Indian J. Plant Genet. Resour. 27(3): 201-208 (2014)
DOI 10.5958/0976-1926.2014.00015.1

Collecting Crop Genetic Resources from Mon, A Remote District of Nagaland

K Pradheep*, Soyimchiten and E Roshini Nayar
Division of Plant Exploration and Germplasm Collection, ICAR-National Bureau of Plant Genetic Resources, New Delhi-110012

(Received: 27 June 2014; Revised: 20 September 2014; Accepted: 23 September 2014)

An exploration for agri-horticultural crops from Mon district of Nagaland has resulted in the collection of 138 accessions representing rich variability in major field crops such as rice, maize and foxtail millet, besides first time collection of local germplasm of chenopod and prosomillet in this state. Drastic reduction in cultivation of Job's tears, a native crop of North-eastern Hill region, was observed. Diversity in exotic vegetables–*Abelmoschus caillei*, *Capsicum chinense* and *C. frutescens*, *Solanum aethiopicum* and *S. macrocarpon* along with important crops *viz*. okra, chilli and brinjal was also noted. Brief information on the salient collections, cultivation practices, local type preferences, folk use and conservation strategies are also highlighted.

Key Words: Collection, *Konyak*, Mon district, Nagaland, Plant genetic resources

Introduction

Mon district is located in North-East Nagaland, bordered by Sibsagar district of Assam in the North, Tuensang district of Nagaland in the South, Myanmar in the East, Longleng district of Nagaland in the West and in the North-East lies the Longding district of Arunachal Pradesh. The Naga tribe *Konyak* predominates in this district, and are challenged by inhospitable mountainous terrain, poor communication and transport facilities. Almost all the cultivated areas are under *jhum*; of these, about 70% area belong to cereals (Department of Planning and Coordination, 2011). This district is known for rich diversity in rice, maize, millets, chilli, cucurbits, etc. and the inhabitants of this district have a rich tradition of biodiversity conservation strategies (Godbole, 2000). This area has not been extensively explored and a very meagre collection exists in the National Genebank (NGB) of NBPGR, New Delhi from this district. Thus a special exploration trip was undertaken for collecting germplasm of different agri-horticultural crops, especially those that can be conserved through seeds.

Materials and Methods

Exploration was undertaken in five (out of six) blocks of Mon district *viz*. Chen, Mon, Phomching, Tizit and Wakching for ten days during November 2013, lying between latitude 26° 30' to 26° 53' N and longitude 94° 51' to 95° 13' E with altitude ranging from 174 to 1,626 m. Climate of the upper region is sub-temperate, while the middle region is warmer and the lower region is sub tropical. Temperature varies from 16 to 31° C in summer (March-September), 4 to 24° C in winter (October to February) while average rainfall is about 200-300 cm and average relative humidity is 76%. Soil is mostly lateritic while red soils occur in the plains bordering Assam. Besides *jhum* cultivation, handicraft, hunting and collection of minor forest products are other important occupations. Staple food of these people includes rice, taro, pork, etc.

The collection sites were identified based on published information on environmental variation, diversity and distribution of target crops, coupled with interaction with the officials of Krishi Vigyan Kendra (KVK) and agricultural departments at the district/sub-divisional level. Visit to local markets (within the broader collection sites) helped to further narrow down, sometimes to the particular farmer(s) within the site. In general, efforts were made to collect the desired germplasm from field (farmer's field/home garden). Where the crop had already been harvested, collections were made from the threshing yards/farm store. In general, random sampling was followed for field collection and farm-stored germplasm whereas small samples were bulked in case of wild species. Passport data for each collected sample were recorded as per standard format (Moss and Guarino, 1995). A semi-structured questionnaire was used to record the characteristics/cultivation practices (method of cultivation, sowing and harvesting time, frequency/ extent of cultivation, specific use, and important grain characteristics, etc.) of collected local types through

*Author for Correspondence: E-mail:hort_pradheep@yahoo.co.in

direct observation or questioning the family members or more often by a combination of both after necessary triangulation. Each collection was assigned a unique collector number. Most of the collected materials are conserved in NGB, and under characterization.

Results and Discussion

A total of 138 accessions belonging to 42 taxa were collected from 34 sites in the district (Table 1 and 2; Fig. 1).

