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RESEARCH ARTICLE

Surveying Mango Diversity and its Custodian Farmers in the States of Bihar and Jharkhand, India

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In Bihar and Jharkhand, mango (*Mangifera indica* L.) is a very popular fruit grown extensively in the area with great economic importance for livelihood security of the orchardists. A survey was carried out in 35 districts of Bihar and 8 of Jharkhand based on a set of questionnaire and complemented by visits to the mango orchards in the region after the interaction with *DHOs* (office of District Horticulture Officers) and *KVKs* (Krishi Vigyan Kendras) of concerned districts about farmers growing more than 10 cultivars of mango in the locality. All surveyed farmers were men.

Through participatory rural appraisal (PRA) and interaction with mango growers, it was found that the Langra (vernacular name *Maldah* in the region) is the predominant cultivar of Bihar (likewise '*Jardalu*' in Bhagalpur Region) and '*Amrapali*' in Jharkhand. The unique local varieties which were conserved in the region are *Jalbanda* (large sized fruit with sweet at mature green stage), *Jalmarai* (uneven shape but very tasty with hard peel), *Bhastara* (syn. *Baramasi*, bearing twice in a year) *Sabja* (syn. Bombaiya, an early and sweet even at mature green stage), *Dalma* (syn. *Kalkatia Malda*, dark greened, large sized), Malda seedling (fruit weigh up to 750 g, superior in taste and sweetness compared to grafted one), *Bhont* (thin stoned, papaya shaped and mid maturing), *Sinduria* (earliest maturity), *Raja* (sweet and easily digestible), *Kaveri, Bahadura, Balajee*, *Kerwa*, *Tairia* (heavy fruit bearer with regularity), *Baelkhash* (leaves/fruits contains flavour of bael), *Chitranjan* (late maturity, taste like curd of buffalo milk), and '*Gaurjeet*, (good smelled and highly flavoured) of West Champaran which has an excellent market in the bordering area of Bihar, Uttar Pradesh and Nepal.

Key Words: Custodian farmers, Diversity, *in-situ* conservation, Mango

Introduction

Given that the native mango gene pool is the basic unit of conservation and the ultimate target of the current genetic resource collection, it is very important to correctly identify the varieties and capture maximum diversity of the species. The genetic materials are kept viable under field conditions as part of the *ex-situ* conservation activities by the mango orchardists. The diversity in mango comprises of native landraces, local selections, and elite cultivars. In Bihar and Jharkhand, mango (*Mangifera indica* L.) is a very popular fruit grown extensively with great economic importance for livelihood security of the orchardists. India has vast germplasm and varietal diversity with about 1100 named. No other country surpasses India in this respect, but only a few varieties are grown on a commercial scale. The mango genetic diversity and even the species diversity is threatened due to various human interventions. Concerted efforts are required to take corrective measures (Bhag Mal *et al*., 2011). Bihar and Jharkhand have enormous wealth of mango genotypes with respect to plant and fruit characteristics. The need has been felt to conserve the mango diversity at national and global levels. Due to shrinking land resources, smart strategies have to be developed for conservation of mango diversity. Different stages of conservation of mango diversity have been envisaged which include secret groves, forbidden orchards, cultivated orchards, field gene banks, diversity parks, homestead gardens and so on. In the centre of these conservation programmes, the *'custodian farmers'* who dedicate time and effort to conserve them [mangos] and make maximum use of diversity for their livelihood security. Such custodian farmers maintain, adopt and disseminate the agro-biodiversity over time and in space. Research and development links with these custodian farmers should be maintained and to conserve mango diversity over time.Furthermore, while geneticists and plant breeders are particularly interested in diversity at

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the molecular level, farmers are more concerned about visible morphological and agronomic variation, which helps them to identify cultivars that are productive and do well in their location specific environment (this refers to narrow adaptation given that farmers are unfamiliar with the characteristics of the many different cultivars of mango (Singh *et al*., 2015). While *ex-situ* conservation poses largely technical challenges, *in-situ* and *on-farm* conservation also need to consider several social parameters with regards to farming communities and the knowledge they hold. It is impossible to undertake *on-farm* conservation of 'nature' without considering people, their rights, their needs, their values and their relationships (Sthapit *et al*., 2016).

