

IDENTIFICATION OF BAMBOO CLONES,
DENDROCALAMS LATIFLORUS,
IN TAIWAN⁽¹⁾

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Abstract

Eighty-five samples of bamboo clones collected from various locations of Taiwan were used in the study. Peroxidase isozymes, leaf bristles and stomata were analyzed to identify their genetic variability. A total number of eight bamboo categories were found.

The west central parts (Yunlin, Nantao, and Changhua) of the Island has the most numbers of categories and those located to the north of Taichung and the south of Chaoyi least. The result suggested that the plant was introduced through the central ports of the Island.

Bamboo has been an important crop in the long Chinese history. Its culms are used for light construction, furniture and a great numbers of useful handicrafts. The young shoots are noted for their nutritional value (Su, 1965; Li, 1965) and are the favorite materials in many Chinese dishes. The plant was brought to Taiwan by the early settlers from the Chinese Mainland about two hundred years ago. Since the early settlers from the Mainland landed on the northern, central, and southern ports of the Island, it was generally assumed that the plants were carried in from the same routes, though no record can be found to substantiate the supposition. Various genetic variability should be preserved due to the vegetative propagation of the plant.

Before any definite breeding program is formulated for the crop, it is thought of importance to identify the genetic variability of the present materials. Since the collection from various locations of this Island are morphologically similar, analyses of peroxidase isozymes and microscopical comparison of leaf bristles and stomata are employed for the purpose.

Materials and Methods

Eighty-five collections of bamboo were made from the Island and planted

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at Luhguei bamboo station for 2-3 years. Samples for this investigation were taken from the station.

Isozymic analysis

The apparatus and procedures of starch gel electrophoresis were essentially similar with those described by Smithies (1955) and Chu (1967). Starch gels were prepared in 0.03 M borate buffer at pH 8.5, using hydrolyzed potato starch. The gels were poured into plastic molds and stood for over-night at 4°C. Leaf samples were ground in a mortar, and homogenate was placed on a strip of filter paper at the middle of the gel. A current of 10 V/cm (ca. 1.7 mA) was applied for three hours at 10°C, the gels were then taken to stain with a mixture containing 0.03% hydrogen peroxide, 0.1% benzidine acetate and 0.01 M trisacetic acid buffer at pH 4.0 (Endo, 1966).

Three preliminary studies were made to investigate the possible relation of enzyme from different locations of a leaf. Samples were taken from five leaves of a shoot, four separate sections of a leaf and shoots of 1 to 3 years old.

Microscopical study of leaf bristles and stomata

The study was dependent upon the use of Sump micro-printing method to investigate the leaf surface. Microscopic field for the bristles was 0.500 mm² while that for stomata was 0.274 mm². Preliminary studies were made to investigate the numbers of these two characters on the linear portions of a leaf and also on five leaves of a shoot. Data of the study were then dependent upon the third leaf of a shoot.

Experimental Results

Analysis of peroxidase isozyme

Results of our three preliminary studies on sampling indicated that no difference of enzymic bands was found among the samples taken from different leaves, different sections of a leaf, and shoots of different ages. Thus, samples of further study were taken from the third leaf of a shoot. In general there were ten peroxidase bands. One moved for the anode and the others for the cathode (Figure 1). Only bands 6, 8, and 9 varied among the eighty-five samples. According to the variations of having these bands, four categories of isozymic patterns were classified as follows:

Categories	No. of bands
A ₁	6, 8, 9
A ₂	6, 8
B ₁	6
B ₂	none

Based upon the isozymic study, the categories of the eighty-five collections were identified and are given in Table 1. Forty-eight collections belonged to

category A₁, 6 for A₂, 12 for B₁, and 19 for B₂. The A₁s were distributed along the coastal plain, and the A₂s located only at Changhua and Nantao of Taichung district. Category B₂s were found from most of the locations of the island, whereas the B₁s only at mountainous region of Central Taiwan.

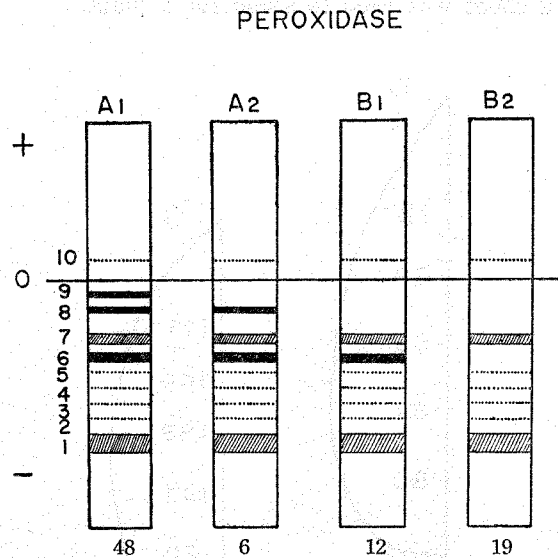


Fig. 1. Zymograms of peroxidase from eighty-five bamboo collections.

