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Won Bok & Pak Choi

Economic Fact Sheet #18
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Department of Agricultural and Resource Economics
College of Tropical Agriculture and Human Resources
University of Hawaii

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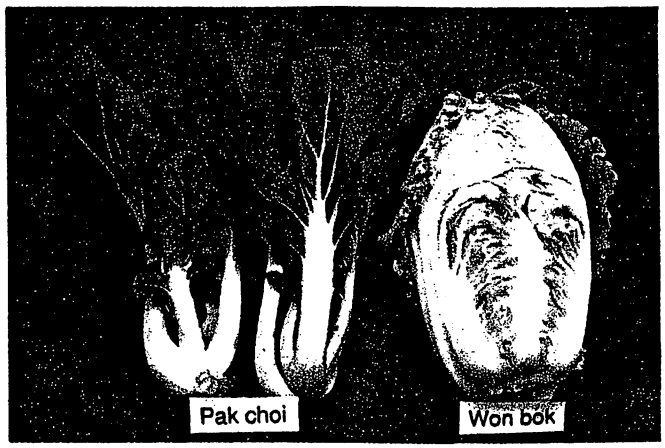


CROP PROFILE

SPECIES AND VARIETIES

- Won bok, *Brassica campestris* ssp. *pekinensis* (heading group), and pak choi, *B. campestris* ssp. *chinensis* (nonheading group), are members of the family Cruciferae. The common and scientific names are often confused. Both are relatives of head cabbage, broccoli, and cauliflower.

- Won bok and pak choi are known to have been cultivated in Asia since the fifth century A.D. Distinct types have evolved because of natural crossings in the field and because of human selections of the desired traits.

- Won bok is characterized by compact heads and leaves with a thick, white central vein. Leaf color varies from cream to pale green. There are two major types: the first is light green and round; the second is tall and cylindrical with lacy Savoy-type leaves.

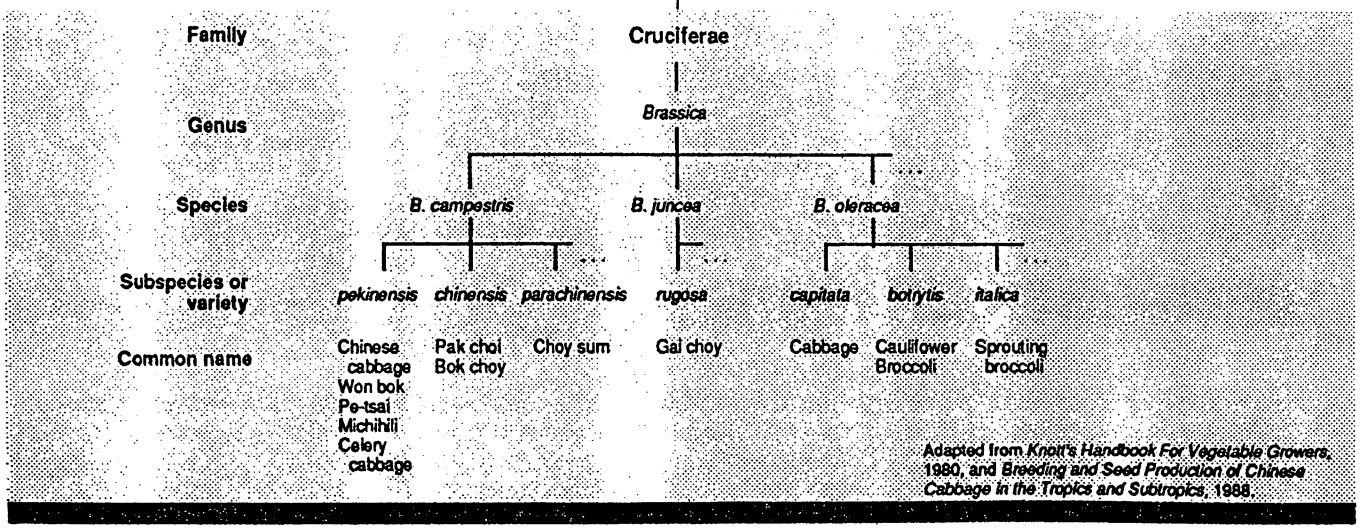
- Pak choi has thick white leaf stems and large, spoon-shaped, dark green leaves. Color and size of the stem and leaves vary with different types.