Cereals, Millets and Pseudocereals

Usually seeds are sown during end of February to first week of March and harvested during June-July for millets, July-August for maize, August end to September first week for rice. Upland direct seeded rice (in *jhum* lands) is the most common rice cultivation system in the areas surveyed. Popcorn type maize is grown at lower altitudes up to 1,200 m while the larger-grained types are generally at higher altitudes that are unsuitable for rice cultivation. Millets are generally grown as mixed crops with chenopod, perilla and soybean. In cooler areas lying in eastern and southern regions, chenopod is cultivated.

Rice forms the single most common crop and rich diversity covering 35 local types were collected (Table 2 and Fig. 2). Data from questionnaire revealed that two-thirds of local types belong to the less-sticky type which is preferred for daily consumption. Sticky types of rice are special utility ones used in preparation of homemade biscuits and rice beer, and in ceremonies, festivals, etc. They, in general, are poor yielders, and hence farmers grow these in less quantity (Nakro, 2011). *Gam* (KP/SC-1538) is a popular sticky type with scented-grains and early maturity. *Tahnyu* (KP/SC-1449) is a speciality less sticky type exclusively given to children in Ngangching area. Another scented upland type *Thaling* (KP/SC-1537), confined to the areas bordering Myanmar (Longwa and Phomching), takes nearly nine months to harvest, but is popular owing to its good taste. Both scented and non-scented types are found in both sticky and less-sticky categories. White sterile lemma colour, a very rare character, was recorded in three accessions (KP/SC-1504, KP/SC-1564 and KP/SC-1582).

The maize germplasm collected during the exploration belongs to flint (77%), dent and popcorn types (Table 2 and Fig. 3). Mature kernels are roasted and pounded in traditional wooden mortar and pestle; the fine powder is either used for preparing soup/ porridge or as an alternative to milk powder for preparing tea; the coarse granules are either cooked and eaten as rice or used as pig feed. Different varieties are grown for specific purpose – immature grain (*Shiyam*; KP/SC-1453), mature grains (for food use in winter), popcorn (puffed kernel) and for pig feed. *Thoagong* (KP/SC-1477), however, is one common flint-type grown for multiple use.

Millets contribute the main food until the harvest of rice. Foxtail millet grains are easy to cook and cooked either alone or with rice; also used in the preparation of biscuits and as a substrate for making local beer. *Kho* (KP/SC-1532), a local type in Longwa area, is preferred to rice due to superior taste. Local type *Keisa* (KP/SC-1579), confined to Yannyu area of Tizit block, has a distinctive panicle shape like a cat's foot (four well-developed lobes at the distal end). Prosomillet, a first time collection from Nagaland, is another crop under occasional cultivation in this area since long. Its grains are cooked like rice (after pounding) and were once used as a substrate for beer.

Job's tears was once a common staple crop, but now is not preferred in the entire tract owing to long duration, difficult cultivation methods and availability of alternative crops. At present in Chenwetnyu village, only 2-3 families out of 450 continued to cultivate this crop (an elliptic-oval grain type) whereas almost 40 years back every household used to cultivate it.

Two types of *Chenopodium album* are cultivated, *Yaolu* (also known as *Waothroi*), a short type (1.2-1.5 m) with small pink-tinged leaves, maturing early (i.e. June, nearly 120 days) and grains used in biscuit preparation; *Yaoha* (also known as *Aphom*) is a common tall type (3-4 m) with big green leaves and huge inflorescence, maturing late, (i.e. November-December, nearly 280 days) and grains used to prepare tasty gruel. In either case, young leaves are plucked for vegetable use till flowering, and later left undisturbed for their mature grains (used as pseudocereal). It was collected for the first time from Nagaland, though Hore (2007) reported the cultivation of tall type as pseudocereal in other districts of Nagaland–Phek and Tuensang. Unlike in the Himalaya, *Amaranthus caudatus* L. is grown here more as an ornamental than pseudocereal.

