# Baby corn development: Thailand


## ABSTRACT

Maize is adaptable, high-yielding and fast-growing. These characteristics make it suitable for wider production and use in the developing world. Thailand has achieved considerable success growing maize as an alternative to rice, demonstrating that the young cobs, or baby corn, can be used as a nutritious vegetable and an export crop.

Baby corn development in Thailand began in 1976 with the open-pollinated variety (OPV), followed in subsequent years by hybrids developed by both private and public sectors. In the past two decades, baby corn production has proved a remarkable success for farmers and the nation as a whole and has lessons for replication elsewhere.

Baby corn is the ear of maize plant (*Zea mays* L.) harvested young, especially before or just after the silks have emerged and no fertilization has taken place, depending on the cultivar. The de-husked ears can be eaten as a vegetable, whose delicate flavour and crispiness are much in demand in Thailand and abroad. Baby corn is free from pesticide and its nutritional value is comparable to cauliflower, cabbage, tomato, eggplant and cucumber. Its by-products, such as tassel, young husk, silk and green stalk, provide good cattle feed. Cattle manure can then be used, enabling organic recycling through the plant-animal chain.

Baby corn provides benefits to people from every walk of life. Farmers can grow four crops a year and production of baby corn generates employment among the rural poor of all ages. Brokers who buy from farmers, canneries, wholesale and retail merchants in Bangkok and exporters have already benefited from the crop in Thailand.

Baby corn for domestic and foreign consumption has become a significant contributor to the Thai economy. Thailand is today a world leader in the export of canned and fresh baby corn. In 1974, Thailand exported only 67 tonnes, worth 800 000 baht (US$38 095); by 1997, exports had risen to 59 585 tonnes, worth 1 598.4 million baht (**US$63.9** million), as shown in Table 1. Between 1988 and 1995, average quantity and value for export of fresh baby corn were 2 150 tonnes and 43.44 million baht (US$1.74 million), as shown in Table 2.


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47 **The silk-like filiform styles** of **unripe** maize.

TABLE 1
**Quantity and value of Thailand's exports of canned baby corn, 1974-97**

| Year | Quantity *(tonnes)* | Value *(million baht)* |
|---|---|---|
| 1974 | 67 | 0 8 |
| 1975 | 58 | 1 4 |
| 1976 | 235 | 3 6 |
| 1977 | 553 | 8.9 |
| 1978 | 489 | 9.5 |
| 1979 | *866* | 17.3 |
| 1980 | 917 | 21.4 |
| 1981 | 962 | 22.4 |
| 1982 | 1 496 | 36.6 |
| 1983 | 4 014 | 89.6 |
| 1984 | 4 468 | 101 1 |
| 1985 | 6 281 | 141 5 |
| 1986 | 11 317 | 230.6 |
| 1987 | 17 251 | 335.5 |
| 1988 | 25 616 | 489.9 |
| 1989 | 33 323 | 710 9 |
| 1990 | 26 795 | 536 8 |
| 1991 | 41 145 | 961 5 |
| 1992 | 36 766 | 826 2 |
| 1993 | 34 557 | 756 2 |
| 1994 | 46 187 | 963 7 |
| 1995 | 50 426 | 1 071.9 |
| 1996 | 46 638 | 1 085.3 |
| 1997 | 59 585 | 1598.4 |

**US$** 1 =Baht *25*
Source: Department of **Export** Promotion, **Ministry** of Commerce.

Development of baby corn as a nutritious crop for domestic and foreign use is an innovative example to other countries. Twenty years ago, people in Thailand and other developing countries considered maize and baby corn as grain for the poor or animal feed, rather than a vegetable for human consumption. Through a well-publicized research and development programme and training initiatives, Thai farmers and consumers were encouraged to sample baby corn and participate in production, preparation and use. Domestic markets for baby corn are continuing to grow and the number of farmers producing the crop is increasing.

The key to progress has been cooperation by the Thai government and involvement of researchers from the public and private sectors in an integrated approach. International agencies have provided breeding materials, support for research and human resources, making sustained development possible.