- 'WR-55', 'WR-60', and 'WR-70' are won bok varieties recommended by the College of Tropical Agriculture and Human Resources, University of Hawaii.

PRODUCTIVITY

- Won bok can be harvested 50–80 days after sowing seed. After harvest, the heads are trimmed to remove all damaged leaves and remains of roots. Pak choi can be harvested in 40–60 days.

- Won bok and pak choi can tolerate a wide range of soil conditions and can be grown at elevations up to 4900 feet. Soils that are too well-drained are not suitable, however. The optimal temperature for growing is 59–68°F.



Adapted from *Knott's Handbook For Vegetable Growers*, 1980, and *Breeding and Seed Production of Chinese Cabbage in the Tropics and Subtropics*, 1988.

- Crop yields vary according to cultivar, planting density, and environmental conditions. Yields for pak choi may range from 4450 to 26,700 lb/crop/ac, while yields for won bok may range from 8900 to 44,500 lb/crop/ac. It is possible to harvest four crops of won bok per year at 27,000 lb/crop/ac in Kula, Maui, and in Kamuela on the Big Island.

- Harvested plants should be kept away from direct sunlight to prevent excessive wilting. Both won bok and pak choi can be stored up to 4–6 months at a temperature of 32–33°F with 98% relative humidity.

- The major diseases of won bok in Hawaii are turnip mosaic virus, bacterial soft rot, and yellow disease associated with *Alternaria brassicae* leaf spots. Diamond-back moths, cabbage loopers, and aphids are some of the pests that affect won bok.

PRODUCTS AND USES

- Won bok and pak choi are eaten raw or cooked. Typical uses are in soups and salads, cooked alone as a vegetable side dish, and stir-fried with other vegetables or meats. Won bok is also preserved by various methods for dishes such as pickles or kim chee.

- A 100 g (3.53 oz) serving of raw pak choi contains more protein (25% more), calcium (36%), potassium (6%), iron (158%), vitamin A (150%), and vitamin C (67%) than the same serving of won bok.

Nutritional content of raw cabbage, won bok, and pak choi per 100 g (3.53 oz)

Selected nutrients	Cabbage	Won bok	Pak choi
Protein (g)	1.21	1.20	1.50
Carbohydrate (g)	5.37	3.23	2.18
Fiber (g)	0.80	0.60	0.60
Potassium (mg)	246.00	238.00	252.00
Calcium (mg)	47.00	77.00	105.00
Iron (mg)	0.56	0.31	0.80
Vitamin A (IU)	126.00	1200.00	3000.00
Vitamin C (mg)	47.30	27.00	45.00

WON BOK IN ASIA

- Won bok is one of the most important vegetables in Asia. It is the most widely grown vegetable in China, where in the north, won bok accounts for more than one-fourth of the total annual vegetable consumption.

- In Japan, won bok ranks third after radish and cabbage in term of annual production of vegetable crops. In 1983, there were 88,220 planted acres of won bok, with a total annual production of 3.3 billion lb.

- In 1983, the total production of won bok in South Korea was 6.6 billion lb. Sixty percent is consumed on-farm. It is the most important vegetable in term of production area and per capita consumption. Over 90% of the harvested won bok is used for making kim chee, a spicy pickled side dish eaten year-round.

- The average 1985 cost of production for autumn won bok in South Korea was $1158/ac (two crops), with an average production of 35,400 lb/crop/ac. Labor (47.2% of the total cost) and fertilizer (20.5%) were the two major cost items.