Table 1. Crop genetic resources collected from Mon district, Nagaland

S.No.	Crop group/Species	Common name	Local name	Accessions (No.)
Cereals (51)				
1.	*Coix lacryma-jobi* L.	Job's tears	Nyekok	1
2.	*Oryza sativa* L.	Rice	Ong, Dhan	37
3.	*Zea mays* L.	Maize	Shoavang, Shongta, Wongli, Phom	13
Millets (17)				
4.	*Panicum miliaceum* L.	Proso millet	La	4
5.	*Setaria italica* (L.) P Beauv.	Foxtail millet	Shee	12
6.	*Sorghum bicolor* (L.) Moench	Sorghum	Manlom	1
Pseudocereals (6)				
7.	*Chenopodium album* L.	Chenopod	Aphom, Waothroi	6
Pulses (6)				
8.	*Cajanus cajan* (L.) Millsp.	Pigeon pea	Mansha	1
9.	*Mucuna pruriens* (L.) DC. var. *utilis* (Wall. ex Wight) Baker ex Burck	Velvet bean	Peo	1
10.	*Vigna umbellata* (Thunb.) Ohwi & H Ohashi	Ricebean	Naga dal	4
Oilseeds (11)				
11.	*Glycine max* (L.) Merr.	Soybean	Longphe	6
12.	*Perilla frutescens* (L.) Britton	Perilla	Num	5
Fibres (3)				
13.	*Gossypium barbadense* L.	Sea Island cotton	Pai, Laken	3
Vegetables (35)				
14.	*Abelmoschus caillei* (A Chev.) JMC Stevels	West African okra		1
15.	*Abelmoschus esculentus* (L.) Moench	Okra	Bhendi	1
16.	*Allium chinense* G Don	Chinese onion	Temam	1
17.	*Allium sativum* L.	Garlic	Luson	1
18.	*Amaranthus blitum* L.	Purple amaranth	Chekoi, Phowang	1
19.	*Benincasa hispida* (Thunb.) Cogn.	Ash gourd	Waolo	1
20.	*Brassica juncea* (L.) Czern. var. *integrifolia* (Stokes) Sinskaya	Leafy mustard	Layeepatta	1
21.	*Canavalia gladiata* (Jacq.) DC.	Sword bean	Powo	1
22.	*Capsicum annuum* L.	Chilli	Maktikülow, Muktek	3
23.	*Capsicum chinense* Jacq.	King chilli	Rajamircha	1
24.	*Capsicum frutescens* L.	Bird's-eye chilli	Maktek	2
25.	*Cucumis sativus* L.	Cucumber	Maiko	1
26.	*Cucurbita moschata* (Duchesne ex Lam.) Duchesne ex Poir.	Pumpkin	Kamkai, Khailo	5
27.	*Lablab purpureus* (L.) Sweet	Lablab	Yonghe	2
28.	*Lagenaria siceraria* (Molina) Standl.	Bottle gourd	Vim	1
29.	*Luffa acutangula* (L.) Roxb.	Ridge gourd	Naovün	1
30.	*Luffa aegyptiaca* Mill.	Sponge gourd	Nauoah	1
31.	*Solanum aethiopicum* L.	Scarlet eggplant	Chamka	2
32.	*Solanum macrocarpon* L.	African eggplant	Chamkei	1
33.	*Solanum melongena* L.	Eggplant	Anthao	2
34.	*Vigna unguiculata* (L.) Walp.	Cowpea	Linglo	5
Crop Wild Relatives (9)				
35.	*Abelmoschus manihot* (L.) Medik. subsp. *tetraphyllus* (Hornem.) Borss.Waalk. var. *pungens* (Roxb.) Hochr.			1
36.	*Solanum viarum* Dunal	Tropical soda-apple		1
37.	*Solanum violaceum* Ortega		Khasa, Koikha	1
38.	*Trichosanthes bracteata* (Lam.) Voigt			2
39.	*Trichosanthes cordata* Roxb.		Nagpotak	1
40.	*Trichosanthes lepiniana* (Naud.) Cogn.			1
41.	*Vigna pilosa* (Willd.) Baker		Henyaam	1
42.	*Vigna sublobata* (Roxb.) Babu & SK Sharma			1
Total				138

