Preserving diversity

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V I S I T any night market, fruit shop or supermarket and chances are you will find very few varieties of bananas being sold. For a crop that has been cultivated since ancient times in Malaysia (reputedly its place of origin), the lack of choice is surprising. A myriad of local species used to be available but not anymore. A random check at two hypermarkets revealed only two choices: the imported Cavendish and the local pisang kerang.

The future scenario appears bleak for our local banana cultivars, which are not only up against foreign competition — in the form of the hardy and unblemished Cavendish — but also against other more profitable and productive crops. The problem is not just confined to bananas. Other fruits like pineapples and mangoes, too, suffer from dwindling varieties.

As farmers focus on growing only the best breeds for maximum yield, the challenge lies in the hands of the Malaysian Agricultural Research And Development Institute (Mardi) to stimulate research and conservation work to sustain diversity of these crops, and to ensure that a wealth of genetic resources exist for breeding quality and high-performing varieties.

Mardi director-general Datuk Dr Sharif Haron acknowledged Malaysia as a centre of diversity for wild and cultivated bananas.

“We’ve been collecting cultivated bananas since the 1980s, with over 200 accessions (each unique specimen group) currently conserved in our field gene banks in Serdang, Selangor, and Jerangau, Terengganu.”

There are about 27,500ha planted with bananas throughout Malaysia, with average productivity being 10 tonnes per hectare. That said, banana isn’t a staple fruit for us, and is often plagued by diseases like the Panama fungus and Moko bacteria that stunt productivity. It may not necessarily be a good thing to have too many varieties in the market too, as supply would be a problem. What matters more is high yield.

Sharif says there are just two successful commercialised varieties so far. “Given the fact that there are a lot of banana germplasm in the country, there’s definitely potential for more varieties to be commercialised,” Mardi is currently developing them for the local market, though not so much for international release.

In Malaysia, banana varieties like berangan, mala, and Cavendish are used in cooking while nipah, nangka, tanduk and pisang awak are used in desserts. These edible cultivars are derived from two wild species, Musa acuminata Colla and Musa balbisiana Colla. (The Musa acuminata is reportedly the most variable species and progenitor of cultivated bananas.)

Sharif says the commercial success of Cavendish, which dominates supermarkets, has a lot to do with promotion. For a fruit to do well, he says it has to meet consumers’ expectations and acceptance — the fruit must not just look good but taste good.

Maintaining variety: Pisang Ilir is one of the many native banana species in Mardi’s germplasm collection in Jerangau, Terengganu. Photos: Mardi

Bananas, a crop that has been cultivated since ancient times in Malaysia, have dwindled down considerably when it comes to the myriad of species available in today’s marketplace.

Filep: “The fruit’s features are as important as the quality, which means that for us to be competitive, we need to research and extract value-added properties like possible medicinal values. After that, we look into the yield, and how easy it is to plant and harvest, before domesticating it and planting it commercially.”

At Mardi’s research centre, we use technology to screen for genes responsible for certain elements or quality, as well as for pest- and disease-resistant traits. We also have a seed unit that produces high-quality foundation seeds and planting materials for our research programmes.

The production sites are located at Mardi stations in Serdang, Simrok (Kedah), Kuala Kangsar (Perak), Jerangau (Terengganu), Kuala Selangor (Selangor) and Batu Pahat (Johor).

In the case of mangoes, the Department of Agriculture has registered 77 varieties and 200 clones to date, though only a few clones are popular for commercial planting — chokanam, harum manis, golen, maha, and mas muda. The common mango, Mangifera indica, is the only widely cultivated species, though there are several other lesser-known species like the Mangifera odorata (kuim), Mangifera tomentosa (bancang) and Mangifera coriacea (hiral).

An extensive 170 accessions of indigenous and exotic mango clones are kept as germplasm (seeds, tissue or plants, maintained for the purpose of breeding or preservation) in field gene banks in Mardi stations in Simrok, Kuala Lumpur, and Serdang. Additionally, some 100 accessions of the Indian species and 40 of the banana species are stored in Serdang. The best accessions have since been planted nationwide. Malaysia produces about 25,000 tonnes of mangoes from approximately 9,500ha of land; states like Perak, Perlis, Kedah, Malacca, and Sarawak are noted as top growing mango regions.

With the pineapple, Sharif says Mardi has a few hybrid species ready for market release next year. Two cultivars are now in the market, the Jaisapine and Maspine. “Most of our pineapple varieties are imported from the Philippines, with another two or three varieties from Sarawak.”

