber crops.*

Introduction

India with its diverse agro-ecological and climatic conditions holds a rich genetic diversity of root and tuber crops which are most important after cereals. Indo-Burma region is the centre of origin for many crops including taro and yams (Sharma and Hore, 1995). The two hot spots of global biodiversity *viz*. North Eastern Himalayas and Western Ghats are particularly rich in wild relatives of tropical root and tuber crops (Edison *et al.,* 2006). They have the highest rate of dry matter production per day and are major calorie contributors in human nutrition. Tuber crops find their important place in dietary habits of small and marginal farmers especially in the food security of tribal populations in not only enriching the diet but also possess medicinal properties to cure many ailments or check their incidence (Arora and Pandey, 1996 and Roy *et al.,* 1988). Many of them are used and are being used in the preparation of stimulants, tonics, carminatives and expectorants. They are rich source of dietary fibre and carotenoids *viz*. â carotene and anthocyanin (Balagopalan *et al.,* 1999).

[1]Assistant Professor, [2]Scientist, [3]Principal Scientist & Head, [4]Principal Scientist

North-eastern region of India is divided into three divisions, namely Meghalaya plateau, the North--eastern hills and basin, and the Brahmaputra valley, where Brahmaputra valley is the largest river basin and covers nearly 22% of the total area (56,000 km^2), characterized by rich alluvial plains (Borthakur, 1992). Assam, one of the states of this region, has wide array of genetic resources in agri-horticultural crops. Natural vegetation of the region has a great variety of herbs, shrubs and trees and possess high nutritional and medicinal properties (Neog and Mohan, 1994; Saikia and Shadeque, 1993 and Shadeque, 1989). A number of wild and semi wild relatives of vegetable and tuber crops have been reported from these areas (Swarup, 1973).

Agriculture is the main occupation of the people inhabiting these areas and the crops cultivated include rice, brinjal, ginger, chillies, maize, turmeric, grain legumes, sweet potato, cucurbits, taros, yams, minor cereals etc. The people in the hills practice '*Jhum*' or 'Shifting Cultivation' in which they grow cereals and vegetables in mixed cropping. Many tribes celebrate region specific festivals majorly associated with agriculture (Mao, 2009).

The people of these regions are still maintaining a strong agriculture based social structure. Every household collects vegetables from wild areas and maintains them either in *Jhums* or under homesteads. They also maintain a parallel life support system using wild edible and non-edible medicinal plants. Yet, there is a need to collect, conserve and document these novelties, as there is a threat of extinction looming over with the increasing population, indiscriminate exploitation and influence of floods resulting in depletion of the natural bio-diversity. In order to assess the local crop diversity, inventorization and collection of wild edible plants coupled with the documentation of related ITK's explorations were undertaken (Barua *et al.,* 2007; Rathi *et al.,* 2013). The present paper summarizes the root and tuber crop collection mission undertaken in selected districts of Southern Assam comprising of Karbiyanglong, Dima Hasao, Hailakandi and Karimgunj made specific to tuber crops with special emphasis on (*Dioscorea bulbifera*) and Taro.

Physiography and Agro-climatic conditions of the area surveyed

Karbianglong: On the basis of topography, altitude, rainfall, soil type & existing farming practices etc. the district is divided into four Agro- Ecological situations (AES). Medium Hills Medium Rainfall (AES–I), Medium Hills Low rainfall (AES–II), Low Hills Medium Rainfall (AES–III) & Foot Hills & Plains Medium to Low rainfall (AES–IV). The present explored area falls under AES-III consisting of Manja, Dokmoka, Bakulia under Bokajan Civil Sub-division covering the villages Rupsing Hanse, Rongpi, Vophong Timung and Upper Deopani. and under Diphu Sadar Sub-Division Thakarajan, areas surrounding Longnit river. This area is a main shadow area and receives less than 1000 mm rainfall and is mainly inhabited by Karbies also call themselves as "ARLENG" which literally means a man. Racially Karbies belongs to the Mongoloid groups. The hills of Karbianlong are rich in tuber crop diversity. Though broom grass is commonly grown in the hills, rubber as cash crop is gaining more importance. Jhum cultivation is prevalent in hills, mostly occupied by tapioca, rosellee, castor, Upland rice (Chobok cultivar), cucurbits and yam with other minor crops. In lowlands a popular rice variety "Ranjit" is occupied in majority of the area.