Table 2. Local types of major crops collected from Mon district, Nagaland

S.No.	Crop	Local types
1.	Rice	***Sticky***: Gam*[a], Khamgong*, Kezak, Nyakha, Phuha, Shüovem, Tahmei, Yam, Yamshang*; ***Less sticky***: Chah[b], Chahkat[b], Chahpang[b], Chungchak, Dhaoha*, Gamgan, Hahpang, Kongkosh#, Laihee (=Shachu)#, Menjyu, Phesha*, Shahshu*, Shago*[a], Sheleai, Taha*, Tahnyu*, Taheang, Tahtak (=Pantah)*, Thosa*[a], Thrahsu*, Tishah#, Wongshu, Yemtong **(*stickiness not recorded*: Paajah, Tahzyah, Thaling*[b])**
2.	Maize	***Dent type***: Wangshang; ***Flint type***: Khuzyak, Kongliak, Neihelo, Paochao, Thoagong, Shenei, Shiyam; ***Popcorn type***: Phuhwonglick, Yongleng
3.	Foxtail millet	Hanei, Kawkha, Keisa, Kho, Konyu, Junsee, Seebhuk, Seeha, Seeong, Shanei, Shetak, Shi
4.	Prosomillet	Jeha, Jela, Lah, Thela
5.	Soybean	Ekhalonghi, Longphe, Pheo, Sheyonghe
6.	Cowpea	Kowlinglo, Linglo, Phealo, Tohlinglo, Wethrui

*scented; [a]early maturing; [b]late maturing; #wetland cultivation

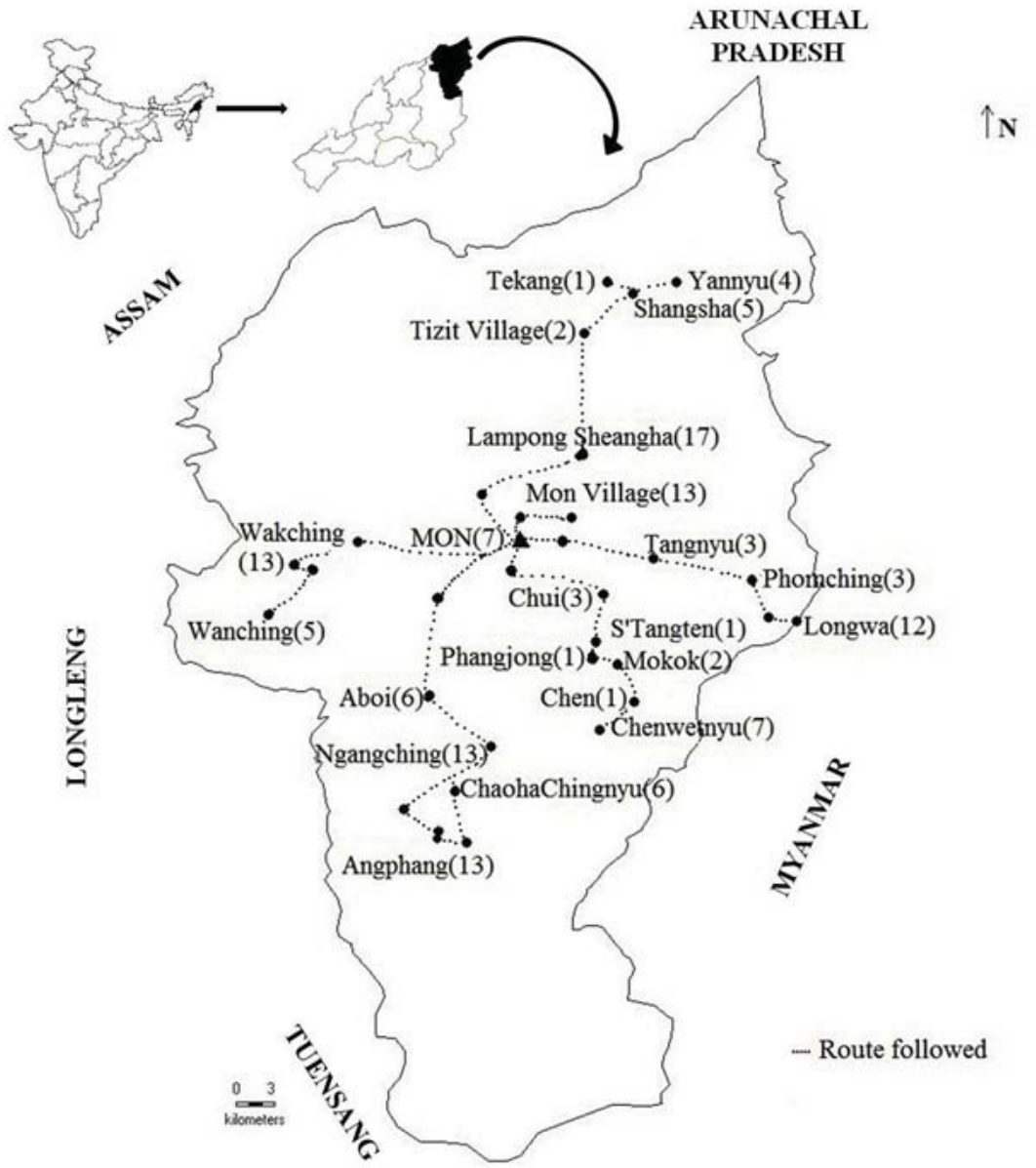

Fig. 1. Sites of germplasm collection in Mon district, Nagaland (numbers in parenthesis are collected accessions)

