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EVALUATION OF BREADFRUIT CULTIVAR 'MA'FALA' FOR COMMERCIAL PRODUCTION IN TRINIDAD AND TOBAGO

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ABSTRACT: One of the constraints to commercial breadfruit production in the Caribbean is the very limited genetic diversity of this introduced species. During the 1990s, 'Ma'afala', a common breadfruit cultivar in the Pacific, was introduced to Trinidad and Tobago by the University of the West Indies (UWI) and the former Ministry of Agriculture, Lands and Fisheries. 'Ma'afala' has been propagated and sold to homeowners and farmers by the Ministry. At the UWI, this cultivar has been evaluated for horticultural characteristics important to commercial production including propagation, tree height, time to bearing, seasonality, yield, fruit traits and susceptibility to disease. For purposes of utilisation, the nutrient composition and its suitability for flour production have also been evaluated. Information on on-farm performance was obtained through interviews with farmers. The results suggest that for commercial orchards, 'Ma'afala' compares favourably with the local cultivars, 'Yellow' and 'White', in terms of tree form and that it may extend the season of breadfruit availability. However, its susceptibility to tree decline and death, and certain fruit characteristics which are undesirable for processing and consumer acceptance in certain markets, can significantly limit its potential for commercial use in Trinidad and Tobago. However, the advantages offered by 'Ma'afala' justify additional research to address its limitations. This evaluation emphasises the importance of comprehensive cultivar evaluation before release for commercial production.

Introduction

Breadfruit (*Artocarpus altilis*) is an introduced crop which has been a part of the agricultural landscape of Trinidad and Tobago since the 19th century. The initial introduction to the Caribbean was to St. Vincent and Jamaica to provide relieve from chronic food shortages, but its adoption as a food source did not begin until the post-Emancipation era when it became an important mainstay in the diet particularly when other preferred foods, whether locally grown or imported were in short supply. While breadfruit became a highly appreciated crop especially in these two countries, in some others, including Trinidad and Tobago, its consumption was stigmatized as it was considered to be food for pigs or the very poor. Nevertheless, it can be found growing extensively, mainly in wet areas and has traditionally been planted on cocoa estates as a shade tree and also as food for the labourers.

Recent studies indicate that the negative attitudes to consumption in Trinidad and Tobago are changing with consumers across income groups expressing appreciation for breadfruit (Roberts-Nkrumah and Badrie, 2005). Furthermore, a recent survey among farmers showed that the crop had become a cash crop among 58% of farmers

who grew breadfruit and that prices were responsive to supply at different times of the year (Roberts-Nkrumah and Legall, 2013). However, the most significant indication of the recognition now being given to this crop is its inclusion in the Ministry of Food Production's National Agricultural Action Plan 2012 – 2015, as a staple that is targeted for increased production in the thrust towards food and nutrition security.

Like most countries outside of the Pacific, a major constraint to commercial production in Trinidad and Tobago is the limited germplasm base. An expanded germplasm is necessary to address several constraints to commercialisation. It is within this context that the evaluation of breadfruit cultivars for commercial production becomes relevant and the case of the cultivar, 'Ma'afala' provides the useful reference.

Ma'afala Description and Status

According to the Breadfruit Institute (www.ntbg.org) the tree of 'Ma'afala' breadfruit is relatively compact in habit since trees growing in the Pacific are described as being relatively shorter than most other common cultivars, but it is not a dwarf at this height. It fruits from July to December in Hawaii and there may be a minor season between January and May. The fruits are small and the cream to light yellow flesh is tender when cooked.

This cultivar occurs throughout the Pacific and very common in Samoa. Since 2007, the cultivar has been micro-propagated and distributed in efforts to alleviate hunger in several parts of the world including Central America, the Caribbean (Jamaica and Haiti) and Africa.

Ma'afala in Trinidad and Tobago

'Ma'afala' was introduced to Trinidad and Tobago at least since 1990 when a single cutting was brought in from the NTBG to establish the breadfruit germplasm collection at the University of the West Indies. The first tree was planted in 1992. Around that time the Ministry of Agriculture also acquired cuttings directly from the Pacific. From these introductions, 'Ma'afala' trees are now found at the UWI, the La Reunion propagation station of the Ministry of Food Production, farm holdings, the farm school at Kendall in Tobago and at the PCS Nitrogen breadfruit orchard.

Performance

Propagation

Like most other breadfruit cultivars, 'Ma'afala' is propagated vegetatively. The trees produce many suckers naturally. Due to this characteristic, this cultivar is easily propagated by the adventitious shoots that arise on root cuttings. Stem cuttings from the adventitious shoots are used to produce a large numbers of plants for sale at the Ministry of Food Production La Reunion nursery. The cultivar is offered for sale as a type of 'Yellow', and not by its name and is referred to by several farmers as a breadfruit

hybrid. Beside the adventitious shoots, 'Ma'afala' has also been propagated using layers and micro-propagation at the UWI. So far it has been the easiest cultivar to propagate using plant tissue culture techniques (Rouse-Miller, personal communication).

Growth and Development

'Ma'afala' trees are generally shorter than trees of the local 'Yellow' and 'White' of comparable age, therefore, some farmers refer to it as a dwarf breadfruit. Four and a half year old 'Ma'afala' and 'Yellow' trees grown in pure breadfruit stands at a spacing of 10 m x 10 m had a mean tree height of 2.7 and 3.8 m, respectively. Notably, the canopy height, of 'Ma'afala' was also lower which indicated that branching began earlier in this cultivar. 'Ma'afala' also produced more branches compared to 'Yellow', therefore, the former cultivar has a more compact and dense canopy.