Table 1. List of enzymic categories of peroxidase at various locations of Taiwan.

	A ₁	A ₂	B ₁	B ₂	Total
Taipei	5			3	8
Taoyuan	4			1	5
Hsinchu	3			1	4
Miaoli	1			1	2
Taichung	8				8
Changhua	4	3	1		8
Nantao		3	3	2	8
Yunlin	5		3	3	11
Chaiyi	5		5	1	11
Tainan	9				9
Kaohsiung	3			7	10
Ilan	1				1
Total	48	6	12	19	85

Study of leaf bristles and stomata

Results from the preliminary study are illustrated at Figure 2a and 2b. It indicated that the variations of these two characters from different portions of a leaf and from different leaves of a shoot within a single plant was smaller than those variations with other plants. Number of bristles and stomata from the central portion of a leaf was taken to be the leaf data, and the data of the third leaf of a shoot was used to stand for a plant.

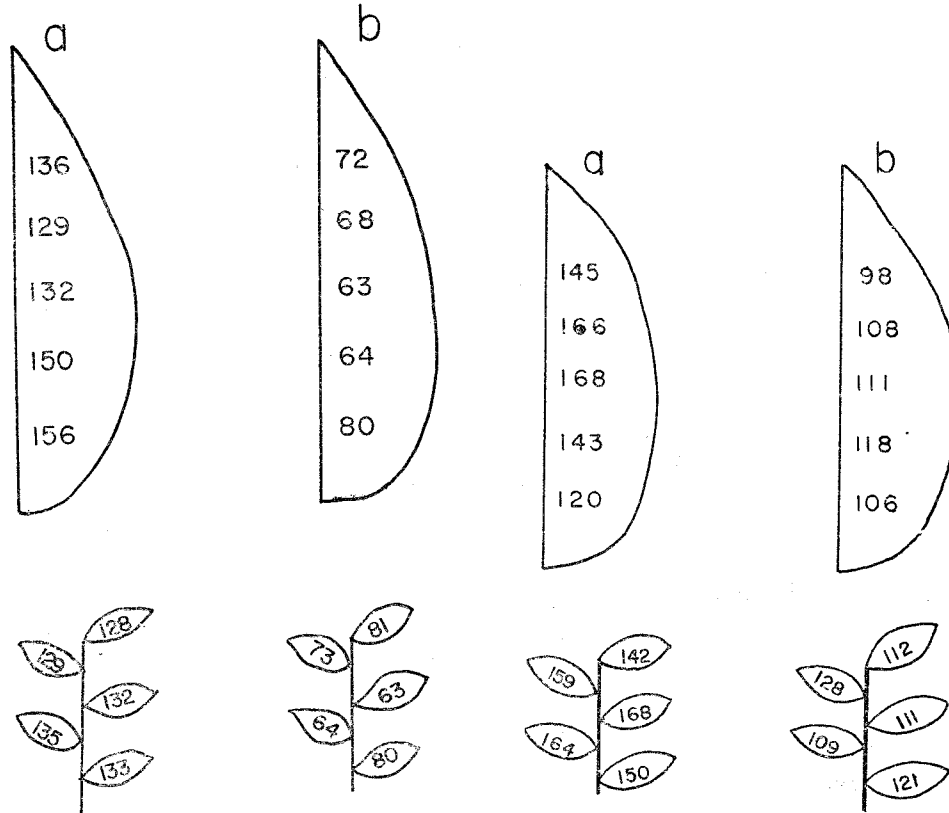


Fig. 2a. Numbers of bristles per unit area (0.500 mm²) at different portions of a leaf and different leaves of a shoot.

a, leaf having more bristles.
b, leaf having less bristles.

Fig. 2b. Numbers of stomata per unit area (0.274 mm²) at different portions of a leaf and different leaves of a shoot.

a, leaf having more stomata.
b, leaf having less stomata.