- In Taiwan, most vegetable production is for domestic consumption. The production value of won bok in 1987 was $44 million. In 1985, the cost of production for one acre of won bok was $1240.

THE UNITED STATES MARKET

- Won bok is grown in California and Hawaii all year. It is also grown seasonally in New York, Florida, New Jersey, Michigan, and Ohio.

- Per capita consumption figures for won bok, pak choi, and other oriental vegetables are scarce. In 1989, per capita consumption of fresh vegetables reached an all-time high at 91.8 lb/person, and had increased at an annual growth rate of 2.4% since 1980.

- The total market size of won bok in 22 major U.S. cities was 51.6 million lb in 1990, 2 million lb higher than the previous year. California was the largest shipper, accounting for about 85% of total quantity, followed by Florida with 7%.

- Los Angeles was the largest market for won bok, with total arrivals of 21.5 million lb in 1990. San Francisco (7.2 million lb) and Boston (3.6 million lb) were the second and third largest markets, respectively.

- In 1990, the wholesale prices for won bok and pak choi in Los Angeles ranged from $9 to $23 per wga (Western Growers Association) crate (65–70 lb) and $9 to $25.50 per wga crate, re-

Total arrivals of won bok in 22 selected U.S. cities, 1990 (in 100,000 lb)

	Origin			
	California	Florida	Other*	Total
Baltimore	25	2	2	29
Boston	21	7	8	36
Los Angeles	215	6	17	238
New York	17	5	4	26
San Francisco	71		1	72
Seattle	23		5	28
Other	65	18	4	87
Total	437	38	41	516

* Including Canada and Mexico

spectively. Won bok prices seem more variable than those of pak choi, but both have remained in a relatively constant range since 1986.

WON BOK AND PAK CHOI IN HAWAII

- In 1991, the total farmgate value of won bok was $1.9 million for the 8.2 million lb harvested from 460 acres statewide. Over 55% of the won bok production was on the Big Island. The remainder of the production was on Kauai, Maui, and Oahu.

- The total market supply of fresh won bok in Hawaii has been increasing over time, growing from 4.2 million lb in 1972 to 7 million lb in 1991. Hawaii-grown won bok provided an average of 96.7% of the total market supply during that period. Some won bok is occasionally exported to the Mainland. About 1.3–1.4 million lb are processed annually.

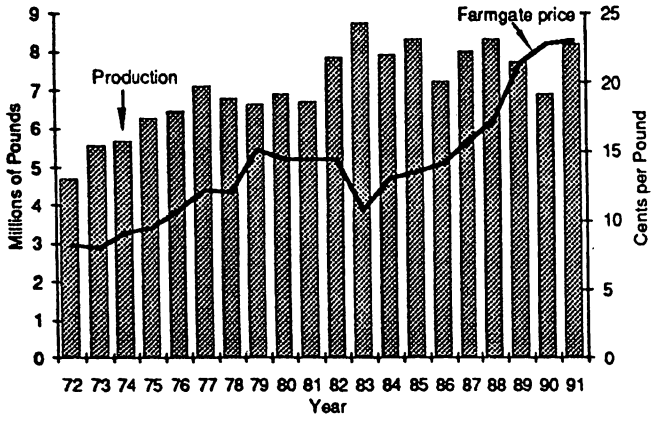
- Pak choi and gai choy are combined under "mustard cabbage" in Hawaii's statistics. Production was 1.4 million lb in 1991, up 7.7% from a year before, but the farmgate value increased only 2.8% to $595,000. The total production of mustard cabbage was relatively unchanged from 1972 to 1991, but with wide variations between years.

- Between 1972 and 1991, Hawaii-grown mustard cabbage provided an average of 93.7% of the total market supply. The total market supply of mustard cabbage reached a record high of 1.8 million lb in 1984.

