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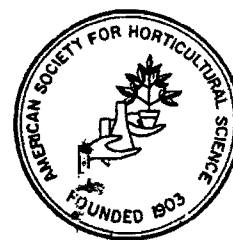
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POTENTIAL FOR HERBS AND SPICES PRODUCTION IN TRINIDAD & TOBAGO AND METHODS OF THEIR PROPAGATION

P. Bridgemohan and R. Griffith

Central Experiment Station, Centeno via Arima, P.O. Trinidad

ABSTRACT

The potential for herbs and spices production in Trinidad and Tobago is favourable on account of the climatic and soil conditions. At present there is a flourishing trade in manufactured packaged spices, but due to high cost of production and unavailability of suitable planting material, spice cultivation will be restricted to turmeric, ginger, peppers and now cardamoms. A review of the methods of propagation of a wide range of culinary, medicinal and perfumery herbs and spices is presented.

RESUMEN

Las posibilidades de producción de hierbas y especias en Trinidad y Tobago son favorables, debido a las condiciones del clima y del suelo. Existe actualmente un comercio floreciente de especias manufacturadas y envasadas, pero, debido a los altos costes de producción y la inasequibilidad de material de plantación adecuado, el cultivo de especias se restringirá a la curcuma longa, el jengibre, las pimentas y, últimamente, los cardamomos. Se resume los métodos de propagación de una serie de hierbas y especias usadas en la cocina, la medicina y la perfumería.

The status of herbs and spices production in Trinidad and Tobago

A report on "The economic study on production and marketing of spices*, essential oils, and oleoresins in Trinidad and Tobago," (I.T.C.**, 1980), stated that this country has little tradition in the growing or cultivation of spices, with the exception of ginger and hot peppers, which are grown by small farmers as vegetables for the local market.

Market demands are satisfied by imported spices which show imports of 667,244kg. at a value of \$2.75 million (T.T.\$) in 1980, and T.T. \$3.4 million in 1982. (C.S.O. Overseas Trade Reports 1976 – 1982). However, Trinidad and Tobago ranked fourth as the world's major exporter of nutmeg and mace for the period 1970 – 1974 (T.P.I.*** quarterly reports, 1973–1974). The decrease in spice production after 1975 has been part of the general decline in domestic agricultural production witnessed over the last ten years.

Potential for production of herbs and spices in Trinidad and Tobago

There appears to be a great potential for the exploitation of herbs and spices as economic crops in Trinidad and Tobago. This can be supported by the fact that much of the world's production is on tropical

islands, e.g. Jamaica, Grenada, Zanzibar, Sri-Lanka, Sarawak, Seychelles etc.

Most spice crops thrive best at low altitudes in hot climates, without a prolonged dry season. The annual rainfall should be in the vicinity of 2,000 – 2,500mm., and average temperatures around 28 – 30 °C. When planted on well drained soils with adequate supplies of humus, and where the natural vegetation is tropical rain-forest, they grow well (Purseglove, 1973).

Advantages of herbs and spices cultivation

1. The final product is often high in value and small in volume.
2. Although they are labour intensive crops, particularly in harvesting and processing, they are ideal for small holdings, utilizing family labour.
3. Cultivation of spices would broaden the range of crops grown at present, and thus lower the dependency on the traditional export crops as foreign exchange earners.
4. There is an increasing international market for herbs of medicinal and cosmetological value, that are grown locally, and which are used in folklore remedies e.g. Aloe (*Aloe-vera*) and Khus Khus (*Vetiver zizanoides*).
5. A number of spice crops also produce important essential oils and oleoresins that are important in the food, beverage, pharmaceutical, and perfumery and cosmetic industries e.g. bay (*Pimento racemoso*), nutmeg (*Myristica fragrans*) and pathchouly (*Pogostemon cablin*).

There is a growing awareness today of the value of renewable natural resources, and this has led to an increasing consideration of certain wild plants as

* There is no standard definition of the term 'Herb', and the distinction between herb and spice is an imprecise one (Greenhalgh, 1980). The American Spice Trade Association defines spice as 'a product of plant origin which is used primarily for the purpose of seasoning food', while reference is made of it to include herbs and aromatic seeds. Heath (1973) and Rosengenten (1973) described spices as being more highly aromatic and often containing large percentages of essential oils than herbs.