TABLE 2
**Quantity and value of Thailand's exports of fresh baby corn, 1988-95**

| Year | Quantity *(tonnes)* | Value *(million baht)* |
|---|---|---|
| 1988 | 2 220 | 38 *6* |
| 1989 | 1476 | 33 4 |
| 1990 | 1 785 | 43 5 |
| 1991 | 1666 | 41 1 |
| 1992 | 1929 | 47 9 |
| 1993 | 2 066 | 25.1 |
| 1994 | 2 522 | 36.7 |
| 1995 | 3 536 | 81.2 |

**US$** 1 = Baht *25*
Source: Department of Export Promotion, Ministry of Commerce

Extension at all levels has been essential. Lessons from the Thai'experience are being disseminated to neighbouring countries. In 1995, for example, the Food and Agriculture Organization of the United Nations (FAO) requested a leading Thai researcher to train scientists from 15 developing countries in the Asia-Pacific region in baby corn production.

## INTRODUCTION

In the past, no suitable variety of maize existed for use by the baby corn industry. Thai farmers were restricted to sweet corn and local varieties that were low-yielding and susceptible to downy mildew ***(Peronosclerospora sorghi).*** Since field corn varieties are more resistant to downy mildew and give better yields, they replaced sweet corn in most areas.

Thai researchers realized the importance of finding a baby *corn* variety suited to industrial requirements in order to increase farmers' incomes and started a baby corn breeding programme in 1976. There were initial problems:

- the existence of diverse germplasm sources for yield and quality;
- baby corn was a new crop;
- lack **of** awareness of the economic importance of the crop;
- crops were restricted to areas where irrigation water was available;
- resources for research and development were limited.

The objective was to breed a composite variety with high yield, yellow colour, good row arrangement, resistance to downy mildew and wide adaptation that would meet the specifications of the canning industry.

Between 1977 and 1981, 147 varieties were derived, tested and selected at experimental stations and in farmers' fields. Researchers were finally able to develop the Rangsit 1-OPV, a composite variety that met the objectives. This

was accepted in 1981 by the Committee for Varietal Recommendations of the Department of Agriculture.

The pedigree of Rangsit 1 is: (UPCA Var **1 x** Cup FC DMR (F) C2) **x** D475, where UPCA Var 1 is from the University of the Philippines, College of Agriculture, Cup FC DMR (F) C2 is Cupurico Flint Compuesto, Downy Mildew Resistance, Full-sib, Cycle 2 from the Thailand National Corn and Sorghum Programme and D 745 is from India.

The performance **of** Rangsit 1 was tested in 1979, 1980 and 1981 in four locations at experimental stations and on farms. Results demonstrated that average yield was 1 052 kg/ha, higher than the 650 kg/ha of Thai DMR. This led to Rangsit **1,** a good source of germplasm, becoming a leading baby corn variety in Thailand before the advent of the hybrid era.

## INTRODUCING INNOVATION

### Research and development on Rangsit 1-OPV

Breeding programmes using Rangsit 1 baby corn were run at Khon Kaen and Kasetsart universities. In 1983 at Khon Kaen University, the Vegetable Project of the Department of Plant Science in the Faculty of Agriculture used Rangsit 1 as the base population in the Material Line Selection method and named the progeny Rangsit 1-KKU. The research activities followed different cycles of selection and extracted lines to form another new population.

In 1986 at Kasetsart University, the Corn Breeding Project improved Rangsit 1 by dividing it into two populations, RS 1-KU1 and RS 1-KU2, by the **S** 1 Line Selection Method. Results indicated that when untreated for downy mildew with chemicals, RS1-KU1 and RS1-KU2 produced respectively 51 percent and 49 percent higher standard ear weight without husks than the original varieties.

Rangsit 1 is a good source of germplasm for inbred line extraction and baby corn hybrid production. An example is the new baby corn hybrid of Kasetsart University, Kasetsart Baby Corn Three-way Cross 3501, KBTX 3501. One of its inbred lines is Ki 39, which was extracted from Rangsit 1. The private sector has also used Ki 39 in breeding programmes.