Trees from adventitious shoots come into bearing can come into bearing in less than three years after field establishment if maintained in proper growing conditions of light, water and nutrition. Under the shaded conditions of a cocoa estate, where most farmers in Trinidad and Tobago grow breadfruit, the trees may remain juvenile for up to five years or more.

Seasonality: Like the other two traditional cultivars, bearing is seasonal in 'Ma'afala', with the major harvesting period extending from June to December, and an occasional minor season, from January to February depending on the duration of the major season.

Yield: Breadfruit tree yield varies with age, environmental conditions and management. With respect to age, four-year old trees of 'Yellow' and 'Ma'afala' growing at the University Field Station gave yields of 87 and 37 kg/tree, respectively, with differences due to both to lower fruit number (37 compared with 154 for 'Yellow') and fruit weight (1.0 compared with 1.8 kg). Notably, even at eight years old, 'Ma'afala', produced only 97 fruits/tree at this site. At another site, under more limiting soil conditions, pruned trees four year old trees of both cultivars responded differently, with 'Ma'afala' producing much more fruit than 'Yellow' (99 vs. 6/ tree) but 'Ma'afala' fruit size was unmarketable (0.5 kg) compared with that of 'Yellow' (1.3 kg). The higher fruit number in 'Ma'afala' was attributable to a much higher branch number in response to pruning.

Fruit characteristics: The mature fruit is oval in shape and with a bright green skin. Under good growing conditions the mean fruit length and diameter average 13 cm and 12 cm, respectively. The flesh is light yellow to yellow with a mean flesh thickness of 4.4 cm, and may contain 1 to 4 seeds. The fruits mature in 14 to 15 weeks.

Management

Water and nutrition management – Adequate water must be available for successful establishment and growth. Water must be available even for mature trees during the

dry season to avoid excessive stress and the resulting loss of foliage, delayed fruiting and a high percentage of fruit drop. The trees respond well to fertiliser application in soils low in N, P and K.

Pruning

The young trees require pruning to remove excess suckers and to maintain one plant per position. Pruning for height control can be quite effective on young trees since vertical regrowth is not as rapid as in pruned 'Yellow' trees. However, outgrowth of epicormic shoots is greater and further pruning is required to reduce crowding within the canopy.

Diseases – Of great concern is the susceptibility of this cultivar to early tree decline and eventual death. At the UFS, the average life of a tree over the period 1992 to 2011 was 4 to 5 years. The longest survival period has been 8 years. Several farmers reported that their trees died without bearing or after the first one or two bearings. One farmer reported losing all 40 plants that he had purchased before they bore fruit. This problem has caused farmers to become wary of purchasing plants of this cultivar and those interested in new or extend plantings have expressed preference for the traditional cultivars. Fruit rots, also occur on 'Ma'afala' fruits but have not been reported as a major problem. Even more important is that it has not been possible to assess the true yield potential in Trinidad and Tobago. Tree decline also occurs in 'Yellow' but it is usually associated with older trees especially these are grown in areas prone to waterlogging. The disease has also been attributed to the fungus, *Rosellinia* spp. (Weir et al 1982).

Harvesting

Fruits were easily harvested directly by hand or with a harvesting aid without the need for climbing. This was a function of the age and height of the trees.

Post-harvest handling – Fruit harvested at the green mature stage can be held at ambient temperatures for two days before they ripen.

Nutrient Composition and Utilisation

In terms of nutrient composition, studies at the UWI indicate no significant differences between 'Yellow' and 'Ma'afala' in the content of energy, carbohydrate, dietary fibre, crude protein and most micronutrients. Both 'Yellow' and 'Ma'afala' have been processed into flour. The estimated edible portion after removal of peel and core was similar for both cultivars, but in terms of the weight of the edible portion per fruit, values for 'Ma'afala' were as low as 50% of those for 'Yellow' due to lower fruit size.

Overall Evaluation

Strengths

'Ma'afala' has several desirable characteristics which recommend its use in commercial pure stand orchards. These include:

- availability of planting material either from adventitious shoots or from tissue culture
- shorter stature which facilitates application of pesticides, pruning and very importantly, harvesting. Therefore, it is suitable for pure stand cropping systems.
- early bearing will allow for early revenue generation
- production, suitability for different production systems e.g. pure stands at higher plant populations, height management, season of bearing, yield?

Weaknesses

'Ma'afala' has three main deficiencies that limit its use for commercial production. These are:

- low fruit size
- seededness which may increase if grown with chataigne; this characteristic with low fruit size make this cultivar unattractive to consumers who prefer larger fruits and undesirable for processing;
- high susceptibility of young trees to tree decline and death.

While the deficiencies may not necessarily be insurmountable, they indicate the need for research to address these issues in order to make use of the strong characteristics of this cultivar. It is very important to determine whether early tree death is due to pathogens, abiotic stress or both.

This evaluation of 'Ma'afala' has clearly been limited by the availability of data only for young trees because of the poor survival. It would also have benefitted from a survey of all farmers who planted this cultivar to determine exactly how widespread has been the problem of tree death, and where trees might have survived and performed well, the conditions under which this was achieved. However, given its performance under some of the best environmental and management conditions for breadfruit in Trinidad and Tobago and the complaints of numerous experienced farmers, the evaluation is valid in this context.

The experience of 'Ma'afala' performance in Trinidad and Tobago provides a very useful lesson on the importance of proper tree crop germplasm evaluation prior to release for commercial purposes under new conditions. It also highlights the need for collaborative research efforts for evaluation across multiple locations, improvement and improved technologies for cultivars with desirable characteristics.

Conclusion

'Ma'afala' does not appear to be a suitable candidate for commercial production in Trinidad and Tobago without further research effort to improve the fruit characteristics of size and tendency to produce seeds, and its susceptibility to tree decline and death.

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