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AGRONOMIC CONSTRAINTS TO PASSION FRUIT (*Passiflora edulis f. flavicarpa*) COMMERCIALISATION IN TRINIDAD AND TOBAGO

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ABSTRACT

Since the beginning of this decade there has been an interest in developing a passion fruit industry in Trinidad and Tobago (T&T) based on locally produced raw material. At present a few commercial ventures exist, but the scale of processing and related commercial activities, such as marketing, falls significantly short of what was originally envisaged. The major factor accounting for the slow «take-off» of this industry is raw material supply. This paper gives an account of the agronomic constraints encountered by passion fruit producers in T&T and describes the role of the University of the West Indies, Faculty of Agriculture, in addressing these problems. The collaborative efforts of the Caribbean Industrial Research Institute, other local research institutions and Government agencies to develop the industry are also discussed.

Keywords : Passion fruit ; industry ; raw material supply ; agronomic constraints ; Trinidad and Tobago.

RESUME

LES CONTRAINTES AGRONOMIQUES POUR LA COMMERCIALISATION DE LA GRENADILLE (*Passiflora edulis F.flavicarpa*) A TRINIDAD ET TOBAGO

Depuis le début de cette décennie, il y a intérêt pour développer une industrie de la grenadille (fruit de la passion) à Trinidad et Tobago à partir de la matière première produite localement.

Jusqu'à maintenant, il y a quelques entreprises commerciales mais l'échelle du traitement et les activités commerciales connexes sont en deçà des projets initiaux. Le principal facteur de ce lent «décollage» est la fourniture en matière première. Cette communication donne un bilan des contraintes agronomiques auxquelles sont confrontés les producteurs de grenadille à Trinidad et Tobago et décrit le rôle de la Faculté d'Agriculture de l'Université des West Indies dans l'approche de ces problèmes.

Les efforts de collaboration entre l'Institut Caraïbe de Recherche Industrielle (CARIBI), d'autres institutions locales de recherche et des agences gouvernementales pour développer cette industrie sont aussi discutés.

INTRODUCTION

At the beginning of this decade, Trinidad and Tobago (T&T) was importing \$21 M (TT) worth of juice annually, 85 % of which consisted of citrus juices and concentrates. Since one of the policy objectives set for the agricultural sector was self-sufficiency in food, in 1981, the Caribbean Industrial Research Institute (CARIRI) decided to promote the establishment of a passion fruit (*Passiflora edulis f. flavicarpa*) industry based on locally produced raw materials. The institution therefore, embarked on a product development programme, the first and major product being a passion fruit cordial which was expected to reduce juice imports by approximately 10 %. This product, which could be diluted into a drink, was chosen because it was felt that the flavour was refreshingly new and exciting, and that, based on back-yard performance, the crop appeared to have few pests and disease problems. This paper describes the collaborative approach developed to initiate the establishment of the passion fruit industry and documents the problems experienced with raw material production and the effects on the industry.

A COLLABORATIVE APPROACH

From the very inception of the passion fruit project, CARIRI recognised the importance of a reliable supply to the success of the agro-processing venture. A collaborative approach was forged between this institution and the agricultural division of Trinidad Tesoro Ltd (TTL) - now Trinidad and Tobago Petroleum Co. - which not only funded the product development activities, but also established a 0.9 ha (2 ac) passion fruit orchard to supply fruit for processing and to provide cost of production data. When TTL withdrew from the project two years later, considerable progress had already been made in developing a passion fruit cordial which was being test-marketed on a very limited scale. The response to the product was encouraging but due to crop management problems and consequent low supplies, estimates of commercial viability either at the production or at the processing end could not be derived.

Thereafter, CARIRI continued the project with internal funds and since 1985, the University of the West Indies (UWI), Faculty of Agriculture, has been a major collaborator. UWI is conducting research to improve the production technology for the crop under local conditions and also supplies fruits to CARIRI's processing plant. Caroni (1975) Ltd, which is now the largest producer in the country with 5.3 ha (13 ac) under cultivation, has also participated with the project since 1985. This company supplies fruit to the CARIRI plant and has assisted with cost of production data.

In 1986, CARIRI began processing passion fruit cordial on a commercial scale to demonstrate to entrepreneurs that the venture was financially viable. There are now at least four other processors of passion fruit cordial in T&T. In early 1988, the present Government began to advocate the establishment of several small-scale multi-fruit processing plants throughout the country, with 50 % of the throughput consisting of single strength passion fruit drink. The project is to be implemented later this year and the major supporting agencies for this thrust are the Ministry of

B RAW MATERIAL SUPPLY

The passion fruit types grown in T&T are mainly the yellow fruit which was first introduced around the mid-1960's and to a lesser extent, a light - purple type called «Martinique Pink» which was brought in from Martinique in 1978. According to Raj kumar (1987), the growth and fruiting of both types are similar, therefore, the «Martinique Pink», like the yellow type, is referred to as *P. edulis f. flavicarpa* . Generally, these types have vigorous, prolific vines which are higher yielding than the purple passion fruit, *P. edulis f. edulis* . This type performs best in sub-tropical climates or in upland tropical areas and is reported to have better flavour than the yellow type ; it is often consumed as a fresh fruit.