### Research and development on hybrid baby corn

Some researchers suggested that hybrid corn was more suitable **for** future baby corn production because it produced ears of better quality and more uniform size. Since research related to improvement of yield and quality of baby corn in Thailand was limited, an important strategy for improvement was the use of heterosis from diverse breeding sources to make baby corn hybrids. A practical measure of heterosis for

baby corn is the percentage of yield and other agronomic characteristics of the hybrid or variety over the standard variety. Economic yield may be separated into three components: husk yield, young ear yield, and standard ear yield.

A number of lines and inbred lines were developed from different sources of germplasm. Several breeding systems have been employed in the development of new hybrids. Variety/hybrid testing has been carried out following the KU Corn Breeding Project procedure. In 1988, the Kasetsart University Baby Corn Three-way Cross 3501, KBTX 3501, was identified as a promising hybrid and evaluated in different locations. It produced the highest yield with and without husk and gave an attractive standard ear yield. In 1991, this hybrid was tested with other promising hybrids from the public and private sectors in five provinces, Kanchanaburi, Ratchaburi, Samut Sakhon, Pichit and Chiang Mai. Relative to average yields of fresh standard baby corn, with husk and de-husked, and the percentage of downy mildew infection in tests in the five provinces in 1991, KBTX 3501 provided a with-husk yield of 6 701 kg/ha and a de-husked yield of 1 044 kg/ha, higher than Suwan 2(S) C7, the check variety, by 147 percent. The average percentage of downy mildew infection in KBTX 3501 was 0.2 percent, the lowest among the varieties in the trials.

It is clear that KBTX 3501 should be recommended throughout the baby corn growing area. KBTX 3501 was developed from the inbred lines of the Corn Breeding Project of Kasetsart University, Ki 20, Ki 39 and Ki 40. Its pedigree is (Ki 39 x Ki 20) x Ki 40.

Other promising baby corn hybrids, which were released to the public later on, are: SW2(S)C7-F3-S6-28 x Ki 28, (Ki 21 x SW2(S)C7-F2-S6-28) x Ki 28, and (SW2(S)C7-F2-S6-28 x Ki 28) x (SW2(S)C7-F2-S6-146 x RSl(H)S4-288). These single-cross, three-way-cross and double-cross hybrids produced standard young ear yields of 1 237, 887 and 706 kg/ha, respectively 354 percent, 418 percent and 332 percent more than Suwan 2(S)C7, the check variety.

### Transfer of baby corn technology

About 20 years ago, the idea of producing and consuming corn as a vegetable was new to most Thais. As in most developing countries, corn was seen as grain for the poor or animal feed. Baby corn production needed a higher investment in terms of inputs and labour than Thai farmers were used to providing for maize.

A public relations campaign was launched to promote the image and benefits of baby corn through newspaper and magazine articles, radio and television broadcasts and advertising. Interest was awakened in the baby corn industry, with consumers and farmers motivated to sample baby corn products and become involved in production, preparation and consumption.

TABLE 3
**Economics of babv corn production, 1988-89 *fUS$/ha)***

| Item | Irrigated | Non-irrigated |
|---|---|---|
| **Variable Costs** | | |
| **Labour** | | |
| Soil preparation | 49 95 | 41 90 |
| Planting and de-tasselling | 18 50 | 22 20 |
| Weed control | 19 62 | 13 50 |
| Fertilizer application | 13 87 | 5.60 |
| Herbicide spraying | 12 50 | 3.75 |
| Water supply | 30 62 | 0 00 |
| Harvesting | 54 02 | 41 04 |
| **Materials** | | |
| Seed | 32.07 | 18.96 |
| Manure | | |
| Chemical fertilizer | 128.32 | 17.53 |
| Herbicide | 12.18 | 1.82 |
| Others | 28.81 | 11.19 |
| **Other costs** | | |
| Upkeep of equipment | 4 60 | 2 11 |
| Loan interest and opportunity cost | 10 05 | 5 14 |
| **Total variable cost** | 420.88 | 189.05 |
| **Fixed Costs** | | |
| Farm rental | 17 25 | 12 25 |
| Farm equipment depreciation | 10 07 | 3 94 |
| **Total Fixed Cost** | 27.32 | 16.19 |
| **Total Costha** | 448.20 | 205.24 |
| **Yield (kg/ha)** | 8 100 00 | 3 243 75 |
| **Total Income/ha (Price/kg=US$.O87)** | 704.70 | 282.21 |
| **Profit/ha** | 256 50 | 76 97 |

Source: Office of Agricultural Economics, **1993.**

Baby corn fairs, workshops and exhibitions were held across the country to spread the message, with cooking demonstrations and hands-on training by government and private-sector home economists.