Dima Hasao: Explored area covered dwellings around Borail ranges and and Jatinga Hills and villages Sontilla and Gurubari. The area is hilly terrain with an altitude around 966 m Rainfall in Borail range being heaviest. Annual average rainfall range varies from 2200 mm to 2700 mm. Major tribes being Dimasas other minor tribes observed were viz., Zeme Nagas, Biate, Hmars, Karbis, Khasi-pnars and Khelmas. Farmers generally practice Jhum-cultivation. The area has rich vegetable diversity specially in cucurbits. The local markets has rich diversity of Brinjal and leafy vegetables.

Hailakandi and Karimganj: These two districts fall under Barak valley. The climatic condition of this region is subtropical in nature with warm experiences of heavy rainfall and humidity. The topography is plain characterized by low lying waterlogged areas (known as beels locally). The major crop grown is paddy and others include tea, sugarcane, pulse, potato, mustard, vegetables etc.

Diversity of tuber crops

The region explored is the richest reservoir for genetic variability of tuber crops. These crops form an integral part of dietary system of tribals and are grown abundantly in their *Jhum* lands or in kitchen gardens as mixed cropping. Politically sensitive parts like hilly terrain grounding highest peak of Karbianglong are rich in diversity due to less devel-

opmental activities over the years. There is great threat to existing diversity due to encroachment of forest land for housing purposes.

Methodology

The germplasm collection mission for root and tuber crops was undertaken in Karbiyanglong, Hafflong, Hailakandi and Karimgunj regions encompassing Southern districts of Assam. The aim of the study was to explore, identify, collect, and conserve the domesticated and wild tuber crops used by locals. The areas for collection were selected based on the available literature and in consultation with Agriculture and its line departments. The major factors considered during the selection of these districts were, diversity potential, gaps in previous collections and accessibility. The local farmers cultivating root and tuber crops were identified based on the information obtained from agriculture and line departments and other knowledgeable local farmers in the exploration areas. The selected farmers were questioned by the team, and information was collected on their use, conservation and cultivation practices of root and tuber crops. The elderly peoples, farmers, herdsmen, shepherds, housewives, and children were contacted to collect the data. Planting materials such as tubers, corms, etc were collected from the respective informants. Passport information of every accession collected was recorded using the standard collection record sheet of National Bureau of Plant Genetic Resources (NBPGR) New Delhi. Global Positioning System (GPS) was used to record altitude, latitude and longitude of the collection sites. As these crops being propagated vegetatively selective sampling method was practiced (Abebe, 2006). In few cases random sampling was made from farmer's field where these crops grown in large number. Specimens consisting of leaves and flowers were collected for herbarium samples and were deposited to the herbarium repository of National Bureau of Plant Genetic Resources, New Delhi (Jain and Rao, 1977 and Devogel, 1995).

Results and Discussion

There was tremendous bio-diversity in all the regions explored in not only with tuber crops but also with other crop species also. A total of eighty nine (89) root and tuber crops germplasm adapted to four agro climatic conditions *viz.,* Karbianglong, Dima Hasao, Hailakandi and Karimganj were collected in this mission (Table 1). The maximum frequency (39.32%) and highest number (35) of the accessions were collected for *Dioscorea* sps. followed by taro with 31.46% (28 in number), sweet potato 8.98% (8 in number), Xanthosoma 6.74% (6 in number), cassava 5.61% (5 in number), Arrow root 4.49% (4 in

