

**CASSAVA BREEDING AND VARIETAL DISSEMINATION
IN THAILAND - MAJOR ACHIEVEMENTS
DURING THE PAST 25 YEARS**

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ABSTRACT

The cassava breeding program in Thailand started with the hybridization of local clones, followed by selection, at the Rayong Field Crops Research Center in 1975, and at Sri Racha Research Station of Kasetsart University in 1983. During this initial period of recombining genes available from a narrow genetic base, progress in yield improvement was limited. In 1983, CIAT established its Asian Regional Program in Thailand. CIAT's role in Thailand has been mainly to supply cassava germplasm from Latin America to this country, in order to increase the genetic variability of parental lines and to help develop an efficient and highly effective scheme of hybridization and continuous selection of this germplasm. The Thai germplasm collection also included earlier introductions from the Virgin Islands and Indonesia. This collaborative effort resulted in the official release of six new cassava cultivars during the period 1983-1993: four from the Department of Agriculture (DOA) and two from Kasetsart University. These new cultivars are characterized by high yield capacity, high harvest index, high root starch content and early harvestability. In 1999, DOA released a new cultivar specifically for planting in the northeastern part of the country; it was named Rayong 72.

Regarding varietal dissemination, in 1994 the government established a special program for the rapid multiplication of new recommended cassava cultivars to replace the local cultivar, Rayong 1. This program involved the cooperation of DOA and Kasetsart University for supplying basic planting material, as well as the Department of Agricultural Extension and the Thai Tapioca Development Institute for multiplication and distribution of this material. The success achieved by this program can be gauged by the fact that by 1997 about 64% of the cassava area in Thailand was planted to the new recommended cultivars.

INTRODUCTION

During the past two decades cassava has been one of the most important cash crops in Thailand, occupying a total area ranging from 1.23 to 1.62 million hectares, and producing annually approximately 16-24 million tonnes of fresh roots (Office of Agricultural Economics (1996). The variation in production is almost entirely due to changes in planted area. Minor fluctuations from year to year are mainly caused by price variations, which in turn are due to the world market situation, especially in the European Common Market.

As a major part of cassava exports is destined for the European Union (EU), it is inevitable that any change in agricultural policy in the EU will have a significant impact on Thailand's cassava policy. In 1992, the EU decided to lower its support price for cereals by as much as 30% within the following three years, beginning in late 1993. This has undoubtedly contributed to a significant reduction in the price of Thai cassava.

In response, the Thai government established a policy to reduce the cassava planted area from 1.5 million ha to 1.28 million ha by encouraging farmers to replace cassava with

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fruit trees, fast-growing timber species, pastures and livestock. In addition, the Thai government policy also aimed at increasing cassava productivity by promoting the use of improved cultivars from the cassava breeding program to replace the traditional cultivar, Rayong 1. The Department of Agriculture (DOA) and the Department of Agricultural Extension (DOAE) of the Ministry of Agriculture and Cooperatives initiated a five-year project, starting in 1992, to rapidly multiply stakes of the improved cultivars and to distribute these to the farmers. The Thai Tapioca Development Institute has also helped to implement this project. Since 1997, the adoption rate of new cassava cultivars has increased dramatically.

EARLY PERIOD OF CASSAVA BREEDING

Before the Second World War, cassava was cultivated mainly in the southern part of Thailand, especially in Songkhla province, for use in the production of starch and sago. In those days, an attempt was made to introduce new cassava clones for selection. Komkrid (1939) reported that three clones from the Philippines and 17 from Malaya (now, Malaysia) were introduced for selection at the Southern Field Crops Station in Songkhla (currently, the Songkhla Rubber Research Center). During that period, two cassava cultivars, Local 1 and Local 2, were used for industrial purposes. No further information, however, was reported on these introductions.

As time progressed, the cassava area gradually moved to the eastern part of the country, especially to Chonburi and Rayong provinces. In 1949, 16,000 ha of cassava were planted in Chonburi, according to reports in Agricultural Statistics of Thailand (1955). Since its establishment in 1954, cassava research has been conducted mainly by the Rayong Field Crops Research Center (RFCRC) of DOA.

Early work at RFCRC, from 1956 to 1961, was concerned mainly with local cultivar collections and clonal selection. One of the local clones was officially named Rayong 1 in 1975 (Sinthuprama, 1983). Rayong 1 has by far been the most successful cultivar in Thailand, and until recently accounted for more than 89% of the cassava planted area.