Variations of bristle number are given in Figure 3. It is apparently shown that the population appeared in two groups. One carried a peak around 65 bristles per unit and the other 125. The former was assumed as category P₁ and latter P₂. Variation of stoma is given in Figure 4. One group has a peak at 125 stomata per unit, while the other 175. The former was named as

S_1 group and the latter S_2 . This analysis indicated that the P_2 (more bristles) and S_1 (less stomata) groups were found from all parts of the island, whereas group P_1 s were only found in Yunlin and Chiayi areas at south western Taiwan. The S_2 s (more stomata) were mainly located in Yunlin, Nantao, Changhua, Taichung, and a few at north to these areas.

In considering the results of three analysed characters, peroxidase isozymes, bristles, and stomata together, eight different categories of bamboo could be classified. They are given in Table 2. Each category differed with others at

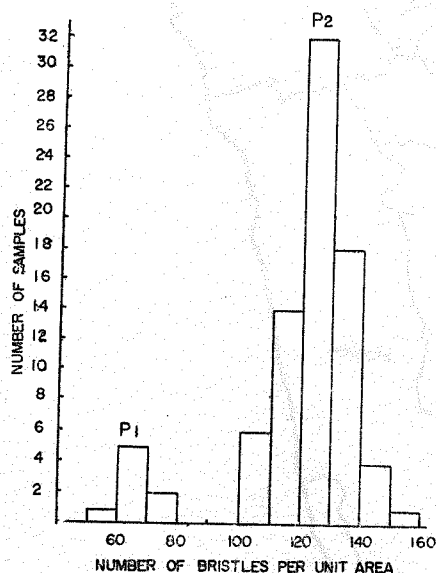


Fig. 3. The variation of bristles per unit area in the collected bamboo population.

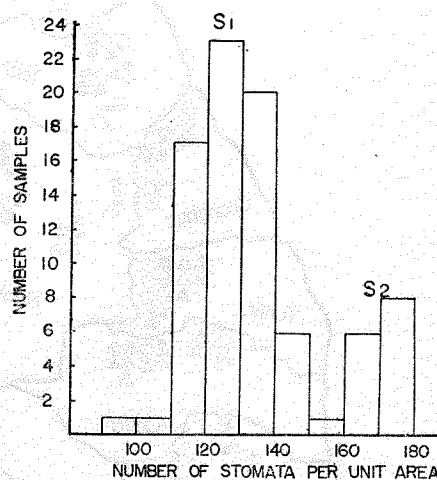


Fig. 4. The variation of stomata per unit area in the collected bamboo population.

Table 2. List of bamboo categories identified according to three studied characters, peroxidase isozymes, numbers of leaf bristles and stomata

	Symbols	Peroxidase	Bristles	Stomata	No. of samples
1	○	A ₁	P ₂	S ₁	43
2	●	A ₁	P ₂	S ₂	4
3	⊖	A ₁	P ₁	S ₁	2
4	⊗	A ₂	P ₂	S ₂	6
5	△	B ₁	P ₂	S ₁	15
6	▲	B ₁	P ₂	S ₂	3
7	△	B ₂	P ₂	S ₁	6
8	△	B ₂	P ₁	S ₁	6
Total					85