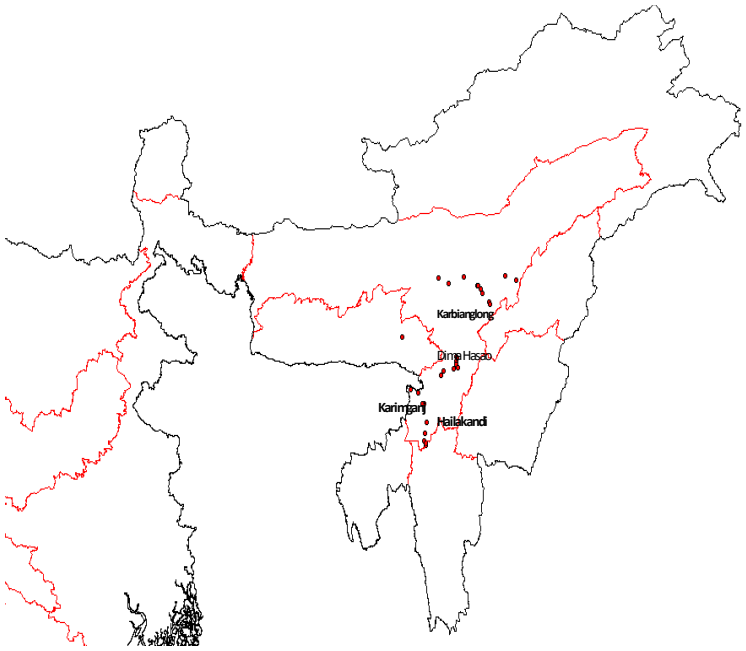

Fig. 1. Digitized map showing collection localities of southern districts of Assam

Table 1. Total number of root and tuber crop germplasm collected during the exploration

S. No	Crop	Number of Accessions	% of accessions
1	Yam (*Dioscorea spp.)*	35	39.32
2	Taro (*Colocasia.spp.*)	28	31.46
3	Sweet-potato *(Ipomoea batatas*)	8	8.98
4	*Xanthosoma sps.*	6	6.74
5	Cassava (*Manihot esculenta*)	5	5.61
6	Arrow-root (*Maranta arundinacea*)	4	4.49
7	Elephant-foot-yam (*Amorphophallus paeoniifolius*)	2	2.25
8	*Stemona tuberose*	1	1.12
	Total	**89**	

Table 2. Number of accessions collected from different districts

S. No	Name of the district	Number of Accessions	% of accessions
1.	Karbiyanglong	38	42.70
2.	Dima Hasao	20	22.47
3.	Hailakandi	17	19.10
4.	Karimgunj	14	15.73

number), elephant foot yam 2.25% (2 in number) and stemona 1.12% (1 in number).

With regard to number of accessions collected from different sources, maximum number of accessions 35.95% (32 in number) were collected from wild habitats followed by backyard of houses 25.84% (23 in number), farmers fields 24.71% (22 in number) and local markets 13.48% (12 in number) (Table 3).

Table 3. Details of number of accessions collected from different sources

S. No.	Source	Number of Accessions	% of accessions collected
1.	Farmers field	22	24.71
2.	Backyard/Homestead	23	25.84
3.	Wild habitat	32	35.95
4.	Local Markets	12	13.48

District wise distribution of germplasm, maximum number of accessions were collected from Karbiyanglong district 42.70% (38 in number) followed by Dima Hasao 22.47% (20 in number), Hailakandi 19.10% (17 in number) and Karimgunj 15.73% (14 in number) (Table 2). The root and tuber crops are commonly grown in homestead using traditional practices where manure is mainly used to fertilize the soil.

Farmers select and maintain the local varieties for seasons together that best meet their needs using their indigenous knowledge. The selected seed from desirable plants will be maintained for next planting either on the farm or in indigenous storage facilities under cool places in the houses. These traditional management practices have been exercised for centuries and contributed for the availability of present day local varieties. Besides this, farmers purchase planting materials through informal seed system from local markets.

The root and tuber crops are commonly grown in homestead using traditional practices where manure is mainly used to fertilize the soil.

Interviewed farmers in the present mission reported that the production of root and tuber crops has been declining over the past few years. The principal staple crops are cereals in terms of the area planted and volume of production.

Use values

Most of the produce is used for the house hold consumption. Occasionally farmers sell tubers in the local market. Women farmers play major role in food preparation, and food preparation of these crops involves boiling peeled and unpeeled tubers. The study also revealed that tubers harvested from plants older than two years are often preferred to use for medicinal purposes and are in agreement with Horton *et al.,* 1984. Prem Singh *et al.* (2015) reported that the effective use of traditional food plants not only meets the nutritional requirements but also used as a remedy for various diseases. Cultural dishes are also prepared from mashed tubers by mixing with various local spices.