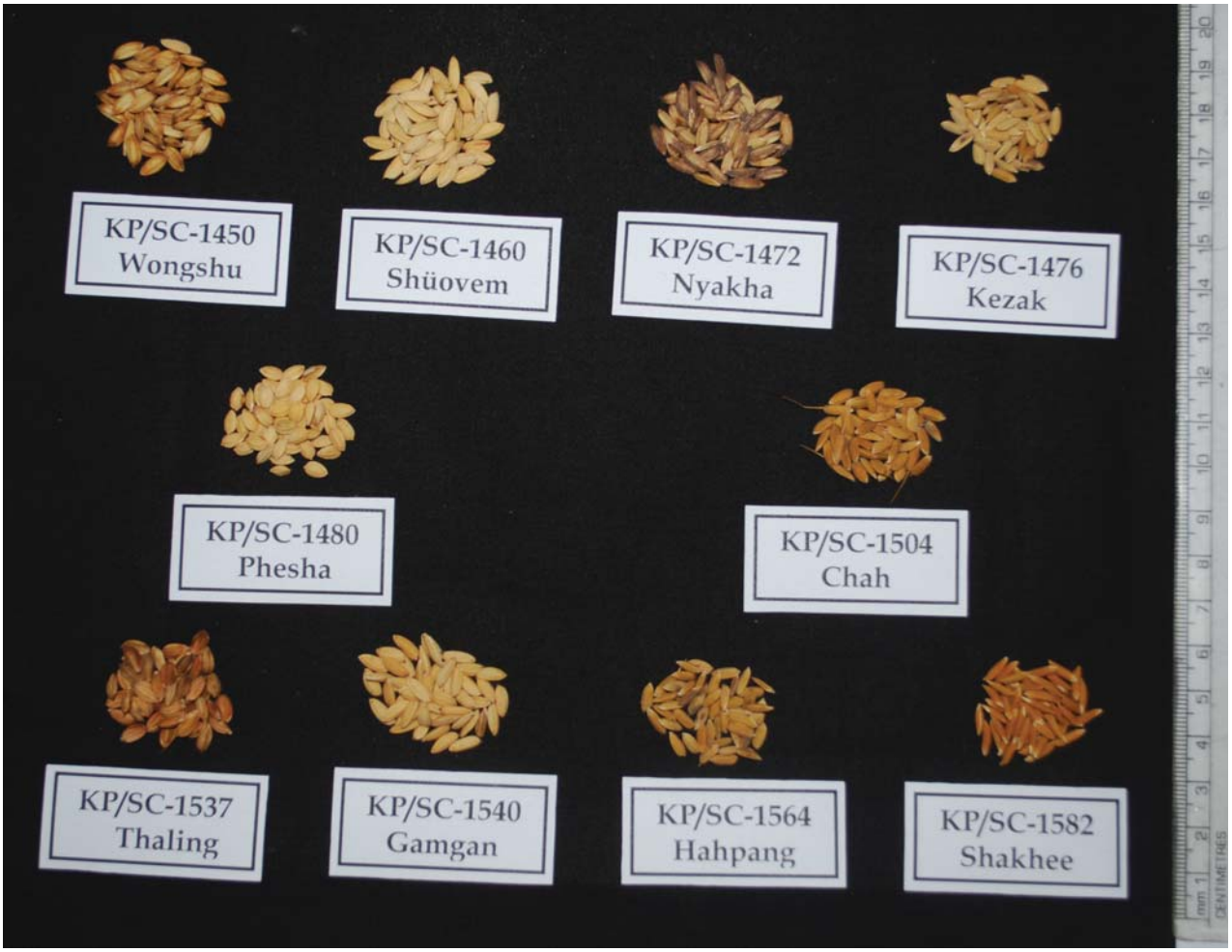

Fig. 2. Diverse local types of rice germplasm

Grain Legumes, Vegetables and Others

Ricebean exhibited variability in grain colour. Annual type red gram (having red coloured standard petal) is cultivated as pulse in the plain areas of Tizit block, while perennial type is cultivated in hilly areas at homestead level and preferred for immature pod as vegetable (rather than as pulse). Most vegetables are cultivated in specialized patches in *jhum* lands as mono-crops or in home gardens or near huts, while beans and cucurbits are grown along the fringes. Diversity in cowpea is rich and invariably for use as vegetable, especially for preparation of soup. *Abelmoschus caillei* is more commonly cultivated compared to *A. esculentus*. Three *Capsicum* species *viz*. *C. annuum*, *C. frutescens* and *C. chinense* and three *Solanum* species *viz*. *S. aethiopicum*, *S. melongena* and *S. macrocarpon* are in cultivation as vegetables in the explored areas and exhibited moderate variability. In *Solanum aethiopicum*, apart from the *Gilo* cultivar group, *Kumba* group (which is *S. integrifolium* Poir. of Arora and Hardas, 1977) was collected. Apart from use of fruits, flowering twigs of *S. macrocarpon* are also sold in markets as edible greens.

Interestingly, a white seeded type of *Perilla frutescens* apart from variability in seed size was collected. Soybean is commonly grown for its fermented product (*akhuni*) for consumption. The milk extracted from its beans is used for treating stomach disorders. *Gossypium barbadense* was occasionally found in cultivation at homestead level.

Traditional Agricultural Practices

Konyak Nagas avert the risk of crop failure by planting several economic species (in home gardens) and diverse varieties of crops (in *jhum* lands). This ensures yield in the long term, maximum returns with low levels of