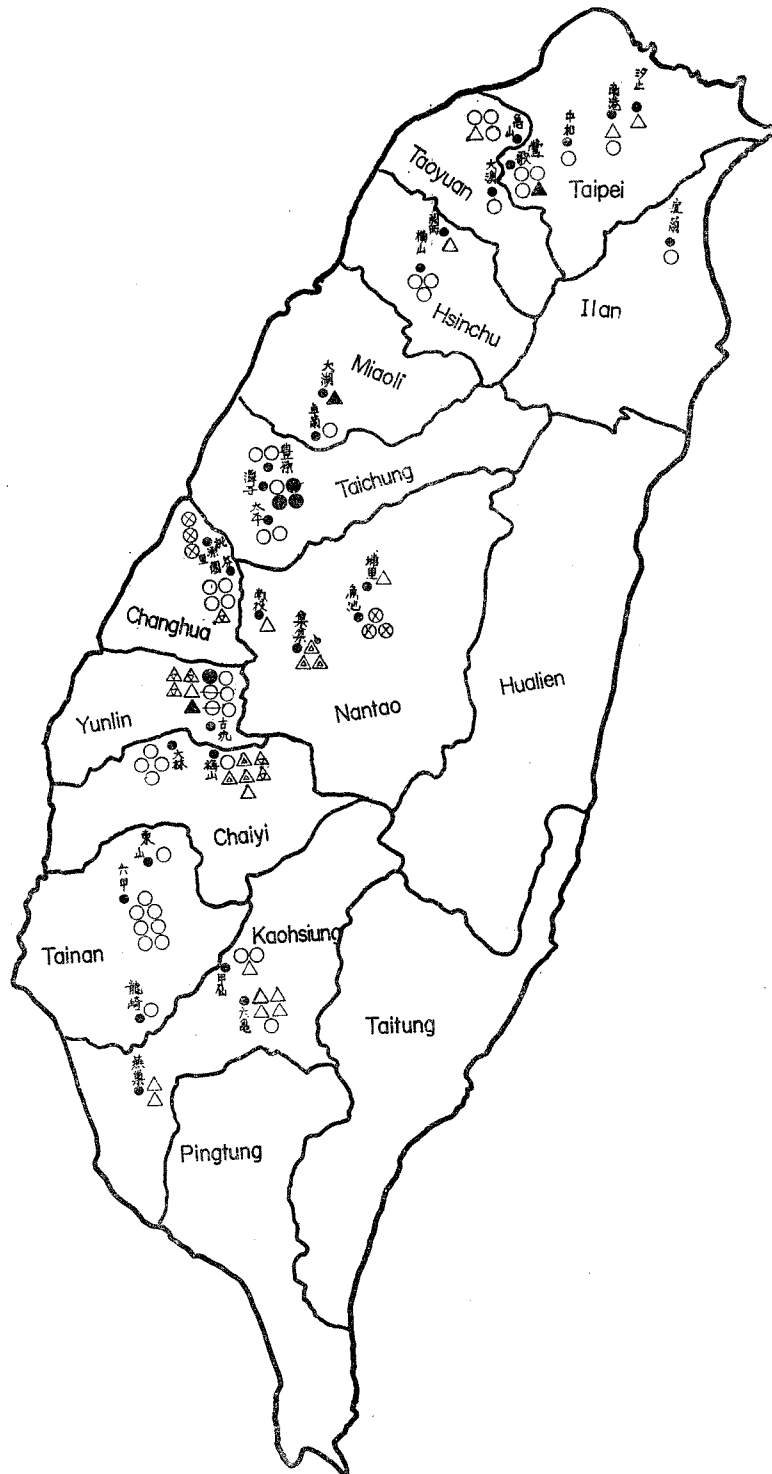


Fig. 5. Distribution of Bamboo Clones on the Island of Taiwan.

least in one character. The eight categories are indicated by various symbols on Taiwan map (Figure 5). It showed that less bamboo categories existed in those locations to the north of Taichung and the south of Chaiyi. On the other hand, six out of eight categories were found in the central region, especially the Yunlin area (county).

Discussion

The collections of bamboo clones from different locations of the Island are morphologically similar. However, the morphological similarity does not suggest that all samples are carrying identical germplasm. Genotypic variation may still exist due to the long history of cultivation in different environment of China. Isozymic analysis, therefore, is designed to investigate the possible existence of various gene product which can not be perceived phenotypically.

Several isozymes, acid and alkali phosphatases, alcohol and malate dehydrogenases, α and β esterases, and peroxidase were analysed. Significant variation was only found for peroxidase. This suggests the existence of genetic variation which does occur among bamboo clones. However, this analysis is yet considered to be preliminary; it does not signify the genetics of bamboo. Nonetheless, the finding in isozymics bands may suggest that the difference is controlled by various genes (Shahi *et al.*, 1969).

The study of bristles and stomata give some support to those of isozymes. Based on these two characters, the four main categories classified by peroxidase isozymes can be further separated into eight. However, these two characters are suspected to be easily modified by environmental factors although all of the collections have been grown together for 2-3 years. Validity of the classification based on these two characters, therefore, remains to be confirmed.

Over all, the genetic variability is highly concentrated at the west central part of the Island. On the contrary, those located to the North and the South of the Island are less variable. This implies that bamboo was mainly brought in from the mainland through the central ports of Taiwan. Due to the transportation difficulty in early days, farmers were likely to obtain their bamboo clones from close neighbors rather than from far distance. In addition to the identification of varieties, this research also give information which might help to understand the early history of bamboo culture in Taiwan.

Acknowledgement

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臺灣麻竹品系檢定之研究

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來自臺灣各地之麻竹85品系，種於高雄縣六龜改良場，2~3年，因該等品系形態極為相似，所以採用 peroxidase isozymes，葉片剛毛及氣孔之研究以檢定品系間之差異。根據本研究之結果，85品系可以區分為8大類，臺灣中部變異較大，尤其是雲林縣具有6大類，臺中縣以北及嘉義縣以南之變異則較少。本試驗足以證明，臺灣之麻竹係由中部輸入，然後向南北兩端分佈。