For the identification of custodian farmers and the mango diversity they maintain, a survey was carried out in some districts of Bihar and Jharkhand with the objective to see the gaps in improved practices they follow and to document the traditional knowledge they use to conserve and utilize mango diversity. An assessment of the diversity grown variants grown by the community may lead to identification of promising accessions/clones with regard to (better) quality and late or early maturity compared to locally acceptable varieties. The present paper highlights the need to group various cultivars based on mopho-physio-biochemical and molecular characterisation and screening for breeding purposes for improvement of commercial cultivars. It concludes that some of the superior germplasm can be directly release as variety for the region.

Material and Methods

An effort was made to collect information on indigenous diversity maintained by interested orchardists and to understand their motivating factors to conserve them (Department of Biotechnology, Govt. of India Sponsored '*National Database on Mango*' Project). The name of districts to be surveyed was given by the Nodal Officer, *National Database on Mango*' Project, ICAR-CISH, Lucknow. Concern districts were selected based on GIS Mapping of mango orchards. A survey was carried out in 35 districts of Bihar and 8 of Jharkhand based on a set of questionnaires (developed by ICAR-Central Institute for Subtropical Horticulture, Lucknow). This was complemented by exchanges with the DHOs and KVKs of concerned districts and by field visits to the mango orchards. Discussion with the farmers growing more than 10 cultivars in the locality were held (Table 1). We asked basic research questions to collect information about; a) Passport data and morphological characterization of genetic resources, b) Digitization of information regarding *on-farm* conservation, c) Characterization of farmers varieties, d) Data on

Table 1. List of custodian farmers conserving mango diversity

Name of the farmers	Location of orchard*	Longitude	Latitude	Altitude (± m)	Total No. of trees	No. of Mango varieties conserved
Sri Kaushal Motani	Gamharia Farm, Chauhatta, Mainatand, (West Champaran)	N27º14´58.0˝	E084º37´50.1˝	2	2000	17
Sri Pankaj Kumar Singh	Jalhan, Khajuria, (East Champaran)	N26º28´50.0˝	E084º43´21.6˝	3	250	26
Sri Shailesh Pandey	Dhamsar, Lahladpur via Jantabazar, (Saran)	N26º03´19.7˝	E084º37´40.8˝	2	150	16
Sri Abdul Rahim	Kumarbag, Sadar, Bettiah, (West Champaran)	NA	NA	-	360	28
Sri Anuj Kumar Rai	Malikaur, Pusa, (Samastipur)	N25º56´44.5˝	E085º38´19.5˝	2	150	21
Sri Vinod Kumar Rai	Jagdishpur, Pusa, (Samastipur)	N25º56´93.4˝	E085º39´25.1˝	34	300	36
Sri Vijay Kumar Sharma	Basuari, Pusa, (Samastipur)	E085º39´29˝	N 26º00´19˝	42	350	20
Sri Sanjay Sharma	Malinagar, Pusa, (Samastipur)	N26º00´28.5˝	E085º40´58.5˝	35	130	19
Sri Washi Akhtar	Dharmparsa, Manjha, (Gopalganj)	N26º21´30.6˝	E084º29´23.3˝	3	400	19
Sri Rajeev Nayan Tiwari	Dahibhata, Uchkagaon, (Gopalganj)	N26º28´42.7˝	E084º22´40.3˝	3	600	16
Sri Harsh Ranjan	Hasanpur Vajhi, Sakra, (Muzaffarpur)	N 26º00´5.16˝	E085º33´2.7˝	14	300	19
Sri Sudhir Kr. Pandey	Vishunpur Bakhari, Muraul, (Muzaffarpur)	NA	NA	-	100	16
Sri Amresh Kumar	Banwra Kothi, Sadar, (Katihar)	N25º36´30.9˝	E087º34´45.6˝	10	1500	17
Sri Kalidas Banerjee	Rautara, Kodha, (Katihar)	N25º39´37.5˝	E087º31´57.9˝	4	450	25
Sri Sameer Kumar Jha	Rampur Kamat, Hasanganj, (Katihar)	N25º37´50.2˝	E087º33´55.7˝	7	400	16
Sri Sanjeet Kumar	Chauhan Tola, Jalalgarh, (Purnea)	N25º56´57.0˝	E087º31´30.2˝	4	25	15
Sri Kumar Tarun		N25º56´54.4˝	E087º31´37.6˝	8	140	22
Sri Ashok Kr. Singh	Nagauali, Basantpur, (Siwan)	N26º09´41.6˝	E084º40´26.0˝	3	200	15

