Two Heat-tolerant F₁ Hybrids of Chinese Cabbage

Yau-Wen Yang¹

Institute of Botany, Academia Sinica, Nankang, Taipei, Taiwan 11529

Ching-Chang Tsai²

Ching-Long Seed Co., No. 4-1, Lane 340, His-Hsu Road, Tainan, Taiwan 702

Tsung-Dao Liou³ and Kan-Shu Chen⁴

Fengshan Tropical Horticultural Experiment Station, Taiwan Agricultural Research Institute, Council of Agriculture, Fengshan, Kaohsiung, Taiwan 830

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Chinese cabbage (*Brassica rapa* ssp. *pekinensis*) is thought to be a native of China where it has been cultivated since the fifth century (Thompson and Kelly, 1957). This plant usually requires a mean temperature range from 15 to 20 °C for head formation. During the hot seasons from May to October in Taiwan, when mean temperatures are above 25 °C, this vegetable is usually grown in the cool highlands (Opeña and Lo, 1979). Some local cultivars showing heat tolerance but low yields were crossed to unadapted cultivars for the purpose of developing high yield, disease-resistant, heat-tolerant F₁ hybrids and open-pollinated cultivars at the Asian Vegetable Research and Development Center (Opeña and Lo, 1979; Opeña and Lo, 1985). An F₁ hybrid, Asveg#1, was officially released in 1982 by AVRDC after being named by the Taiwan government (Lai and Lo, 1983). In contrast to other commonly used cultivars in Taiwan, Asveg#1 had more fibrous texture and hairy leaves. In addition, its flavor was different from those of popular cultivars grown in other seasons. As a result, this hybrid was not accepted by the consumers and was not used in commercial production during the hot seasons in Taiwan. Two heat-tolerant F₁ hybrids, 'Ching-Long 200' and 'Ching-Long 600', were generated by the Ching-Long Seed Company based on the heat-tolerant germplasm in Taiwan. These two hybrids retained

most of the horticultural characteristics such as flavor and texture of other widely used cultivars in Taiwan and can be used for commercial production during summer in Taiwan. Here we describe the pedigree and characteristics of these two F₁ hybrids.

Origin

Heat tolerance was defined as the ability to produce compact heads under mean temperatures no lower than 25 °C (Opeña and Lo, 1979). 'Ching-Long 200' was derived from a cross between P510 and P457 in 1995 and

'Ching-Long 600' from a cross between P510 and P529 in 1997. P510 is an S6 inbred line with stronger self-incompatibility, as compared with P457 and P529, and served as the maternal parent of both hybrids. It was selected from a local cultivar by selfing in Tainan (southern Taiwan) for its tolerance to high temperatures and resistance to downy mildew [*Peronospora parasitica* (Pers.: Fr.) Fr.] and soft rot [*Erwinia carotovora* (Jones) Bergey, Harrison, Breed, Hammer and Huntton subsp. *carotovora*] under field conditions. Heading of P510 occurs 40 d after transplanting. P457 is an S7 inbred line showing less resistance to downy mildew and was selected for its tolerance to high temperatures in Tainan under field conditions. Its heading occurs 30 d after transplanting. P529 is an S7 inbred line selected from a local cultivar at Shi-Hu (central Taiwan) for its fast growth. It is also considered a heat-tolerant cultivar. Both F₁ hybrids produce heads between June (mean temperature of 28.1 °C) and September (mean temperatures of 27.1 °C) in southern Taiwan. When both hybrids were grown in a plastic greenhouse with mean temperature around 31 °C in June and July, 'Ching-Long 200' formed compact heads but 'Ching-Long 600' failed.

Description

Figure 1a shows that both hybrids formed heads during summer in Taiwan. In contrast, the control F₁ hybrid 'Tsun-Fu' failed to form

Fig. 1. 'Ching-Long 600' and 'Ching-Long 200' harvested in the field during the summer as compared with a heat-susceptible F₁ hybrid, 'Tsun-Fu' (a), and their heading structures (b).

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¹Associate Research Fellow; to whom reprint requests should be addressed; e-mail: yauwen@sinica.edu.tw

²Chief Breeder.

³Senior Horticulturist

⁴Associate Horticulturist.

a head. 'Ching-Long 200' has a nearly globose head, 13.3 ± 0.8 cm in diameter and 15.3 ± 1.1 cm in length, while 'Ching-Long 600' has an obovoid head, 13.0 ± 1.2 cm in diameter and 18.1 ± 1.4 cm in length. Both hybrids have crinkle hairless leaf surface and green foliage color. The width of plant spread is 44 cm for 'Ching-Long 200' and 46 cm for 'Ching-Long 600', and the plant height is 22 cm for 'Ching-Long 200' and 25 cm for 'Ching-Long 600'. The head of 'Ching-Long 200' is smaller than that of 'Ching-Long 600' (Fig. 1b). 'Ching-Long 200' can be harvested 32 to 35 d after transplanting, and 'Ching-Long 600' can be harvested 35 to 40 d after transplanting with daily mean temperatures at 27 °C or lower. Higher temperatures result in delayed heading and reduced head weight. In hot summers with mean temperatures above 28 °C, head harvesting was delayed from 7 to 10 d. In both hybrids, early bolting and flowering can occur at 18 °C or lower, especially at the young

seedling stage. Using 'Tsun-Fu' as the control, two field tests were conducted between May and July and between July and September in 1999 in Tainan. Two- to 3-week-old seedlings were transplanted in 90-cm-wide, double-row beds. Spacing between beds was 40 cm and spacing in rows was 55 cm. Before transplanting, sugarcane compost and 16N-5.3P-10K fertilizer were applied at all sites at levels of 6000-8000 kg and 300 kg·ha⁻¹, respectively, before the beds were formed. Additional 16N-5.3P-10K fertilizer (200 kg·ha⁻¹) was sidedressed every 10 d after planting. Each entry consisted of 100 plants. 'Chang-Long 200' and 'Ching-long 600' produced 100% head formation while no heads were observed in 'Tsun-Fu'. The head mass of 'Ching-Long 200' ranged from 560 ± 70 g in July to 830 ± 100 g in September, while that of 'Ching-Long 600' ranged from 800 ± 120 g in July to 1200 ± 200 g in September. The total yield of 'Ching-Long 200' is estimated to reach up to

15-22 t·ha⁻¹ and the total yield of 'Ching-Long 600' to reach up to 21-32 t·ha⁻¹.

Availability

Seed samples can be obtained from Yau-Wen Yang, Institute of Botany, Academia Sinica, Nankang, Taipei, Taiwan 11529.

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