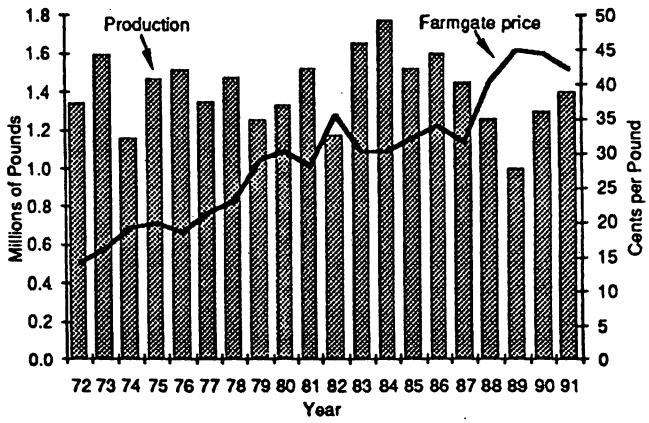
- In 1991, the average farmgate price for won bok was 23.1¢/lb, up 1.3% from 22.8¢/lb in the previous year. The average farmgate price for mustard cabbage (pak choi and gai choy) was 42.5¢/lb in 1991 and 44.5¢/lb in 1990.

- The Honolulu wholesale price range for won bok in 1990 was 20–45¢/lb, while the wholesale price range for pak choi was 35–60¢/lb. Farmgate and wholesale prices show a general upward trend over time.

- According to the most recent cost of production study for won bok in Kamuela, marketing costs accounted for more than 36% of the total operating expenses, followed by harvesting (25%), insect and pest control (16%), weed control (7%), and other costs (15%).



Hawaii won bok production, 1972–91

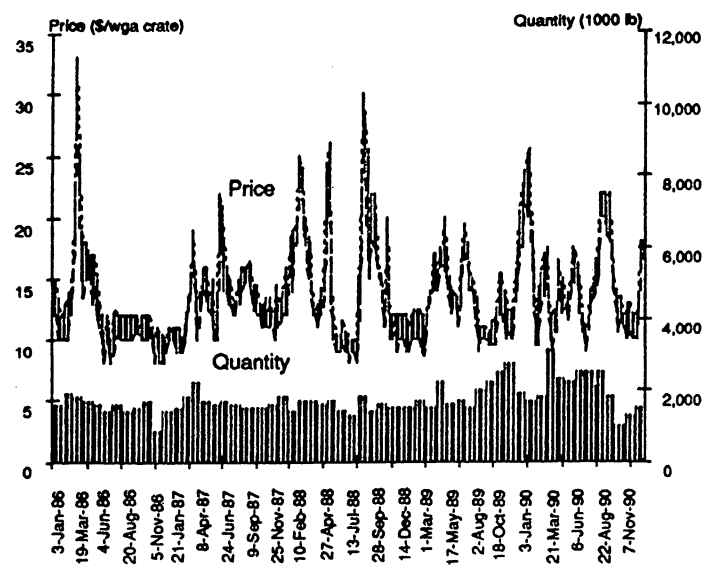


Hawaii mustard cabbage production, 1972–91

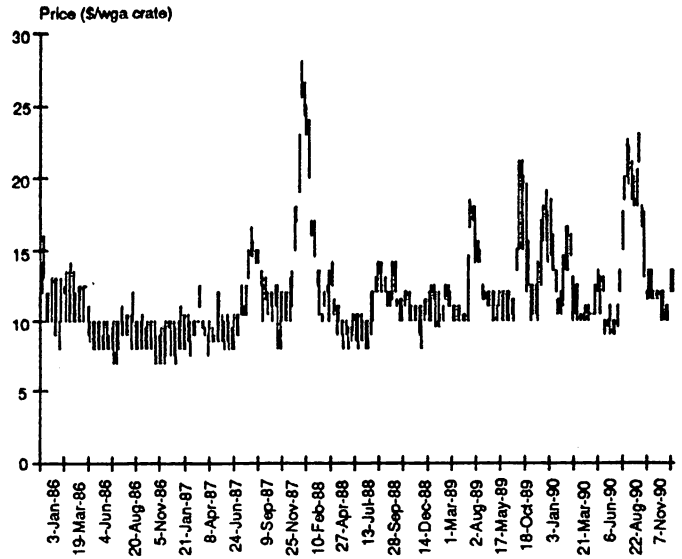
Reference to a company or product name does not imply approval or recommendation of the product by the College of Tropical Agriculture and Human Resources, University of Hawaii. Research for this publication was funded by the Agricultural Diversification Project, administered by the USDA.