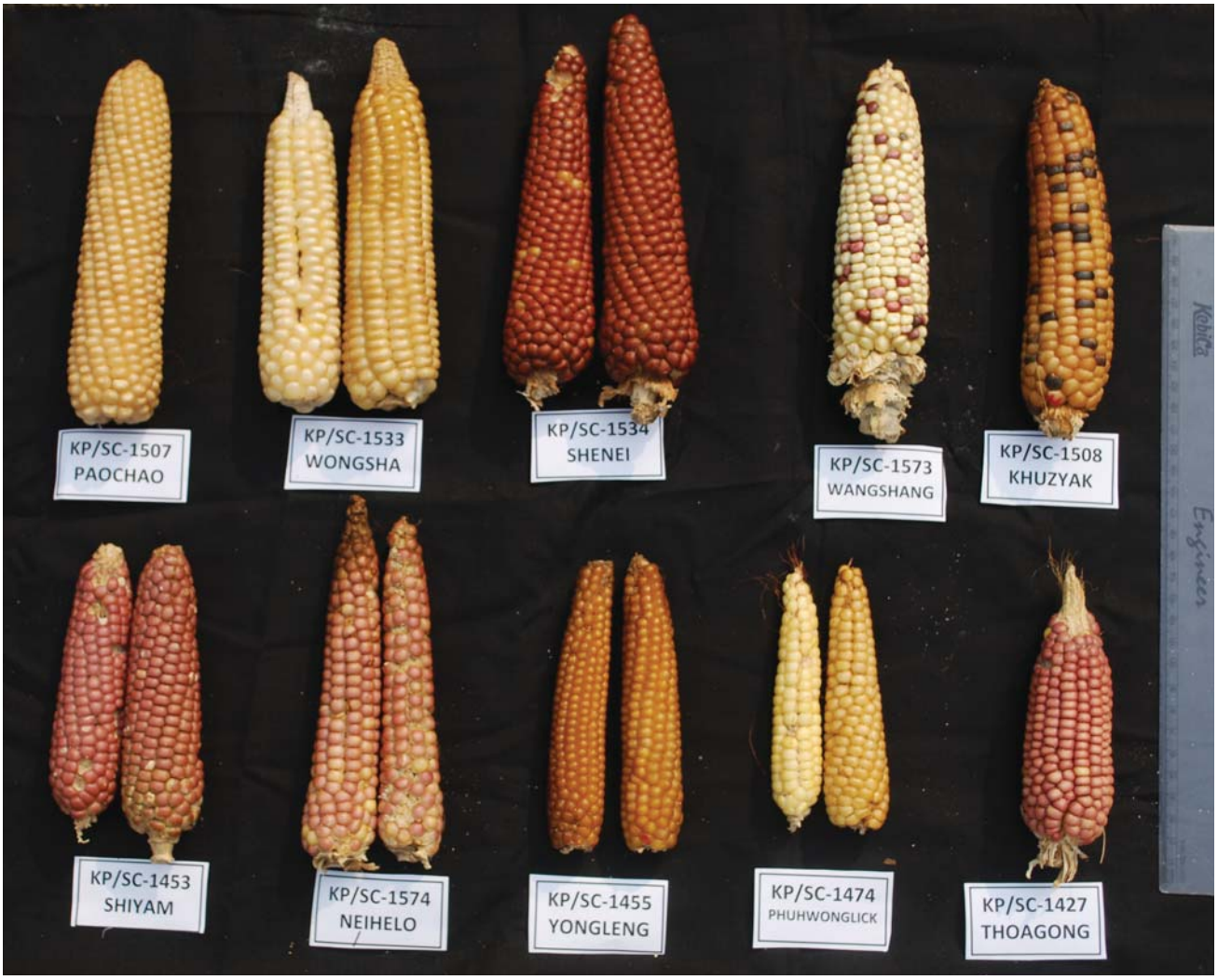

Fig. 3. Variability in cob characteristics of maize germplasm

technology and limited resources and promotes diverse options in diet (Harwood, 1979). Some observations worthy of highlighting are as follows:

- *Konyaks* prefer local varieties to improved ones, select elite material to suit their needs and maintain pure varieties. Two such recently selected rice varieties are *Tahtak* (KP/SC-1471; from an indigenous material) at Wanching village for delicious taste and late harvest (October) and *Shakhee* (KP/SC-1582; from an introduced material) in Tizit area for slender, highly scented grain and early harvest (3 months). Their preference for local varieties was also reported by Godbole and Sarnaik (2009). In maize, local types are maintained pure; in a few cases only, small proportion of dissimilar coloured kernels is observed.
- Women play a major role in conservation of local seed material. They take part in all farm related works including carrying farm products, and wild harvest of fruits, vegetables, etc. to nearby market. Panicles of foxtail millet, ears of maize and bulbs of alliums, dried fruits of brinjal (often longitudinally cut into four splits), chilli and cucurbits are safely kept for next year's sowing by hanging them on the rafter inside the home near smoke kiln to ward off