** International Trade Centre.

*** Tropical Products Institute.

potentially important food sources (Zennie and Ogzewella, 1977). Seaforth (1983), in discussing the suitability of certain under-utilized plants for processing and marketing for the Caribbean Region, reported several herbs and spice plants which remain relatively under-utilized – whether as foods or as medicinal agents. Yet several herbal preparations from outside the Caribbean area are becoming quite important as beverages, food additives, food supplements or “Health foods” for the local people.

Problems associated with the development of the spice industry

Compared to other economic crops, little agronomic research has been devoted to spices, and at present the standards of cultivation are often lower than for other crops. Very little work, if any, has been done on the selection and breeding of many of them, and the numbers of recognised cultivars are often limited (Purseglove 1973). This may be due to the fact that commercial production of spices is a jealously guarded secret, and hence the reason for little published research findings.

Although serious pests and diseases are comparatively rare, the major problems in cultivation are the dioecous nature of most of the crops, the long and delayed period before they come into bearing, and the irregular bearing patterns with a bumper crop only every few years (Purseglove, 1973).

The major reason for the decline of the spice industry in Trinidad and Tobago is due to the fact that the most of the tree crop spices were associated with cocoa and coffee plantations as shade or secondary crops. These include nutmeg, clove (*Syzygium aromaticum*) cinnamon (*Cinnamomum zeylanicum*), and tonka bean (*Coumarouna odorata*), as well as, rocou, anatou or ruku (*Bixa orellana* L.), which is used as a natural food colouring. When most of the cocoa plantations were left abandoned due to falling prices and increased labour cost during the ‘oil boom’, so were the spice crops.

In the past, most of the tree crops were propagated by seeds, which normally have short viability and are heterogenous. In recent times, methods of vegetative propagation of some of the tree crops have been worked out with limited success.

This paper attempts to review the present method of propagation of most of the spice crops with the intention that the shortage of suitable planting material be corrected, and the production of high yielding clonal material of the desired sex, eg. in nutmeg and pimento, be realised. Further, the possible use of micro-propagation and plant tissue culture for certain crops eg. ginger and black pepper, as a means of improving the genetic variability and the mass production of planting material is investigated.

Review of methods of propagation of herbs and spices

The major spice crops showing the greatest economic potential are black pepper (*Piper nigrum*), vanilla (*Vanilla fragrans* (Salisb) Ames. Syn; *V. plainfolia* Andrews), pimento (*Pimenta dioica* Mere.), clove (*Syzygium aromaticum* Syn. *Eugenia caryophyllus*), nutmeg (*Myristica fragrans* Houtt), cinnamon (*Cinnamomum zeylanicum*), bayleaf (*Pimenta racemosa*,

ginger (*Zingiber officinale* Rose), tumeric (*Curcuma domestica* Syn; *C. longa* Koenig non L.), cardomoms (*Elettaria cardomomum* Maton) and curry leaf (*Murraya koenigi* (L.) Spreng).

These particular spices are chosen as they are most commonly used, and are very well adapted to the local environment. Among the wide range of culinary herbs grown, chardon bene (*Eryngium foetidum*) has shown increasing acceptance and potential.

Propagation by seeds

Most of the major spices are propagated by seeds. However due to the problem of dioecism, as in nutmeg and pimento, it is difficult to distinguish between male and female trees until they come into bearing some 5 – 6 years or even later (Chapman 1965; Purseglove, 1981). As a result vegetative propagation has been developed.

Cloves are normally propagated from seeds of fully ripe fallen mother-of-cloves. Hulled seeds have been found to produce better seedlings than unhulled (Purseglove, 1981).

Cardomoms can be propagated by seeds. Seeds for sowing should be collected from ripe capsules, preferably from plants more than five years old (Purseglove, 1972). Seeds should be washed in water and sown immediately. Viability was found to last for not more than 9 days in storage (Purseglove, 1972). Germination is irregular and sprouting may continue even up to one year (Yegna Narayan Aiyer, 1944).

Seedling variability in black pepper has been reported to be wide and the plants may be dioecous (Purseglove, 1981). Vanilla is grown by seeds for breeding purposes using Knudson formula (1950), and hybridization and production from seed has been reported in Puerto Rico and Malagassy Republic (Purseglove, 1972).

All of the seasoning or culinary herbs are grown by seeds, including hot and seasoning peppers. These include; coriander (*Coriandrum sativum* L.), thyme (*Thymus vulgaris*), basil (*Ocimum basilicum*), parsley (*Petroselinum crispum*), celery (*Apium graveolens*), dill (*Anethum graveolens*), fennel (*Foeniculum vulgare*), fenugreek (*Trigonella foenum-graecum*), caraway (*Caruna carvi*), chardon bene (*Eryngium foetidum*), chives and shallots (*Allium schoenoprasum* and *A. cepa*), wildmint (*Hyptis atrorubens*) and peppers (*Capsicum annum* and *C. frutescens*).