We have two main germplasm banks in Pontian and Kuah, Johor, for pineapple cultivation. The new varieties can only be released next year because it takes 15 months to ensure that there is sufficient planting materials (seedlings) for farmers to buy from us.”

Pineapples, too, are not spared from diseases, most notably the black rot that infect the stem. This, Sharif says, underscores the importance...
Hoping for a banana breakthrough

THE banana cultivation industry is plagued by various issues, ranging from the high-yield-destroying Fusarium wilt disease to lack of quality planting materials and the threat from floods and droughts. The practice of monocropping has also exposed the crop’s vulnerability to diseases, which emerge when plantation lands are not rotated.

Professor Dr Maziah Mahnood from Universiti Putra Malaysia’s biotechnology and biomolecular sciences faculty says developing disease-resistant and flood-tolerant banana varieties is critical to protect the industry.

"It's not easy to improve bananas genetically because they have no seeds and there's no way of doing cross-breeding. So, the only method is through tissue culture, and planting them thereafter in the field to observe how well they perform. I have a tissue culture lab where I cultivate mini banana plants from different species which I have collected from all over Peninsular Malaysia," says Maziah.

She also does lab-simulation studies for flood-tolerant bananas. Plants are left submerged in water to determine their survival rate, in order to identify stable species for use in field experiments.

"I'm now in the final stages of selecting the better ones and hopefully get them planted before year-end."

While native banana species can be found in rural villages, Maziah says these varieties are not suitable for large-scale planting as they grow very tall and big, and there is a lack of planting materials. She says farmers often lack knowledge on the optimal growth and yield of bananas.

"One important area is in the use of fertiliser. There isn't any formula currently on the ratio of nitrogen or phosphorus needed to better-grow the crop. Different kinds of banana cultivars may require different kinds of fertiliser. Right now, a common fertiliser feeds all. This can be disadvantageous as some cultivars may experience nutrient deficiency and hence, are unable to survive."

Maziah continues to collect new germplasm. Hopefully, the good varieties once tested, can be passed on to farmers for future cultivation. "One cultivar that I found has high potential is pisang raja but it's hard obtaining the planting material. As it is, bananas are cultivated from plantlets that grow around the mother plants but it’s difficult to determine the time when the flowers can be harvested," she says.

"If there is a threat of native varieties or species becoming extinct in view of farmers growing only a few commercial varieties? Maziah does not think so. "I'm all for promoting native species, especially the cooking cultivars as they are very nutritious. Even our own locals don't know enough about these species. While some native species may not be commercially viable due to the problem of insufficient planting materials, their diversity needs to be upheld as much as possible because we pride ourselves as the birthplace and centre of banana biodiversity."

"Bananas have potential to be a fruit security crop, which can be diversified into products like baby food. I've done a lot of cloning for diversity conservation. What we need are more researchers to keep the study on bananas always moving forward," he says. While bananas are consumed fresh mostly by the global audience, Malaysians prefer fried bananas which require specific quality in the fruit. This is why certain genetic traits from indigenous species may be helpful in our research and development towards producing varieties that meet our needs," he says.

Mardi is also collaborating with Bio-diversity International, working with local communities on on-farm conservation of local fruits. Six conservation sites have been established, which also help to boost the income of local farmers. The sites are in Buku Gantang in Penang, Malaysia, Sibu, and Jerudong in Sarawak, and Kota Belud and Papar in Sabah.

In Sarawak, rambutans and mangosteen are produced in orchards as part of in-situ (natural habitat) conservation while ex-situ (out of natural habitat) conservation is done in the form of seed gene banks and germplasm collections.

Germplasm banks, though costly to maintain and require large spaces, hence, technologies like in-vitro propagation and cryopreservation (in liquid nitrogen) may be key to conserving seeds that can survive when they are regenerates in future. However, some seed cannot survive freezing or drying, so they still have to be conserved as living collections in the field.

Mardi has allotted land in its various stations to conserve some 3,705 accessions, 168 species and 11,694 specimens of local fruits, with a special focus on under-utilized or rare fruits.

"It's our role to expand agrobiodiversity, which are key enablers for future crops. New varieties and crops are needed from time to time to complement the existing," says Sharif.

"Ultimately, conservation requires a solid, consolidated effort so that we don't waste resources, since labs are expensive to build. We have spent a lot on collecting, characterising, evaluating, conserving and documenting these fruits, as well as breeding and selecting them for market release."

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