Farmers were alerted to the fact that producing corn offered a profitable alternative to rice (see Table **3).** They were taken to research and demonstration plots and visited model farms. This was followed by hands-on training for each step of production, from land preparation to harvest, conducted by government and private-sector extension agents.

The public relations and education campaign has successfully fostered sustained growth **of** the baby corn industry in Thailand. Domestic markets continue to expand and the number of farmers producing baby corn is still increasing.

## POST-INNOVATION

The success of baby corn development in Thailand has depended upon various factors:

- Thai government policies have facilitated spectacular growth of the Thai economy and the food processing industry in particular. Cooperation between the government and the baby corn industry in extensive public relations has spread the message about baby corn.
- Collaboration with FAO, the International Maize and Wheat Improvement Centre, the Japanese International Cooperation Agency, the Rockefeller Foundation and the United States Agency for International Development (USAID), has resulted in provision of breeding materials, research support and human resource development.
- New sources of germplasm have been introduced. Appropriate germplasm and breeding methods have been applied to evolve suitable varieties and hybrids and develop production and processing techniques. This has involved sustained cooperation among researchers and development officials for testing technologies.
- Progress in establishing baby corn research and development has been fostered by transferring technology through public awareness campaigns.

## LESSONS LEARNED

The experience of Thailand has lessons for other Asia-Pacific countries. A number of steps, however, will be required to achieve wider and improved application of the technology.

For long-term development of the baby corn industry in the region, research and development must be integrated through inter-disciplinary approaches. Cooperation by the public and private sectors is crucial. Concerted efforts are desirable and should address the following areas:

### Breeding and seed production

Cultivars should be hybrids, preferably single-cross, giving high yields of uniform, good quality ears that meet canning industry specifications. They should mature early and be prolific and adaptable to a variety of conditions. Certified seeds of these hybrids should be made available to farmers in sufficient quantities.

### Soil and water management

To obtain high yield and good quality, attention must be paid to the interplay between variety and soil fertility. Efficient water management is required.

### Plant protection and residual effects of pesticides

Since resistant varieties require practically no application of pesticides, thus eliminating residue and minimizing production costs, resistant hybrids should be promoted in the future.

### Mechanization

The baby corn industry requires intensive labour for harvesting and de-husking. Since labour costs are increasing, mechanization must be promoted in future.

### Post-harvest management

Baby corn has husks to protect the young ear but freshness can only be maintained for a limited period. Information on maintaining good quality for export in the fresh form or for processing in canneries should be made available. Research would have to be intensified.

### Processing

Product quality reflects on the reputations of the cannery and the exporting country. Rigorous quality control is needed to ensure that international standards are met. Further efforts in this field would be helpful in promoting the industry in the region.

### *Extension*

It takes time for results of research and development to be transferred, from the farmer who produces the raw materials to the canneries where the finished product is processed for the consumer who eventually prepares and eats it. Concerted efforts in this direction are critical for the future. In this context, FAO in 1995 requested a researcher to train scientists from 15 developing countries in the Asia-Pacific region in baby corn production.

### Pricing and marketing

Baby corn should be reasonably priced and free to flow from farm-gate markets to regional, central and destination markets in and outside the country. Pricing and procurement policies in countries promoting baby corn will determine the success of new ventures.

### Human resource development

Corn will remain one of the most important field crops in developing countries. Young people in this business will be able to make a contribution to society. Governments should therefore concentrate on development of young farmers,

researchers, extension agents, cannery managers and others in the private sector to find ways to sustain the baby corn industry. Policies for human resource development would assist adoption of such innovative policies.

### Regional cooperation

National efforts need to be complemented by regional cooperation through activities such as:

- exchange of information and germplasm;
- regional testing of selected hybrids and varieties;
- meetings and visits;
- human resource development and training;
- collaborative efforts for research and development;
- motivating policy makers to adopt baby corn production and processing technology.

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