Threats to root and tuber crops and associated traditional knowledge

Any successful breeding programmes mainly rely on the availability of genetic diversity. There is a

need for documentation of indigenous knowledge, the biological and agronomic characteristics of root and tuber crops. The available information is very minimal. Lack of sufficient information might affect the improvement of the crops (Medhi and Parthasarathy, 1999). Documentation of the indigenous knowledge on the use and management is important to enhance their cultivation and sustainable utilization (Yeshitila and Temesgan, 2016).

Gender also play a great role in managing and conserving indigenous germplasm (Eyzaguirre, 2006). During the exploration, it was noted that very few farmers especially elders were still growing them. Polat *et al.,* 2015 reported that farmers who have exposure to modernization were less knowledgeable on the use of food plants.

In all the areas surveyed farmers reported a decreasing trend in the overall production and the number of local varieties maintained by individual farmers. The most cited reasons for the decline of root and tuber crop germplasm include *viz.,* displacement by other crops, little research, drought, short shelf life, shortage of planting materials, little research attention, limited knowledge of youth and pests. Farmers also reported that so as to reduce the damage by wild animals they often grow highly susceptible root and tuber crops in home gardens. These findings are in agreement with Yeshitila and Jens, 2012.

Conservation status

Farmers select and maintain the local varieties that best meet their needs using their indigenous knowledge. They maintain and collect the seed of desirable plants for next planting either on the farm or in traditional storage facilities. For instance, *Dioscorea* spp. and *Colocasia esculenta* L. Schott are mainly maintained in the cool places in the house. These traditional management practices have been exercised for centuries and contributed for the availability of the present day local varieties (Dutta, 1966). Besides, farmers purchase planting materials through informal seed system from local markets. Filed gene banks are used to conserve plant species as these are vegetatively propagated where the importance of seed is less by employing appropriate field management practices (Abdul Ghani Yunus, 2001).

Conclusion

Tuber and root Crops are the most important food crops after cereals in the tropical areas. They find an important place in the dietary habits of tribal and rural population especially at the time of food scarcity. Both tuber and root crops not only enrich the diet of the people but also possess medicinal properties to cure many ailments and check their incidence and are used in the preparation of stimulants, tonics, carminatives and expectorants. They form the important dietary fibre and carotenoids viz., a carotene and anthocyanin.

In the present mission, a total of 89 root and tuber crop germplasm have been collected by which the national root and tuber crops germplasm holdings have increased. These accessions were conserved in field gene banks which will be characterized, documented and utilized in crop improvement programmes in subsequent times.

The indigenous knowledge and traditional farming system that contributed for the availability of present day diversity need to be studied and developed further. Besides, targeted research focusing on various aspects is required to exploit their food potential.

There is an urgent need for collaborative approach among the government and other local agencies for effective plant genetic resources management and to develop/identify new genotypes for different cropping system. Further, diversity mapping is the need of the hour for effective management, conservation and utilization of crop species and their relatives. Efforts are needed for strengthening of 'on-farm' conservation for safeguarding of traditional varieties/germplasm (Yeshitila and Temesgan, 2016) and *in situ* conservation of endangered species, ex situ conservation in field gene banks and in vitro storage and cryopreservation of important germplasm need to be expedited.

Conflict of Interest- None

References

Abdul Ghani Yunus, 2001. Introduction to Field Genebank, In: *Establishment And Managementof Field Genebank, A Training Manual,* edited by Mohd Said Saad and V Ramanatha Rao, (IPGRI-APO, Serdang).

Abebe, D. 2006. Brief crop genetic resources collection field manual. (Eastern Africa Plant Genetic Resources Network, Entebbe, Uganda).

Arora, R.K. and Pandey, A. 1996. *Wild Edible Plants of India, Diversity, Conservation and Use*. National Bureau of Plant Genetic Resources, New Delhi, India.

Balagopalan, C., Nayar, T.V.R., Sundaresan, S., Premkumar, T. and Lakshmi, K.R. 1999. *Tropical Tuber Crops in Food Security and Nutrition*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Barua, U., Hore, D.K. and Sharma, R. 2007. Wild edible plants of Majuli island and Darrang districts of Assam. *Indian Journal of Traditional Knowledge*. 6(1):191-194.

Borthakur, D.N. 1992. Agriculture of the North Eastern Region – with special reference to hill agriculture, (Beecee Prakashan, Guwahati). 1-25.

