4. MAIZE PRODUCTION CONDITIONS IN TAIWAN AND FUTURE PROBLEMS

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Introduction

The cultivation of corn in Taiwan has been over 250 years. The main usage is for raising hogs and poultries, and with a small amount for vegetables or serving as a staple food for the aborigines. Sometimes the fresh stalk and leaves are used for silo or dried for fuel. Varieties with carotene-rich, yellow kernels are prefered for feeds. The ratio of corn in the recommended mixed feeds is 40–50% so it occupies a considerable part of the total production cost of livestock.

In recent years, the demand of corn is raising as a result of the expansion of the local livestock industry. Although corn production has been fortified, yet the gap still be depended upon to import foreign corn for meeting the local consumption (Table 1). It is obvious that more efforts should be done to promote corn production in Taiwan.

Table 1. Corn production and its import in Taiwan during 1957—1967.

Year	Acreage (ha)	Production (M.T.)**	Yield (kg/ha)	Import quantity (M.T.)**
1957	7,645	9,275	1,213	—
1958	9,258	12,320	1,331	—
1959	11,566	17,084	1,477	—
1960	13,854	20,717	1,495	1,538
1961	15,292	27,091	1,772	1,256
1962	18,357	36,265	1,976	2,167
1963	19,892	34,528	1,797	5,917
1964	20,557	42,100	2,103	8,627
1965	18,704	41,078	2,207	56,294
1966	22,328	51,639	2,324	64,814
1967	24,011	64,082	2,669	201,191*

* Relaxation of import control. ** M.T.: metric ton.

The Production

Before 1958, the annual planting acreage of corn in Taiwan was less than 10,000 hectares. However, since the release of the hybrid variety "Tainan No 5" in 1960, both the acreage and the amount of production has increased considerably. In 1967, corn acreage reached at 24,011 hectares and with a total production of 64,082 M.T. The average yield per hectare had also been increased from 1,213 kg of 1957 to 2,669 kg of

1967. The corn production in Taiwan are mainly distributed in Tainan, Taitung and Taichung areas. In 1967, Tainan area alone had an acreage of 9,111 ha and a production of 32,056 M.T. with a record high yield per hectare of 3,518 kg. Among its acreages, there were 7,538 ha of the hybrid variety. Corn in Taitung and Taichung areas are mostly planted on sloping hills or in the mountains. Table 2 shows the distribution of production various areas in 1967.

Corn can be planted at any time within a year in Taiwan, but serious damage may be brought about by typhoon and corn borers during summer season, therefore, spring and autumn crops are predominant.

The corn production in Taiwan are facing two threats at present. Downy mildew (*Sclerospora sacchari*) is the most serious one. It is intertransmissible between corn and sugarcane. Its epidemic had forced the Government declared a law in 1965 to prohibit corn planting in Tainan area for protecting the sugarcane industry. Another threat is the relaxation of import control in 1967. The price of imported corn is cheaper than the local product, thus discourages the farmers and a decrease in acreage is expected in the future.

Table 2. Corn production in Taiwan, 1967*

Area	Acreage (ha)	Production (M.T.)	Yield (kg/ha)
Taipei	231 (89)	510 (207)	2,208 (2,326)
Hsinchu	712 (115)	1,209 (275)	1,698 (2,391)
Taichung	4,293 (1,199)	9,792 (4,090)	2,281 (3,411)
Tainan	9,111 (7,538)	32,056 (28,140)	3,518 (3,733)
Kaohsiung	1,951 (53)	2,797 (121)	1,434 (2,283)
Taitung	5,197 (400)	13,922 (1,214)	2,679 (3,000)
Hawlien	2,516 (165)	3,796 (362)	1,509 (2,194)
Total	24,011 (9,559)	64,082 (34,409)	2,669 (3,600)

* Figures in parentheses denote hybrid corn.

The Production and Extension of the Hybrid Corn Seeds

The seeds of hybrid variety "Tainan No. 5" are produced through double crosses by Taiwan Seed Service. Seeds from single crosses are provided by the Corn Research

Table 3. The extension and production of hybrid corn.

Year	Amount of seeds extended (kg)	Planting acreage (ha)	Total corn acreage (ha)	% of hybrid corn
1960	41,079	1,867	13,854	13.5
1961	48,386	2,199	15,292	14.4
1962	116,031	5,274	18,357	28.7
1963	204,899	8,196	19,892	41.2
1964	113,064	4,522	20,557	22.5*
1965	233,045	9,322	18,704	49.8**
1966	241,751	9,670	22,328	43.3**
1967	238,975	9,559	23,942	40.0**

* Heavy seed loss due to infection of northern corn leaf blight.
** Corn production was prohibited in the main producing areas.

Center and the Farmers' Associations are responsible for distribution of these extension seeds. While the Seed Laboratory of the Provincial Department of Agriculture and Forestry is taking care of all the seed inspection work. The price of the extension seeds is NT$18.00 per kilogram, it is about six times over the ordinary seeds.

The Corn Research Fund Commission is in supervision of all the activities concerning corn research works, hybrid seed production and found management. It is composed of nine commissioners who are concurrently the staff members of the Joint Commission on Rural Reconstruction, the Provincial Department of Agriculture and Forestry, the Taiwan Seed Service and the Tainan District Agricultural Improvement Station.

The Improvement Work

The corn improvement work started at the Tainan District Agricultural Improvement Station in 1953. Some achievements are given below.

1. Breeding of the early and high yield double cross variety "Tainan No. 5".

The hybrid variety "Tainan No. 5" was selected in 1958 and released in 1960. Its combination was (Oh43 × Oh45) (D × C). The female parents, Oh43 and Oh45 were introduced from the U.S. the male parents D and C lines were selfed from the local varieties. Tainan No. 5 is an early high yielding, drought tolerant hybrid variety with yellow kernel. It yields over the native varieties by about 75% and also matures 2–3 weeks early. It has a wide adaptibility over the Island, but is susceptible to downy mildew and northern corn leaf blight (*Helminthosporium turcicum*).