*District's name is delineated in brackets under column 2.

regional varieties, e) Updating information on TK, usage of mango fruits or any parts of mango trees and any new practices followed, f) Knowledge available with mango growers on nutritional and medicinal value of mango, g) The intensity of disease and pests and how fields are managed, and h) The number of germplasm in their field gene bank and what good practices of production and postharvest technologies are followed in their orchard. The selected villages of various districts were surveyed for assessment of *on-farm* mango diversity and motivating factors influencing their continued cultivation by the farmers. Farmers who cultivated multiple mango varieties were asked about the reasons for cultivating them concurrently without any economic profits unlike they would have obtained from an orchard of commercial varieties.

In the present paper, we made an inventory of the mango varieties cultivated with special importance given to local landraces and investigate the role of traditional ecological knowledge of the mango growers, concerning the management and conservation of the agro-biodiversity of Bihar and Jharkhand. During the survey, no any germplasm was collected, but information shared by mango growers was validated with answers to focussed questions given by neighbours/villagers of the vicinity.

Results and Discussion

The typology of motivational factors driving the custodian farmers to maintain agro-biodiversity, as suggested by Sthapit *et al.* (2013), includes personal (hobby, personal interest to collect); social value (heritage value and legacy/or respect for parents/forefathers, for exchange with relatives/friends); economic considerations (good income, risk management); cultural significance (traditions, customs, beliefs or because of its use in cultural or religious functions); natural virtues of a variety (disease or pest resistant or adapted to local climate and soil conditions, provision of eco-system services, regular bearer) and biological (taste, varietal preference) values.

A large array of cultivated and wild types of mango found in the surveyed areas and seedling races derived from mono-embryonic mango stones. They are the most important components of diversity available in India. Almost all commercial cultivars of mango have arisen as a result of seedling selection (Bhag Mal *et al*., 2011) and unique varieties conserved by custodian farmers in this investigation were mostly of seedling origin. Most of the mango diversity in India and the world is conserved *in-situ*, and amongst all diversity conserved, some stunning examples of local mango varieties are conserved by many mango growers in the region. Some unique mango diversity which was identified from the field gene banks includes *Mithua* (from *Patna), *Sewaiaya, Bhont, Jalbanda* (Saran), *Gaurjeet* (West Champaran), and *Baramasi* (Jamui) (Table 2).Others are listed in Table 3. These species possess important characteristics, such as disease resistance, desired fruit quality (which is lacking in the currently cultivated germplasms). [*District name given in parenthesis; name of unique varieties delineated in italic].

Table. 2. Enlisted varieties of mango *in-situ* conserved in various districts of Bihar

S.No.	Name of unique varieties	Conserved in the District
1.	*Jalbanda*	Saran
2.	*Jalmarai*	Purnea
3.	*Baramasi*	Samastipur
4.	*Lamba Bahadur*	Katihar
5.	*Hilsa Peti*	
6.	*Bhastara (syn. Baramasi)*	Siwan
7.	*Sabja (syn. Bombaiya)*	East Champaran and Gopalganj
8.	*Dalma (syn. Kalkatia Malda)*	
9.	*Malda seedling*	Samastipur
10.	*Bhont*	Saran
11.	*Suraypuri*	Purnea
12.	*Raja*	Gopalganj
13.	*Kaveri, Balajee*	
14.	*Esna*	Katihar
15.	*Baelkhash*	*Gopalganj*
16.	*Chitranjan*	Katihar and Purnea
17.	*Gaurjeet*	West Champaran
18.	*Kerwa*	Siwan
19.	*Tairia*	
20.	*Latkampu (Syn. Bahadura)*	*East Champaran and Gopalganj*
21.	*Hajipur Mithui'*	*Samastipur*
22.	*Madhukupia*	
23.	*Paharpur Sinduria*	
24.	*Rari mango*	
25.	*Kapuria*	
26.	*Hajipur Mithui*	
27.	*Ajgavi Sipia*	
28.	*Belwa*	
29.	*Chauaria*	Katihar
30.	*Navras*	
31.	*Jethua*	Purnea
32.	*Kala Pahad*	
33.	*Jing Jing*	

