

THE PRESENT SITUATION OF CABBAGE BREEDING IN BRAZIL

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ABSTRACT

Heading cabbage (*Brassica oleracea* L. var. *capitata*) is one of the most important vegetable crops grown in Brazil. The country imports annually nearly 20 tons of cabbage seeds. However, imported cultivars are very susceptible to black rot (*Xanthomonas campestris* pv. *campestris*). Recently, both private and public research teams have promoted the development of breeding populations and hybrid cultivars of summer cabbage with good resistance to black rot and good commercial characteristics.

Cabbage production in Brazil

Heading cabbage (*B. oleracea* L. var. *capitata*) is one of the most important vegetable crops grown in Brazil with an annual production of 263,647 tons (Ministério da Agricultura, 1988). Cabbage is primarily produced in São Paulo, Minas Gerais, Rio de Janeiro and Paraná. However, the major production and consumption area of cabbage is in the state of São Paulo where, in 1988, a total of 84,179 tons of fresh cabbage were commercialized (Secretaria do Abastecimento-SP, 1988).

The country imports each year nearly 20 tons of cabbage seeds mainly from Japan (Guedes *et al.*, 1988). Japanese cabbage hybrids are very well adapted to our winter conditions and Matsukaze (Sakata Seed Company) is the most cultivated hybrid. However, during the hot rainy season Japanese hybrids are severely affected with black rot (*Xanthomonas campestris* pv. *campestris*). Consequently, during this period the cabbage prices are normally high.

Recently, both public and private research teams have promoted the development of cabbage populations and hybrids with good commercial characteristics and black rot resistance. As a result of such efforts open-pollinated cultivars like "União" (EMBRAPA-CNPH/UNESP) and hybrids like "Mogiano" (ESALQ) and "Master" (Agrocere Seed Company) have been released.

Cabbage breeding in Brazil

Until the 1960s cabbage in Brazil was produced by using an open-pollinated cultivar called "Louco". With the introduction of the Japanese hybrids, the commercial importance of this cultivar decreased. However, this cultivar has been used as a source of inbred lines for the development of hybrids with resistance to black rot (Ikuta, 1971, 1972).

The main constraint to the cabbage breeding seed industry in Brazil has been the lack of improved breeding cabbage populations. Consequently, since 1976, efforts have been made to develop new breeding populations with good quality and disease resistance.

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Objectives of cabbage improvement

1 Disease resistance

Heading cabbage in Brazil is affected with several diseases like black rot, soft rot (*Erwinia carotovora* sub sp. *carotovora*), club root (*Plasmodiophora brassicae*) and Alternaria leaf spot (*Alternaria* spp.). However, black rot is the most serious disease under rainy and humid conditions. Consequently, black rot resistance is the major breeding objective. The open-pollinated cultivar União (Giordano *et al.*, 1988) and the hybrid Master are examples of such efforts. Cultivar União besides being used as a source of breeding lines, has also been planted by farmers near Brasilia during the rainy and hot season.

2 Quality and preferential traits

In Brazil, round-shaped cultivars (longitudinal/transversal diameter ratio ranging from 0.75-0.80) with small but heavy heads (1.5-2.0 kg) are highly preferred by consumers. High yield, small ribs, white internal head color, short core length and cracking resistance are important characteristics considered in our breeding programs.

After ten cycles of mass selection at CNPH/EMBRAPA in Brasilia, we are using seven breeding populations with a high level of black rot resistance and also good commercial traits. Some characteristics of each breeding population expressed in percentage (Matsukaze taken as one hundred) are presented in the table below.

On the average all the breeding populations have heavier and more solid heads than the commercial hybrid Matsukaze. Despite the fact that early flowering has been reduced to a very low level in these populations, seed production is possible even under the mild winter temperatures of Brasilia.

3 Selection for heat and humidity tolerance

In the Central Region of Brazil breeding materials are sown in November and within 25-30 days the plantlets are transplanted to the field. Selection occurs during February/March after the plants are subjected to hot and humid conditions. Plants without black rot symptoms are marked and heads are harvested. Further selection is performed by cutting the harvested heads through the core. This procedure allows for the selection for head shape and internal solidity, and against early flower bud formation and long cores. Later on, the lateral buds are removed from the stump of the selected plants and rooted in a sand seedbed. By April/May, when the temperature starts to decrease, the small plants are transplanted to an appropriate area for crossing.

Advanced selected inbred lines are artificially inoculated with 25 l of a bacterial suspension (10^8 CFU/ml) deposited on a lesion induced with an entomological pin at the axil of the oldest leaf, using a micropipette (Henz *et al.*, 1988). Plants are inoculated at the 2-4 true-leaf stage.

4 Hybrid seed production

Table 1 Characteristics of cabbage breeding population

Population	Weight of head	Core length	Longitudinal diameter (LD)	Transvesal diameter (TD)	LD/TD	Internal solidity	Early flowering* (%)
R88-001(1)	108.45	106.90	93.79	86.30	102.7	113.5	0.84
R88-002	158.23	119.10	112.67	121.01	89.2	124.2	0.00
R88-003	166.73	116.10	113.14	127.59	93.6	115.1	0.00
R88-004	161.82	111.55	114.11	120.82	94.9	138.2	0.00
R88-005(1)	172.64	123.93	118.59	114.64	102.7	133.4	0.00
R88-006(1)	140.73	116.08	110.40	115.08	94.8	106.4	0.00
R88-007(1)	132.24	88.19	109.39	115.59	93.7	117.9	0.00

* Absolute value

For percentage, Matsukaze as reference=100

F₁ hybrid seeds in Brazil have been produced by using the self-incompatibility system. However, the discovery of the cytoplasmic male sterility in radish (R cytoplasm) by Ogura (1968) and its introduction in cabbage through a series of backcrosses performed by Bannerot *et al.* (1974) has created new perspectives for hybrid seed production. Cytoplasmic male sterility was introduced in our breeding program in 1981 (Giordano, 1983). Several male sterile breeding lines have been selected and in a few years hybrid cabbage seeds produced through this system will be released. The presence of pale or white cotyledons and pale-yellow leaves during the cabbage plant growing period in Brazil is minimized by the occurrence of higher temperatures.

References

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Discussion

Yamamoto, M. (Japan) : What type of cytoplasmic male sterility do you use for making F₁ hybrids of cabbage?

Answer : We are using the R cytoplasm discovered by Ogura in radish and introduced to cabbage by Bannerot and Williams (University of Wisconsin) through a series of backcrossing.

Yamamoto, M. (Japan) : If you use the Ogura R cytoplasm under cold conditions, you may have chlorosis problems. Did you experience such problems?

Answer : As we work with summer cabbage this problem does not occur since the temperature does not decrease below 16°C. We also used this cytoplasm for broccoli and were able to select materials with a lower incidence of chlorosis.

Miyoshi, K. (Japan) : 1. As for your CMS system for cabbage seed, are vectors present and 2. How about the fertility of female organs?

Answer : 1. There are many vectors, the most important being bees from the species *A. mellifera*. We have been able to select for broccoli, cauliflower and cabbage showing flowers with nice nectars. 2. The female organs are functional.