pests. Home gardens are mostly managed by women folk. More than 120 species of plants are reported in *Konyak* home gardens (Zaren, 1999) and a market survey of Mon town indicated that out of 68 plant products recorded, 40 were harvested from home gardens (Godbole, 1998). Some notable wild plants commonly observed in home gardens

are *Clerodendrum colebrookianum* Walp. (leafy vegetable), *Crotalaria tetragona* Roxb. ex Andrews (edible flower buds and flowers), *Gynura cusimbua* (D. Don) S.Moore (leafy vegetable), *Hodgsonia heteroclita* (Roxb.) Hook.f. & Thomson (oil-rich seed kernels) and *Solanum violaceum* (young fruits as vegetable).

- Like other areas in the Northeastern Hill region, many crops native to Africa/ South America, are adapted to the local conditions in Mon district, and contributing to agricultural diversity through supplementing/ substituting native crops. Examples include *Abelmoschus caillei*, *Capsicum chinense*, *Cucurbita ficifolia* Bouché, *Cyclanthera pedata* (L.) Schrad., *Cyphomandra betacea* (Cav.) Sendtn., *Eryngium foetidum* L., *Gossypium barbadense*, *Passiflora edulis* Sims, *Sechium edule* (Jacq.) Sw., *Solanum aethiopicum* and *S. macrocarpon*. The role of Christian missionaries in their introduction/ popularization in these regions cannot be ruled out, as also opined by Arora and Singh (1973).