In Trinidad only cloves and the seasoning herbs are propagated by seeds.

Budding and grafting

Vegetative propagation by budding and grafting has become more important where the problem of dioecism is prevalent as in pimento and nutmeg (Chapman, 1965).

Purseglove (1981) has referred to the work of Yegna Narayan Aiyer (1960) who has reported that temporary unions in cloves were achieved by grafting species of cloves (*Syzygium*) on to guava, (*Psidium guajava*), but there is no indication that this technique has been successful.

The success of tongue-approach grafts of twigs of clove species on to *Syzygium cumini* (L) Skeels (syn: *Eugenia cumini* (L) Druce; *E. Jambolana* Lamk) by Duformet and Rodriguez (1972) has been referred to by Purseglove (1981).

Cuttings

Commercial vanilla is usually propagated by stem cuttings (Purseglove, 1981). For black pepper, cuttings should be taken from the terminal branches, as those from the lateral branches are found to produce infertile plants (Singh, 1974). Purseglove (1981) reported that it was found that single leaf bud cuttings were superior to stem cuttings for black pepper, in respect of the percentage rooting, the number and length of roots, and the development of shoots (Choudhary and Phadnis, 1971).

Purseglove (1981) has referred to the findings of Fernie (1974) who had some success with terminal leafy soft wood cuttings for clove, and the rooting of cinnamon cuttings by the Department of Agriculture, Seychelles (1970).

Nichols and Pryde (1958) working in Trinidad, reported that nutmegs could be propagated by cuttings using semi-hard wood, treated initially with 0.5 percent IBA solution followed by a second treatment 8 weeks after, with root induction occurring in 4 months. Similar work in Grenada by Nichols and Cruickshank (1958) using an initial hormone treatment of 0.6 percent IBA, followed by a second treatment of 0.5 percent indicated that basal callusing took about 8 weeks. Propagation by cutting for nutmeg was based on a similar technique developed by Cheeseman and Spencer (1936).

Cruickshank (1973) reported unsuccessful trials made in Grenada in 1956 to shieldbud young nutmeg seedlings, but Nichols and Cruickshank (1964) had fair results in approach grafting. However, with the latter technique, fears have been expressed about stock-scion incompatibility. Also limited success has been obtained with side grafting.

Approach grafting will allow for the production of clonal material of known sex which are earlier bearing, especially for nutmeg and pimento.

Successful rooting of stem cuttings of pimento has been reported by Ward (1961), but the process is very labourious. Chapman (1965) reported a 30 percent success in budding, and 95 percent in approach grafting for pimento, although the latter method is more cumbersome. Pimento has been successful budded onto bay (*Pimento racemosa*) and vice versa (Purseglove 1981).

The Ministry of Agriculture and Forestry of Sarawak in 1969 bud-grafted cultivars of black pepper such as 'kuching' on to resistant stocks of Indian clones, especially 'Balacotta' which is relatively resistant to foot-rot but such grafts did not survive beyond the fruiting stage (Purseglove, 1981).

No propagation of spices by budding and grafting is done presently in Trinidad and Tobago.

Rhizomes

Cardomom, ginger and tumeric are propagated vegetatively by division of the rhizomes known as seed pieces or setts (Purseglove, 1972). For vegetative propagation of cardomoms, rhizomes from large clumps are divided into small units consisting of at least one old and one young shoot.

Vegetative propagation of tumeric requires that the rhizomes must have at least one or two buds. Purseglove (1981) reported that Aryadurai (1966) found that the mother rhizome performed better than daughter rhizomes for use as planting material.

Seeding rate for ginger was found to vary with the method of cultivation. Paulose (1973) reported

that in India using setts weighing 28 – 56g., the rate of planting was 1.2 – 1.4 tonnes ha⁻¹ Bendall and Daly (1966) and the Bureau of Agricultural Economics, Canberra (1971) using the same sett weight for ginger reported the rate of planting as 2.5 – 3.7 tonnes ha⁻¹.

Layering

The present method for vegetative propagation of nutmeg is marcotting or air-layering, a technique modified for marcotting *Theobroma cacao* by Nichols and Cruickshank (1964), using selected, healthy branches from mature bearing trees.