Despite the efforts made by CARIRI to ensure raw material supply, this factor has always been one of the major constraints to the development of the passion fruit industry in T&T. This section identifies the specific causes of low raw material supply encountered and discusses the effects on the industry.

FACTORS AFFECTING RAW MATERIAL SUPPLY

1. *Establishment Costs* - The establishment of trellises as supports for the passion fruit vines is recommended for commercial production (University of Hawaii, 1974). This practise allows not only increased leaf area display for higher yields, but also improves crop management by reducing the incidence of disease, by facilitating the application of pesticides and fertilisers, and by allowing ripe fruit to fall more easily to the ground for collection. The structures must be able to bear the weight of vines and fruit when the crop is at its peak and should last for at least 3 to 5 years which is the normal duration of the crop.

Estimates for establishing trellises on a 0.4 ha (1 ac) orchard range from \$7,000 to \$11,000 (TT). Untreated teak posts and heavy gauge wire are commonly used with varying degrees of success depending on the trellis design, spacing of the posts, presence of other supports between the posts and weight of the vines. Untreated posts can begin deteriorating by the second year, especially in wet areas, and annual replacement may be necessary. One grower is using concrete posts reinforced with 5/8" steel to minimise trellis maintenance and re-establishment costs. These costs are a major deterrent to some growers. At UWI and at Caroni (1975) Ltd different trellis designs are being examined to identify improved systems in terms of costs versus yields.

2. *Seasonal production* - The passion fruit crop has two major production periods in T&T, June to august which is the major season, and September to November. Gurnah and Gachanja (1984) found that while irrigation encourages year-round bearing in passion fruit, it does not eliminate the bi-modal production pattern. It is suggested that factors other than water availability, for example, daylength may also influence seasonality. These findings support the experiences

of a local grower who routinely irrigates the crop during dry periods and the generally observed earlier and heavier flowering and fruiting this year, which may be attributed to the high rainfall receipt during this year's dry season - 253 mm in contrast to the average 195 mm receipt for this period.

3. *Yields* - In Fiji and Hawaii, yields average 30 t/ha and 28 to 50 t/ha respectively, while in Latin America 20 t/ha are obtained. In T&T the highest yields obtained were 16 t/ha and based on reports from other growers here, in Jamaica and in Dominica it appears that low yields - less than 10 t/ha are a major feature of passion fruit performance in the Caribbean. The low yields obtained undoubtedly arise from insufficient information on the following factors :

a. *Varietal selection* - Unlike in Hawaii and Brazil where high-yielding, high-quality, cross-compatible seedling selections are being used, in T&T the relative yield potential of the existing selections is unknown.

b. *Pollination* - The yellow passion fruit is self-incompatible therefore, cross-pollination which is naturally effected by insects such as carpenter bees, honey bees and wasps, is necessary. Fruit set is usually low at 18 to 25 % (Whittaker, 1972). In Fiji, where hand-pollination is practised, fruit set is higher than 75 %. One grower in T&T has placed bee hives in his orchard and has reported good results. In spite of the heavy flowering mentioned previously and a good management programme at the UWI orchard, it is felt that yields this year will be lower than expected, because of a spray programme which has been instituted to control a serious pest problem.

Heavy rains, especially during the afternoon period, adversely affects pollination since pollen may wash off receptive flowers or may burst before germination (Whittaker, *op cit* ; Chandra, 1976).

c. *Crop Management* - The three agronomic practises being referred to here are spacing, fertiliser application and pruning. Gurnah and Gachanja (*op cit*) reported that higher purple passion fruit yields were obtained at narrower spacings and cited similar results from Brazil for yellow fruits. Disease incidence was higher, however, at the narrower spacings. The same authors reported that yield response to different levels of pruning was inconclusive but that in unpruned and severely pruned treatments, fruit weight and juice content were lower than in the lightly and selectively pruned treatments.

Practices vary widely among local growers. Spacing ranges from 3 m x 3 m to 4 m x 6 m and with respect to pruning one grower prunes every week while others may prune once or twice annually. Research is in progress at UWI on plant spacing, fertiliser application and pruning methods.

d. *Pests and diseases* - All commercial growers have been affected at some point during the life of the crop by pest and disease problems. Raj Kumar (*op cit*) identified caterpillars, mites, stink bugs and biting ants as major pests in T&T. A particularly severe and sudden attack of a hemispherical scale, so far unidentified,

but similar in appearance to the barnacle scale (*Ceroplastes cistudisformis*) (University of Hawaii, op cit). This is the first reported attack by this pest in T&T and so far only one other grower has reported being affected. The pest causes severe defoliation and a sooty mold on the leaves and stems is associated with the attack. Actellic and Malathion + Perfekthion are being applied alternately at weekly intervals but the problem is only barely under control.

