Tropical fruit research and development programs of Indonesian Tropical Fruits Research Institute (ITFRI)

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Abstract. Indonesian Tropical Fruit Research Institute (ITFRI) is one of the research institutes under the Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture. The responsibility of ITFRI is to produce technologies for increasing competitiveness of tropical fruit agribusiness in the global market. The priority commodities handled are divided into main and potential commodities. The main commodities are banana, mango, mangosteen, and durian, while the potential commodities are papaya, snake fruit, watermelon, Cucumis melo, pineapple, and breadfruit. Research activities of ITFRI could be divided into three groups namely fruits breeding and genetic resources, ecophysiology, and plant protection. This paper will explain the role of ITFRI to support food security through fruit research and development activities.

Keywords: Fruits, Research, Collaboration, Molecular

1. Introduction

Indonesia is lying on the tropical area, between 6°N – 11°S of altitude, has a total of 253 million inhabitants. Agriculture is very important sector for Indonesian. It is not the only source of income for family, but also because of historically agriculture has been considered as a way of life of Indonesian people and it has been depicted by the agriculture sector (including forestry and fishery) that employed 35.09 % of the population in 2013 and account 23.44 % of GDP [1], while food, horticulture, estate crops and livestock contributed 77.07 % of GDP from Agricultural sectors.

In the development of agricultural sectors, the government place food crops as the first priority and followed by horticulture, estate crops, and livestock. However, food crop cultivation as a staple food has a purpose mainly on fulfilling the need of nation food, while the other such as horticulture, estate crops, and livestock have been expected for foreign earning through the exports.

Based on the domestic market absorption and the prospect of the export market, horticulture would one of the most promising sources of income for the farmers compare to food and estate crops. From the total 40 million ha suitable areas for agriculture, 64 % or 25.6 million ha have been utilized for rice field, estate crops, vegetables, fruits, and ornamental crops. Fruits either tropical or subtropical have been cultivated in Indonesia, but generally in small scale or even subsistence.

Fruit production in Indonesia is seasonal, grown mostly in individual family gardens, and sold mainly to local markets and big cities nearby. Only a small amount is exported to neighboring
countries, such as Singapore and Malaysia. Major fruit crops planted by farmers are banana, mango, citrus, and papaya.

Indonesian Tropical Fruit Research Institute (ITFRI) is one of the research institutes under the Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture. The responsibilities of ITFRI are to produce technologies for increasing competitiveness of tropical fruit agribusiness in the global market and supporting food security. This paper will explain the role of ITFRI to support food security through fruit research and development activities.

2. Materials and Method

Research and development activities of ITFRI are based on the Strategic Plans of tropical fruit crops [2]. In the Strategic Plan 2015-2019 fruit commodities handled are divided into two groups, *e.g.* main or priority fruit crops (mango, mangosteen, banana and durian) and potential fruit crops (papaya, snake fruit, watermelon, *Cucumis melo*, pineapple and breadfruit). However, based on the science research groups, research activities of ITFRI could be divided into three groups namely fruits breeding and genetic resources, ecophysiology, and plant protection. Depend on the commodity, each research activity consists of a combination of two or three research groups.

3. Results and Discussion

The main objectives of research activities of mango research are to produce the new cultivars and an efficient technology of mango cultivation to overcome the problems of water shortage, soil fertility and the development of pests and diseases. Mango breeding programme was started in 1999 to produce the new cultivar with the eating quality similar to Arumanis but with reddish of fruit peel colour [3]. A new hybrid mango cultivar has been released, namely AgriGardina 45, while other progenies are still under the evaluation [4]. The research activities to generate an efficient cultivation technology through the production of micron-sized fertilizer formula, and the utilization of organic materials that can retain water in the soil [5]. The use of microsatellite marker to discriminate mango cultivars has proved that Gadung 21 was different from Arumanis 143 [6]. Ten polygalacturonase genes have been isolated and characterized from six mango cultivars [7]. In addition to in-house research activities are also conducted the evaluation of improved mango cultivation technologies in the farmer's mango field in Cirebon [8].

The growth of mangosteen seedlings is very slow. The application of micorizza (AMF) can accelerate the growth of mangosteen seedlings up to 50% faster than control [9]. Jawal *et al.* [10] demonstrated the environmental condition that enriched with CO$_2$ also increased the growth of mangosteen seedlings. [11] Has proved the diversity among mangos teen cultivars by using RAPD and ISSR markers. She also found the difference of fruit performance of mangosteen from Tembilahan and Kamang [12]. Gamboge disease is a physiological disorder that can reduce production quality on mangosteen. The research activity to control gamboge disease was carried out through an efficient water management technology [13]. To control the scar on mangosteen fruit skin, [14] suggested to apply sanitation and the use of yellow fluorescence sticky trap. It can reduce the symptom of gamboge disease up to 50%.

Banana breeding programme aims to produce new banana cultivars that resistant to fusarium wilt. From the breeding activities started in 1999, we have obtained two candidates that resistant to fusarium wilt, namely INA-02 and INA-03 [14]. Banana explorations carried out in Sumatra, Java, Kalimantan, Maluku, and Papua have collected more than 200 accessions consist of wild and cultivated banana cultivars [15]. Sixteen RGAs have been isolated and characterized from two wild species and one banana cultivated, and those potential to be used as molecular markers for resistance against fusarium wilt [16]. In order to introduce and conserve local banana cultivars, on-farm conservation have been conducted from 2015 in 50 Kota regency. Since 2017, on farm conservation has also been conducted in Selayo, Solok regency with the main objective is to bring back Selayo as the centre production of Kepok (ABB) by introducing bud-less KepokTanjung.
Breeding programme of durian in ITFRI was started in 2010 by crossing of several durian cultivars to get resistant cultivar to Phytophthora disease and to increase the edible portion and quality of fruit [17]. From some crossing of durian parents, around hundreds progenies have been obtained and now are being evaluated on the field at Experimental Farms in Aripan West Sumatra and Subang West Java. SSR molecular markers linked to rind thickness and colour have been generated and being evaluated to young durian plants [18]. Currently, the technology package of durian cultivation are being applied in durian plants belong to farmer in Selayo and will be evaluated during fruit-bearing season next year.

From a series of breeding activities of papaya, a number of superior hybrids and lines have been obtained. One of the lines -released in 2014 has been planted by papaya growers, namely Merah Delima. This cultivar has been distributed to some provinces in Indonesia. Three hybrid cultivars of snake fruit from ITFRI resulted from breeding program in 1995 have been distributed to Bintan and have become the mascots of this region, and currently the plantation area is being expanded. New watermelon cultivar, Serif Saga, and other lines have been evaluated on the field belongs to the farmer in Sijunjung and Painan and let farmer to choose the best fruit quality.

4. Conclusion
A number of research collaborations have been conducted with national and international institutions. Collaboration with agricultural high schools and universities in providing the training to the students about the seed production and fruit crop cultivation technologies. Based on the MoU signed by the director of ICHORD and director of Centre of Remote Sensing ITB, the joint explorations between ITFRI and ITB teams were carried out in Bali and West Java. The collaborations with local governments in assisting the development of fruit crops with the purposes for both improving the welfare of farmers and developing tropical fruit agrotourism. International collaborations have been done with ACIAR, for supply chain management of banana and mango and mitigating the trait of banana wilt diseases. Other banana collaboration with Bioversity International on the cultivar selection to fusarium resistance, banana explorations, and on-farm conservation; and the use of wild tropical fruit for sustainable livelihood and ecosystem services. Current collaboration with the University of Queensland under the sponsor of Bill and Belinda Gates Foundation for mitigation the BBTV on banana.

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