Devogel, E.F. 1995. Manual of Herbarium Taxonomy. *Theory and Values*. 12(2): 52-80.

Dutta, S. 1966. Horticulture in the eastern region of India, Directorate of Extension, Ministry of Food and Agriculture, Govt. of India, New Delhi.

Edison, S., Unnikrishnan, M., Vimala, B., Santha V. Pillai, Sheela, M.N., Sreekumari, M.T. and Abraham, K. 2006. Biodiversity of Tropical Tuber Crops in India, p. 60. NBA Scientific Bulletin Number - 7, National Biodiversity Authority, Chennai, Tamil Nadu, India.

Eyzaguirre, P.B. 2006. Agricultural biodiversity and how human culture is shaping it. In: *Researching the Culture in Agri-Cultur: Soecial Research for International Development*, 264-284. MM Cernea and AH Kassam (Edited), CABI Publishing, Wallingford, UK.

Horton, D., Lynam, J. and Knipscheer, H. 1984. Root Crops in Developing Countries-An Economic Appraisal. *In: Proceedings of the 6th Symposium of the International Society for Tropical Root Crops*, Hosted by CIP in Lima, Peru, 21-26.

Jain, S.K. and Rao, R.R. 1977. A Handbook of Field and Herbarium Methods. Today's and Tomorrow's Printers and Publishers, New Delhi, India.

Mao, A.A., Hynniewta, T.M. and Sanjappa, 2009. Plant wealth of Northeast India with reference to ethnobotany. *Indian Journal of Traditional Knowledge*. 8(1): 96-103.

Medhi, R.P. and Parthasarathy, V.A. 1999. Crop improvement in taro in noth eastern India. p. 183-185. *In*:Balagopalan, C., Nayar, T.V.R., Sundaresan, S., Premkumar, T. and Lakshmi, K.R. (Edited). *Tropical tuber Crops in Food Security and Nutrition*, Oxford & IBH Pub. Co. Pvt. Ltd. New Delhi.

Neog, M. and Mohan, N.K. 1994. Minor and less known fruits of Assam, Indian Hort. 39. 28-31.

Prem Singh, N., Gajurel, P.R. and Rethy, P. 2015 Ethnomedical value of traditional food plants used by the Zealiang tribe of Nagaland. *Indian Journal of Traditional Knowledge*. 14(2):298-305.

Rathi, R.S., Singh, S.K., Misra, A.K. and Dahiya, O.P. 2013. Exploration and collection of germplasm from mizoram state of north eastern india. *Indian J Agricultural Reserach.* 47 (4): 296 – 303.

Ridvan Polat, Ugur, C., Musa Denizhan, U. and Mehmet Yavuz, P. 2015. Survey of wild food plants for human consumption in Elazig (Turkey). *Indian Journal of Traditional Knowledge*. 1(1): 69-75.

Roy, B., Haldar, A.C. and Pal, D.C. 1988. Plants for human consumption in India. *Botanical Survey India.* 63-65.

Saikia, A. and Shadeque A. 1993. Nutritional evaluation of under exploited leafy vegetables of Assam. *Indian Journal of Agrilcultural Science*. 63: 409-411.

Shadeque, A. 1989. Genetic resources diversity in horticultural crops of the northeastern region. *Proceedings of Indian National Science Academy*. 55: 473-476.

Sharma, B.D. and Hore, D.K. 1995. Genetic Resources of Yams in NE India with special reference to Garo hills (Meghalaya). *Indian Journal of Hill Farming*. 8 (2): 145-151.

Swarup, V. 1973. Vegetable research in northeastern region of India, *Proc Seminar on research and training needs of NE Himalayan region, Shillong*.

Yeshitila, M. and Jens. W. 2012. Local customary use and management of Ethopian potato (*Plectranthus edulis* (Vatke)) Agnew in Sodozuria district, South Ethiopia. *Journal of Ethnobotany Research Application*. 10: 381-387.

Yeshitila Mekbib and Temesgan Deressa. 2016. Exploration and collection of root and tuber crops in East Wollega and Ilu Ababora zones: Rescuing declining genetic resources. *Indian Journal of Traditional Knowledge.* 15(1): 86-92.