Purseglove (1981) reported successful vegetative propagation for black pepper and cinnamon through layering.

Root suckers/side shoots techniques

Curry leaf or kara pelay, which is normally propagated through seeds, extracted from fully ripe berries, can also be propagated by means of root suckers (Philip, 1981).

Similarly, chadon bene (Fitweed or culantro) multiplies by side shoots and seeds. Preliminary studies have shown that fresh seeds germinate between 21 – 30 days (Bridgemohan, 1983, unpublished).

Micro-propagation or tissue culture

The dormancy of buds in rhizomes of ginger and tumeric which limits propagation to once a year can be eliminated by clonal propagation *in-vitro*. Pillai (1982) reported that, using *in-vitro* culture, ginger plants could be raised without reference to seasons and dormancy period, and refers to success of rapid multiplication of tumeric plants using tissue culture by Nagauda *et al* (1978) and the clonal propagation of ginger through tissue culture by Hosoki *et al* (1977).

Vanilla can be grown by seeds, but is propagated by cuttings. Kononowicz and Janick (1984) reported that the multiplication of vanilla can be achieved by tissue culture, and successful establishment *ex-vitro* can be achieved. They have referred to the results of Cerra and Madizral (1981) who achieved shoot proliferation and rooting of vanilla, but establishment outside of the culture was not reported.

Research activities in spices at the Crop Research Division (Central Experiment Station) Centeno, Trinidad

The Central Experiment Station, guided by the I.T.C. report (1980) has initiated a programme for the development of spice cultivation in Trinidad and Tobago in three phases:

1. Establishment of a spice museum at C.E.S.
2. Implementation of a spice programme with the cocoa rehabilitation and re-forestation programme.
3. Establishment of a commercial model spice farm.

With respect to phase 1 a spice museum was set up in 1982, and maintains a germplasm collection of black pepper, cardomom, ginger, bayleaf, tumeric, vanilla, clove, cinnamon, and other indigenous spices,

eg. curry leaf and chadon bene. Also a plot of capsicum pepper (hot peppers), of which there are over eight different types, and small amounts of condiments like chives, celery, parsley, aniseed and coriander are grown.

Work with the re-forestation programme has been recently initiated using mainly black pepper and mauby. No commercial model spice farm has been established, but work on the systems of production for ginger and turmeric in soilless medium, intercropping and close spacing has been investigated. A cost of production for chadon bene has been worked out revealing a profit of TT\$7,000 ha⁻¹ (Bridgemohan, 1984).

Currently micro-propagation of black pepper is being studied at the University of the West Indies by Central Experimental Station personnel and the possibility of increasing the variability of ginger using tissue culture will be looked into. (Mohammed, 1985, personnel communication).

Conclusion

At present, climatic and soil conditions as well as level of technology in Trinidad and Tobago permit the cultivation of a number of herbs and spices in suitably selected regions. What is probably necessary is a definite strategy aimed at encouraging their production.

The demand for these commodities is increasing at about 6 – 10 percent per annum (Greenhalgh, 1979), with the demand coming from three areas, the food manufacturing sector, the institutional or food service sector, and the retail or household sector. It is projected that by 1990, this country may be importing close to TT\$4.0 million in spices, (see appendix 1).

If the present consumption trend continues one can envisage that we will be net importers of most of the spices and curry ingredients. This is due to a shortage of labour and available lands, unwillingness of farmers to take the risk of cultivating the crops, the lack of suitable planting material and the major problem of the non-acceptance of locally produced materials by the local processors.

This presentation attempted to review the present methods of propagation, and the potential use of micro-propagation to make available suitable planting material, and to stimulate intensive production of black pepper, ginger, cardamom, turmeric, and curry leaf on small holdings to meet local requirements, and finally the possible development of an export market.

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Appendix I

Annual importation of spices into Trinidad and Tobago

Year	Total value of spices imported (\$TT)
1976	1,352,632
1977	3,467,972
1978	2,279,641
1980	2,718,083
1981	2,993,010
1982	3,412,726

Value of spices imported (\$TT), 1976-1982

Spice	1976	1977	1978	1980	1981	1982
Ginger	28,976	31,960	61,390	55,808	59,626	65,000
Turmeric	274,944	814,493	433,114	245,369	342,741	214,000
Cardomon	167	-	5,991	31,237	37,182	26,000

Source: C.S.O. – Overseas Trade Bi-monthly Report – 1976–82.