Disease problems have been more common. There have been regular outbreaks of Brown Spot (*Alternaria spp.*), Anthracnose (*Colletotrichum spp*) and Septoria Leaf Spot (*Septoria spp.*). A collar rot problem at Caroni (1975) Ltd has had the most devastating results however; an entire 4 ha (10 ac) orchard declined over the last two years. This disease is also present in Hawaii and Fiji with *Phytophthora spp*, *Pythium spp* and *Rhizoctonia solani* as the causal organisms (University of Hawaii, op cit; Chandra, op cit).

e. **Harvesting** - only ripe passion fruits which have fallen are collected for processing since the cyanide content of such fruit is much lower than that of immature fruits on the vine (Gondwe, 1976). Fruit should be collected 1 to 2 days after falling but owing to the high cost of harvesting most growers collect fruit only once or twice weekly. Losses of 10 to 20 % due to moisture loss and disease have been reported.

f. **Physiological conditions** - In addition to the rainy dry season experienced earlier this year, there has been a noticeably slow onset of the rainy season. Two problems have occurred in the field which may be associated with this unusual weather pattern. Firstly, there is a premature fruit drop which is threatening to reduce both total and marketable yields. Mature but not fully ripe fruit still have the dried calyces attached; when such fruit are processed tiny, black particles appear in the end product thereby lowering its quality. Secondly, some immature fruits have been developing growth cracks which can serve as points of entry for pests and pathogens and these are therefore, a potential threat to marketable yields.

THE EFFECTS OF LOW RAW MATERIAL SUPPLY ON COMMERCIALISATION

Constraints during both the product development phase and the commercial phase of the passion fruit industry will be identified. The main effects of low raw material supply during product development were :

- a) Very limited test-marketing of the passion fruit cordial,
- b) delayed development of other passion fruit products,
- c) serious distortion of the results of the trials at UWI thereby delaying the recommendation of improved practices.

In the commercial phase problems included :

- a) low level of enthusiasm among entrepreneurs prior to the availability of loans from the ADB for growing and processing this crop. This might have been due to lack of awareness of the crop and its potential, or lack of capital. The uncertainties surrounding passion fruit production practises and yield have reportedly fostered a certain unwillingness by banks in Jamaica to fund ventures based on this crop.
- b) lack of comprehensive test-marketing,
- c) subsequent on b. the passion fruit cordial is promoted to a very limited extent. The major distributor expressed the view that the quantities of product available and its seasonality could not justify mounting a promotion campaign,
- d) the product is perceived as being high-priced in relation to the more traditional juices (Table 3). This notion does not take account of the instructions for diluting one part cordial with four parts water.

As a result of the foregoing local passion fruit processors have not been very successful in dispelling the dislike expressed by many Trinidadians for the passion fruit flavour.

Sales are generally slow. The highest level of acceptance is obtained in the hotel industry, certain restaurants and the more affluent residential areas, where consumers have recognised the versatility of the product and use it as a base for rum punch, in juice blends and as a topping for desserts.

CONCLUSIONS AND RECOMMENDATIONS

The passion fruit industry in T&T is obviously in its infancy and much work needs to be done before it becomes a viable industry. Recent developments in the citrus industry will not make this goal easy to achieve. Besides the on-going rehabilitation of existing orchards, citrus cultivation is expected to expand by some 1820 ha (4500 ac) mainly through the diversification efforts by Caroni (1975) Ltd.

There are encouraging signs however, including the growing numbers of growers and entrepreneurs entering the industry, for example the estimated area under production increased from 8 ha to 20 ha (20 ac to 50 ac) during the last year (Wilson, personal communication). Furthermore, although it may be unlikely that the passion fruit drinks will command a significant share of the local juice market in the foreseeable future, the prospects for export are promising. There has been a growing trade in passion fruit concentrate in Western Europe, North America and Japan. If local entrepreneurs are to penetrate foreign markets successfully, high quality raw material must be available in sufficiently high quantities. This therefore calls for continued and increased research on the crop geared to increased yields, lower costs of production and reduced risks, and higher raw material quality. More specifically the agronomic constraints identified in this paper must be minimised.

Ironically, research funds have now virtually disappeared. It is being suggested that future funding be sought from some of the larger participants in the industry and from

regional and extra regional agencies. Furthermore a more integrated approach to passion fruit research should be adopted at UWI and greater collaboration developed with other local research institutions. This will enhance the timeliness with which support is provided to producers and will maximise the use of the limited resources available.

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