Table 3. Details of uniqueness of indigenous mango varieties conserved by custodian farmers of mango across Bihar and Jharkhand

S.No.	Name of unique varieties	Distinct attributes	District
1.	*Jalbanda*	Large sized fruit with sweet at mature green stage	Saran
2.	*Jalmarai*	Very tasty with hard peel hard peel, better shelf life Latest maturity (September) led to fruit fly attack Shape is not uniform i.e. distorted	Purnea
3.	*Baramasi*	Flowering thrice in a year; June –July crop is sour in taste and October crop is sweet	Samastipur
4.	*Lamba Bahadur*	Fruit is just like Fazli, shy bearer Large sized fruit (1-1.25 kg per fruit) Resistant to insect pest	Katihar
5.	*Hilsa Peti*	Heavy bearer, ideal sized fruit (4-5 in a kg)	
6.	*Bhastara (syn. Baramasi)*	Bearing twice in a year	Siwan
7.	*Sabja (syn. Bombaiya)*	An early and sweet even at mature green stage	East Champaran and
8.	*Dalma (syn. Kalkatia Malda)*	Dark greened, large sized	Gopalganj
9.	*Malda seedling*	Fruit weigh up to 750 g Superior in taste and sweetness than grafted one	Samastipur
10.	*Bhont*	Thin stoned, papaya shaped and mid maturing	Saran
11.	*Suraypuri*	Regular bearer, scented, bunch bearer Greenish while ripening with white pulp Small sized fruit with prominent beak, thin peel Sucking varieties, can be eaten as much as possible	Purnea
12.	*Raja*	Sweet and easily digestible	Gopalganj
13.	*Kaveri, Balajee*	Heavy bearer with regularity	
14.	*Esna*	Ripening in September (latest to ripen) Fibreless, and high yielder (4 quintal per tree) Bangladeshis are fond of pickle out of it	Katihar
15.	*Baelkhash*	Leaves/fruits contains flavour of bael	Gopalganj
16.	*Chitranjan*	Cross of Chauria × Bombai (presumed) Very sweet (taste like curd of buffalo milk) Tight skin with firm, yellow pulp Thin stone, High shelf life, Weight: 6-8 per kg Fibreless, light-yellow peel But milk sap is more and highly acidic Matures in mid-June and Fetch premium price Resistant to insect pests	Katihar and Purnea
17.	*Gaurjeet*	Good smelled and highly flavoured, has excellent market in the bordering area of Bihar, UP and Nepal	West Champaran
18.	*Kerwa*	Long and big sized fruit, (banana shape) A sucking variety matures in late August, Small seed with 3 inch in length, red shoulder with fibre.	Siwan
19.	*Tairia*	Heavily fruited, regular bearer, Even un-ripen fruit and peels are also sweet	
20.	*Latkampu (Syn. Bahadura)*	Big sized, matures in first week of July	*East Champaran*, *Gopalganj*
21.	*Hajipur Mithui'*	Thick peel, better shelf life	*Samastipur*
22.	*Madhukupia*	Pulp taste like honey	
23.	*Paharpur Sinduria*	Bears fruits in late July with firm pulp	
24.	*Rari mango*	Small but very juicy and sucking variety liked by many locals	
25.	*Kapuria*	Fibreless, firm pulp, red blush at shoulder Matures in Late June, high yielder (3 quintal per tree with 10 year old)	
26.	*Hajipur Mithui*	Big sized, yellow golden in colour, heavy bearer, Very less fruit drop	
27.	*Ajgavi Sipia*	Thin stoned, long fruited with thick shoulder	
28.	*Belwa*	Fibreless, pulp consistency like *malda* very sweet and ideal fruit sized, attractive red coloured Thick skin, makes suitable for long distance transport	

Contd.