From the 1960s to 1977, about 86 clones (**Table 1**) were introduced from Indonesia, Virgin Islands and from CIAT, Colombia, and were evaluated at RFCRC; however, none of these clones was found to be superior to Rayong 1.

Table 1. Introductions of cassava germplasm into Thailand through the Department of Agriculture (up to 1977).

Year	No. of genotypes introduced	Origin
Before 1960	About 20 accessions	Malaya, Java
1963	7 cultivars	Java
1965	44 clones	Virgin Islands
1970	5 accessions	CIAT
1977	10 hybrid clones	CIAT

Source: Field Crops Research Institute, Department of Agriculture.

THE THAI BREEDING PROGRAM IN COOPERATION WITH CIAT

Thailand started the cassava breeding program in earnest with hybridizations of local cultivars, followed by selection, at RFCRC in 1975, as well as at Sri Racha Research Station of Kasetsart University (KU) in 1983. During this initial period of recombining genes available from a narrow locally available genetic base, progress in yield improvement was slow.

Since the establishment of the CIAT Cassava Asian Regional Program in Thailand in 1983, cooperation with Asian national programs, particularly the Thai program, has been greatly enhanced. CIAT's activities contributed to the establishment and improvement of national cassava research programs in many Asian countries. CIAT's role has been mainly to transfer cassava germplasm from Latin America to Asia, in order to increase the genetic variability of parental lines, and to help develop an efficient and highly effective scheme of hybridization and continuous selection of this germplasm. The main objective of the Thai-CIAT cooperation is to improve root yield and starch content in order to satisfy the needs of the farmers and of the processing industry. It was suggested by Kawano *et al.* (1990) and Rojanaridpiched *et al.* (1998) that cassava yield should be improved through the simultaneous improvement of total biomass and harvest index. Aside from these traits, the following characteristics are also our breeding and selection criteria:

- early harvestability
- good plant type (tall and no- or little-branching)
- good stake quality (germination and storage duration)
- good root shape with white flesh
- tolerant to major pests and diseases

MAJOR ACHIEVEMENTS DURING 1975-1999

From 1975-1999, the cassava breeding program, started by DOA at RFCRC in 1975 and by KU at Sri Racha Research Station in 1983, involving Thai-CIAT cooperation, released eight new cultivars, all for industrial use. The background and outstanding characteristics of these cultivars are given in **Table 2**. In addition, a variety suitable for human consumption, called Rayong 2, was released in 1984. This variety, however, was never widely planted as the use of cassava for human consumption is almost negligible in Thailand.

RECENT PROGRESS

In 1999, DOA released its most recent industrial cultivar, named Rayong 72, suitable for planting in the northeastern regions of Thailand.

Rayong 72, previously identified as CMR 33-57-81, was obtained from a cross between Rayong 1 and Rayong 5 made in 1990 at RFCRC. This cultivar has now officially been released by DOA, following the completion of all regulations for the certification of a new cultivar.

Rayong 72 is capable of both high fresh root yield and dry matter yield, it is easy to harvest due to its good root shape and root formation, and has good germination and drought tolerance. However, Rayong 72, when planted in the eastern region has a relatively lower dry matter content than when grown in the northeast. Thus, Rayong 72 is

Table 2. Background and outstanding characteristics of seven released cultivars in Thailand (including Rayong 1).

Cultivar	Year of release	Parents	Background and outstanding characteristics
Rayong 1	1975	Unknown	Selected from a local land race. Excellent agronomic traits. Relatively high yield. Moderately resistant to major pests and diseases. Well-adapted to low inputs.
Rayong 3	1983	(F) MMex 55 (M) MVen 307	Selected from CIAT F ₁ hybrid seeds. High dry matter content.
Rayong 2	1984	(F) MCol 113 (M) MCol 22	Selected from CIAT F ₁ hybrid seeds. Recommended for human consumption. Relatively high yield and carotene and Vitamin A contents. Low in HCN.
Rayong 60	1987	(F) MCol 1684 (M) Rayong 1	Selected from CIAT F ₁ hybrid seeds. High fresh yield. Recommended for early harvest. Excellent agronomic traits.
Sriracha 1	1991	(F) MCol 113 x MCol 22 (M) Rayong 1	Selected from KU F ₁ hybrid seeds. Excellent agronomic traits. High dry matter content.
Rayong 90	1991	(F) CMC76 (M) V43	Selected from DOA F ₁ hybrid seeds. High dry matter content. Relatively high yield.
Kasetsart 50	1992	(F) Rayong 1 (M) Rayong 90	Selected from KU F ₁ hybrid seeds. High yield and high dry matter content. Well-adapted to unfavorable conditions.
Rayong 5	1994	(F) MR27-77-10 (M) Rayong 3	Selected from DOA F ₁ hybrid seeds. High dry matter content. Relatively high yield.
Rayong 72	1999	(F) Rayong 1 (M) Rayong 5	Selected from DOA F ₁ hybrid seeds. Relatively high dry matter content, high fresh yield. Good germination and drought tolerant. Especially adapted to northeast Thailand.