Hawaii Agricultural Experiment Station, HITAHR, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa. Noel P. Kefford, Director and Dean.

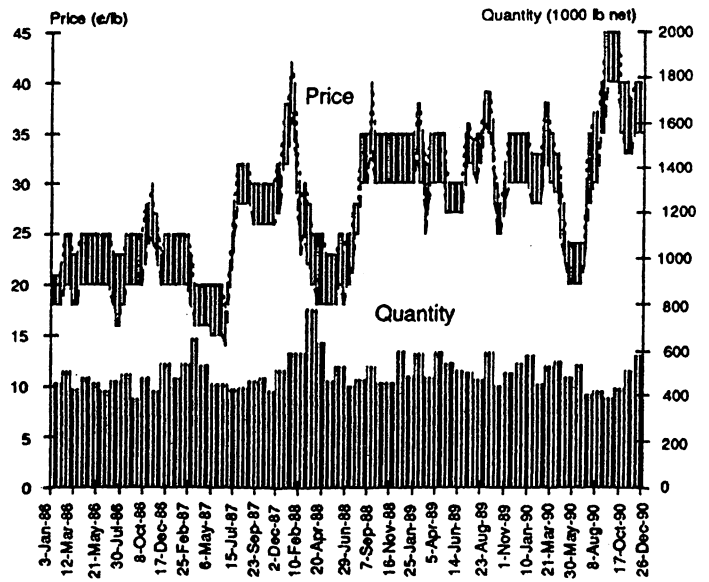
A list of references is available from the authors upon request.



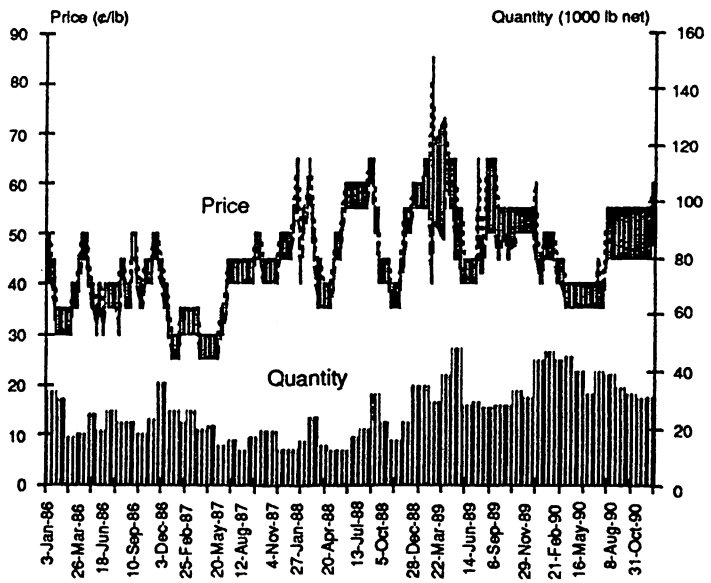
Weekly wholesale prices and arrivals of won bok in Los Angeles



Weekly wholesale prices of pak choi in Los Angeles



Weekly wholesale prices and arrivals of won bok in Honolulu



Weekly wholesale prices and arrivals of pak choi in Honolulu