S.No.	Name of unique varieties	Distinct attributes	District
29.	*Chauaria*	Early maturity and sweet even at un-ripened	Katihar
30.	*Navras*	Fibreless, with nine type of flavour, mid maturity	
31.	*Jethua*	Earliest to mature, long and small fruit Yellow pulp with scented aroma	Purnea
32.	*Kala Pahad*	Big sized fruit with thin peel Taste is better than Calcuttia malda	
33.	*Jing Jing*	Sucking varieties, small sized with yellow pulp	

Fig.1. 'Mallika' mango (Average fruit weight 720 g), conserved by Sri Anoj Kr. Rai, Malikaur, Samastipur

Fig. 2. Mango malformation in Jamui, and custodian Farmer of West Champaran, Bihar

Fig. 3. Custodian Farmer of Ranchi, Hazaribagh and Lohardaga district, Jharkhand

Fig. 4. Custodian Farmer of Gopalganj, Siwan and Katihar, Bihar

Fig. 5. Custodian Farmer of Samastipur, East Champaran districts, Bihar
[Note: All of the above farmers are conserving more than 10 varieties in their orchard, and standing near the tree of unique varieties they grow and conserve]

The farmers' responses to the survey questions underscore the importance of diversity as a mechanism for not only meeting the multiple needs of farmers, but also for increasing fruit availability for longer periods. While there was some overlap in the responses, farmers recognized that each variety reacts differently, season to season, depending on environmental conditions. Therefore, farmers seem aware that planting more varieties may assure yields which will be stabilized and maximized in due course of time in comparison to growing a single variety. Farmers mentioned several main motivational factors to maintain mango diversity: love for maintaining many varieties at the same time, interest in a maximum number of differently tasting fruits, regular source of income, recognised social status/prestige and availability of fruit, fuel and timber as a source of earning during emergency. Custodian farmers, apart from playing a critical role in conserving the rare varieties, act as local guides to disseminate the good practices. They also play as scions donors of local varieties to the community and share their traditional knowledge (Gajanana *et al*., 2015). One farmer of the Patna district (growing >11 cultivars of mango) practices grafting and has hobby of planting new trees. He has been distributing 20-25 plants every year to the neighbours, free of cost. He also shares meteorological information received as messages on his mobile and disseminates traditional knowledge and newer information related to marketing.

In the survey, we identified a maximum number of orchardists of *Darbhanga* (25) and *Samastipur* (16), *East Champaran* (15) and *Katihar* (15) district having more than 10 varieties in their orchard. Through the survey, we identified 22 orchardists who have more than 15 varieties in their orchard. Most of the mango growers of Jharkhand are conserving *on-farm* mango biodiversity using organic inputs, in Bihar there are fewer. Among 210 farmers of thirty four districts of Bihar and 8 districts of Jharkhand, the maximum number of varieties of mango is grown and maintained by Sri. Vinod Kumar Rai of *Jagdishpur*, Samastipur (36 in total) and Sri. Abdul Rahim of *Kumarbagh*, West Champaran (28 in total) (Table 1) and Sri Harendra Kumar Singh of Makhdumpur, Bihta, Patna. The later has been identified as torch bearer for farmers who needs information on e-marketing, weather forecast, skilled grafter/budder. This custodian farmer encourages farmers to grow *Jamun* and *Datepalm* as per land availability. Sri. Anoj Kumar Rai, Malikaur, Pusa, Samastipur are growing more than 25 types of fruit trees in their orchard including temperate and arid fruits, do self marketing and have the hobby of growing maximum number of varieties.

The major problems of orchards of Bihar found in the survey are young plant mortality, grazing of small plants by goat and blue bull, thefts of fruits, poor irrigating facility due to deep water table, drying of '*Sipia*' mango, dieback, fruit drop, burl disorder, monkeys (stealing fruit), termites, mealy bugs, stem borers, irregular bearing and lack of marketing of rare varieties. In Jharkhand, the main problems are black tip, hailstorm, mango malformation and fruit drop. The major problems affecting of mango orchards in West Champaran were fruit borers. Mango malformation was found to be severe in *Jamui* of Bihar and *Lohardaga* of Jharkhand and severe labour scarcity for various agricultural operations were mentioned in both the states.

Farmers reported that traditional varieties show superior performance in terms of pest resistance, flood resistance and have better adaptation to the variable production environment. Farmers in the study area have a deep knowledge about the characteristics of the traditional varieties and their performance under different

environmental stresses. Apart from *Sukul* mango (most suited for pickle making in Bihar), *Lal Malda*, *Dudhia Malda* are also used for pickle making in Patna. *Jarda* and *Bombai* are main sucking varieties, *Malda* is the main table variety and *Sukul* and *Fazli* are pickle varieties (see Table 3 for unique traits of mango varieties).