Note: (F) = female, (M) = male parental line.

Source: Adapted from Limsila et al., 1998.

now specifically recommended to be planted in the northeastern part of the country. **Table 3**, showing data compiled from 48 trials in the northeast, indicates that Rayong 72 had a fresh root yield that was 25, 21, 31 and 18% higher than that of Rayong 1, Rayong 5, Rayong 90 and Kasetsart 50, respectively; its dry matter yield was also 30, 19, 28 and 16% higher, respectively, than those of these same varieties. However, the dry matter content of Rayong 72 is similar to those of all the other cultivars, but slightly higher than that of Rayong 1.

Table 3. Agronomic traits of Rayong 72 compared to four recommended cultivars in the northeastern region of Thailand (data from 48 trials conducted from 1993-1998).

Cultivar	Root yield (t/ha)		Dry matter content (%)
	Fresh	Dry	
Rayong 72	34.69 (100)*	11.94 (100)	34.3
Rayong 1	25.88 (75)	8.38 (70)	32.3
Rayong 5	27.50 (79)	9.62 (81)	34.7
Rayong 90	23.94 (69)	8.56 (72)	35.5
Kasetsart 50	28.38 (82)	10.06 (84)	35.3

*Figures in brackets are percentages

Source: Field Crops Research Institute, Department of Agriculture.

VARIETAL DISSEMINATION

Since the release of new cultivars for industrial use, namely Rayong 3, Rayong 60, Rayong 90, Kasetsart 50 and Rayong 5 from 1983 to 1994, DOAE has had projects for multiplication and distribution of stakes of these cultivars to farmers, with the aim of increasing cassava yields. Klakhaeng *et al.* (1995) estimated that the area planted to Rayong 3 in 1993/94 was 108,000 ha or about 7.3% of the total cassava area. Subsequently, Rojanaridpiched *et al.* (1998) reported that there were two major programs for cassava multiplication and distribution to the farmers, with the following objectives: "To increase the potential of cassava production" by DOAE, and "To reduce costs in cassava production" by the Thai Tapioca Development Institute. These two programs succeeded in increasing the cassava area planted to the new cultivars in 1994/95 to 28%.

The rapid expansion of cultivated area occupied by the new cultivars is not only a consequence of those two programs, but also partly due to the farmers' own efforts. Thus, by 1997/98, the area planted to new cultivars was increased to about 56% and in 1999/00 to 81% of the total planted area (**Table 4**).

In 1999/00 only about 20% of the total area was still planted with local varieties, basically Rayong 1, while 32% was planted to Kasetsart 50, 18% each to Rayong 90 and Rayong 60, and 10% to Rayong 5. Rayong 3 and Sri Racha 1 have almost disappeared, while the two eating varieties, Rayong 2 and Hanatee, are planted only in very small areas, mainly for the preparation of some special snack foods.

Table 5. Spread of new cassava varieties in Thailand from 1989/90 to 1999/00.

Variety	Area (ha)						% in 1999/00
	1989/90	1991/92	1994/95	1995/96	1997/98	1999/00	
Local variety ¹⁾	1,470,382	1,400,256	949,204	840,253	416,113	146,297	12.7
Rayong 3	17,158	50,283	135,421	14,953	NA	27,004	2.3
Rayong 60	-	-	125,049	207,589	206,057	216,897	18.8
Rayong 90	-	-	35,461	81,049	143,055	220,926	19.2
Kasetsart 50	-	-	322	17,846	149,270	410,852	35.7
Sri Racha 1	-	-	NA	NA	NA	4,125	0.4
Rayong 5	-	-	NA	66,424	129,594	125,823	10.9
Total new varieties	17,158	50,283	296,253	387,861	627,976	1,005,627	87.3
Total cassava area	1,487,540	1,450,539	1,245,457	1,228,114	1,044,089	1,151,924	
% with new varieties	1.1	3.5	23.8	31.6	60.1	87.3	

¹⁾ >90% Rayong 1

Source: Klakhaeng et al., 1995; Rojanaridpiched et al., 1998; Office of Agric. Economics, 2000.

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