With the shortening of *jhum* cycle (to 6-7 years), climate change and imposition of high yielding varieties in recent years, collection activity is of paramount importance in this region. However, tribal people's preference for indigenous germplasm over improved varieties is a ray of hope for *in-situ* conservation activities. Considerable diversity in rice, maize and foxtail millet and chenopod was collected for the first time. Eastern and southern parts of the district, which were explored during the later phase of the trip, are in fact richer in crop biodiversity as evident from equal or higher diversity in germplasm collections from these parts as compared to northern and western parts. Future explorations need to be undertaken in remaining diversity rich pockets like Hunza, Longchang, Longshen, Mopong, Monyakshu, Naginimora, Tobu and Zangkham areas of Mon district, preferably in August-September and end of January. Yanger (1999) mentioned that Nagas cultivate about 360 different varieties of rice; our collection from a single tribe itself accounts for nearly 10% of it. Matching of names of local types indicated that about 95% of collected ones were not represented in NGB. People in this region expressed the need for cold-tolerant rice germplasm suited for higher hills so as to extend the area under this staple crop, which warrants the need for detailed characterization of the collected germplasm. Considering the enormous number of wild edible plants utilized by this tribal people, proper documentation and studies pertaining to nutritive value, method of utilization and identification of elite types would be beneficial for the sustainable growth of this native community.

Acknowledgements

Authors express their sincere thanks to Director, National Bureau of Plant Genetic Resources (NBPGR), New Delhi, for guidance and Drs Anjula Pandey and KC Bhatt, Division of Plant Exploration and Germplasm Collection, NBPGR, for providing constructive suggestions for the improvement of this paper. We owe our sincere thanks to Dr MS Sachan, KVK, Mon; Mr S Jamir, District Agricultural Officer, Mon and Dr A Thirugnanavel, ICAR Research Complex for North-eastern Hill Region, Nagaland Centre, Medziphema, for their valuable suggestions and logistic support during exploration.

References

Arora RK and MW Hardas (1977) Occurrence of *Solanum integrifolium* and *S. gilo* in northeastern hills. *J. Bombay Nat. Hist. Soc.* **73**: 423-424.

Arora RK and HB Singh (1973) Occurrence of Malabar gourd (*Cucurbita ficifolia* Bouche) in Khasi Hills. *Curr. Sci.* **42**: 29.

Department of Planning and Coordination (2011) *District Human Development Report - Mon*. Department of Planning and Coordination, Government of Nagaland, India, 223 p.

Godbole A (1998) Homegardens: traditional systems for maintenance of biodiversity. In: A Rastogi, A Godbole and P Shenghii (eds) *Applied Ethnobotany in Natural Resource Management–Traditional Homegardens*. ICIMOD, Kathmandu, pp 9-12.

Godbole A (2000) Participatory ethnobotanical research for biodiversity conservation: experiences from northern Nagaland. India. In: E Friis-Hansen and B Sthapit (eds) *Participatory Approaches to the Conservation and Use of Plant Genetic Resources*. International Plant Genetic Resources Institute, Rome, Italy, pp 173-180.

Godbole A and J Sarnaik (2009) Biodiversity, cultural diversity and sustainable development in north east India. In: A Jha, S Jha and S Munjal (eds) *Bio-cultural Diversity and Sustainable Development in North East India*: *Status, Vision and Challenges*. Readworthy Publications (P). Ltd., New Delhi, pp 139-157.

Harwood RR (1979) *Small Farm Development– Understanding and Improving Farming Systems in the Humid Tropics*. Westview Press, Colorado, USA, 160 p.

Hore DK (2007) Diversity in agri-horticultural plants: an experience with north-east India. In: P Tandon, YP Abrol and S Kumaria (eds) *Biodiversity and its Significance*. IK International Publishing House Pvt. Ltd., New Delhi, pp 167-191.

Moss H and L Guarino (1995) Gathering and recording data in the field. In: L Guarino, V Ramanatha Rao and R Reid (eds)

Collecting Plant Genetic Diversity: *Technical Guidelines*. CABI International, United Kingdom, pp 367-417.

Nakro V (2011) *Traditional Agricultural Practices and Sustainable Livelihood – A Thematic Report*. Department of Planning and Coordination, Government of Nagaland, 57 p.

Yanger YP (1999) Rice ecosystems in Nagaland. In: *Building upon Traditional Agriculture in Nagaland, India*. Nagaland Environmental Protection and Economic Development, Nagaland, India and International Institute of Rural Reconstruction, Philippines, pp 31-34.

Zaren M (1999) Home gardens. In: *Building upon Traditional Agriculture in Nagaland, India*. Nagaland Environmental Protection and Economic Development, Nagaland, India and International Institute of Rural Reconstruction, Philippines, pp 151-155.