There is need of grouping of various cultivars based on mopho-physio-bio-chemical and molecular characterization and screening for breeding for improvement of commercial cultivars. Some of the superior germplasm can be directly release as variety for the region. The existing unique variety maintained by growers must be assessed for quality parameters to harness for breeding purposes and export demand. Singh's *et al*. (2015) study revealed that great variability exists among different mango seedling progenies and this can be exploited for the selection of elite genotypes in the future after evaluating their performance.

National policy support in the form of establishing a network of custodian farmers and upgrading of skill (e.g. grafting, management of genetic resources) and registration of farmers' varieties will go a long way to ensuring conservation of mango diversity on sustainable basis (Gajanana *et al*., 2015). The yield from traditional varieties is low but farmers still continue to cultivate them, even as they adopt newer varieties. The main reason is that compared to modem varieties the yield from traditional varieties is reliable and prevents the risk of yield failure (Harwood, 1979). The traditional varieties can serve as important source of genes for developing improved varieties. Swaminathan (1998) emphasized the urgent need to encourage and strengthen (mango) field gene bank such as describe here that already can be found at the village level for *in-situ* on-farm conservation.

Conclusion

One of the strategies of conserving diversity, *on-farm*, is identification of custodians and extending support to them. These farmers have maintained the diversity without any formal support. The farmers also choose varieties for conservation depending upon the type of motivation. Furthermore, while all custodians maintain diversity, a good number of them (50-60%) also promote and adapt the diversity. A concerted action is needed to locate the most useful variation in the entire genepool, to collect and evaluate it efficiently, and to exploit the most useful diversity both by direct use as well as through hybridization.

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References

Bhag Mal, V Ramanatha Rao, RK Arora, Percy E Sajise and BR Sthapit (2011) Conservation and Sustainable Use of Tropical Fruit Species Diversity: Bioversity's Efforts in Asia, the Pacific and Oceania. *Indian J. Plant Genet. Resour.* **24**(1): 1-22.

Budathoki K (2003) Conservation and Use of Mango and Citrus Species Biodiversity in Nepal. Final Country Report for Nepal submitted to IPGRI under the ADB-funded project on Conservation and Use of Native Tropical Fruit Species Biodiversity in Asia. Nepal Agricultural Research Council, Kathmandu, Nepal. 90 p.

Gajanana TM, MR Dinesh, S Rajan, R Vasudeva, Sanjay Kumar Singh, Hugo AH Lamers, VA Parthasarathy, B Sthapit and V Ramanatha Rao (2015) Motivation for On-farm Conservation of Mango (*Mangifera indica*) Diversity in India: A Case Study. *Indian J. Plant Genet. Resour.* **28**(1): 1-6.

Harwood RR (1979) Small farmer development-Understanding and Improving farming systems in the humid tropics. Westview Press, Boulder, Colorado.

Singh, Sanjay Kumar, Awtar Singh, Vishal Nath, VA Parthasarathy, B Sthapit, S Rajan and S Vinoth (2015) Genetic Diversity in Seedling Populations of Mango. *Indian J. Plant Genet. Resour.* **28(**1): 123-131.

Sthapit B, R Vasudeva, VA Parthasarathy, S Rajan, Idha Widi Arsanti, Salma Idris, Songpol Somsri, Hugo AH Lamers and V Ramanatha Rao (2016) On-farm/*In situ* Conservation of Tropical Fruit Tree Diversity: Emerging Concepts and Practices. *Indian J. Plant Genet. Resour.* **29**(3): 285-288.

Sthapit B, Hugo AH Lamers and V Ramanatha Rao (2013) Custodian farmers of agricultural biodiversity: Selected Profiles from South and South East Asia. *In:* Proceedings of Workshop on Custodian Farmers of Agricultural Biodiversity, 11-12 February, 2013, New Delhi, India.

Sthapit B, R Vasudeva,VA Parthasarathy, S Rajan, Idha Widi Arsanti, Salma Idris, Songpol Somsri, Hugo AH Lamers and V Ramanatha Rao (2016) On-farm/*in situ* Conservation of Tropical Fruit Tree Diversity: Emerging Concepts and Practices. *Indian J. Plant Genet. Resour.* **29**(3): 285-288.

Swaminathan MS (1998) Government-Industry, Civil society partnerships in integrated gene management. *Indian J. Plant Genet. Resour.* **12**(3): 307-316.