2. Breeding for downy mildew resistance varieties.

The yield of Tainan No. 5 may be reduced by about 50% in case of a heavy infection of downy mildew. Breeding for resistance is the best way to control this disease. This breeding work started at Tainan District Agricultural Improvement Station in 1957. A double crossing hybrid "Tainan No. 8" was developed in 1965. Although it has a resistant ability to that disease, yet its yield is lower than that of "Tainan No. 5" and thus it can hardly be accepted by farmers. Through continuous efforts, hybrid DMR 113 and DMR 131 were selected. From a 2-year testing record, they are not only resistant to downy mildew but also have an equivalent yield of Tainan No. 5.

The resistance breeding program is now carrying on at the Corn Research Center with the support of the Rockefeller Foundation.

3. Developing special short-season varieties for winter cropping.

Most of the fall corn crop is growing on the paddy field between the harvest of the second crop and transplanting of the first rice crop. The corn seeds are planted in the rows of rice plants about two weeks before the harvest of second rice crop and this is usually done from early Oct. till mid Oct. This is so called inter-relay planting, it is a time and labor consuming practice. Under such circumstances, early mature corn varieties which growth period can be just fit in between the two rice crops are badly needed. Hybrid EE40 and EE26 were selected, they mature 2–3 weeks early than Tainan No. 5.

4. Selection of composite varieties for mountainous area.

The selection of better composite corn varieties to replace the native varieties is a way for improving corn cultivation in the mountainous area where an extensive farming system is still existing. This selection work was started in 1965 and several varieties as American central, Caribbean composite and Piramex have been selected. They have high yield and resistance to northern corn leaf blight, but have a longer growth period.

5. Improvement of cultural practices.

Experiments are carrying on to find out the best cultural methods, for hybrid corn,

the best planting date and spacing, proper amount of chemical fertilizer application, and pest control. Some achievements had already been recommended to the farmers.

Future Problems

1. Diseases problems.

Downy mildew (*Sclerospora sacchari*) and northern corn leaf blight (*Helminthosporium turcicum*), are present in Taiwan. The downy mildew is intertransmissible between corn and sugarcane and was strongly suspected to have been brought into Taiwan from Australia embedded in sugarcane seed setts in 1909. The disease is mainly prevalent in the Chiayi-Tainan area where both corn and sugarcane are widely grown. The disease is characterized by the systemic long, yellowish stripes appearing on the leaves. The upper parts of the affected plants are frequently malformed. Of these phenomena, ear and tassel malformations are the commonest, and plants thus infected at early stages may grow poorly or die prematurely. The disease may reduce corn yields over 50% under severe conditions. Susceptibility of corn plants to downy mildew infection only at the seedling stages and the degree of susceptibility is gradually reduced as the plants become older. One-month-old plants are practically immune from downy mildew attack. Besides corn and sugarcane, the disease also attacks teosinte, gama grass, and broomcorn.

Northern corn leaf blight generally occurs at late growing stages of spring corn. Early and heavy infection may occasionally occur and cause drastic losses in yield.

Among some of the minor diseases of corn are southern corn leaf blight (*Helminthosporium maydis*), common corn rust (*Puccinia sorghi*) and common corn smut (*Ustilago maydis*).

2. Insect pests problems.

The most important insect pests of corn in Taiwan are European corn borer (*Ostrinia nubilalis*) and corn earworm (*Heliothis zeae*). European corn borer multiplies 7 to 8 generations in the southern parts of this Island. The insect is more active from April to Oct., with its peak feeding period in July. The low toxic insecticide Sevin, diluting 1:500 in water, is recommended to the farmers for controlling European corn borer.

Corn earworm generally infests corn silks as well as the top portions of corn ears. The pest is less important than European corn borer and can also be effectively controlled by Sevin application.

Discussion

K. Murakami, Japan: New hybrids EE40 and EE26 are 2–3 weeks earlier than Tainan No. 5. Are their yields similar or close to Tainan No. 5? If they are not high yielding how many percent are they lower in yield compared with Tainan No. 5?

Answer: The yields are similar to Tainan No. 5 at the increased population from 55,000 plants/ha to 83,000 plants/ha.

H. Ishikura, Japan: You mentioned in your paper that hybrid varieties such as Tainan No. 5 yield 75% more over native variety and hybrid varieties are extended to 40% in term of acreage. However, the average yield (kg/ha in Table 1) increased more than double from 1957 to 1967. What are the major reasons other than improved varieties which contributed to this increase of yield?

Answer: 1. Suitable planting date and spacing. 2. Proper amount of chemical fertilizer application. 3. Pest control.

K. Asano, Japan: How many acreages for maize cultivation per a farmer are in

plain area and mountainous area?

Answer: 1. Plain area: 0.5–0.6 ha/farmer. 2. Mountainous area: 0.2–0.3 ha/farmer.

V. R. Carangal, Philippines: Did you find other chemicals that can effectively and economically control corn ear worm and corn borer?

Answer: EPN and Endrin can effectively and economically control corn ear worm and corn borer.

T. Kajiwara, Japan: 1. Are the hybrids DMR 113 and DMR 131 resistant to other diseases? 2. Do you have any test on the control of downy mildew, especially by the application of fungicide?

Answer: 1. No, susceptible to *H. turcicum.* 2. Spraying Dithane M-22 × 400 + sticker, 6 days interval, until the plants were 30 days old.

N. Mochizuki, Japan: Where is the origin of Piramex?

Answer: From Brazil.

P. Phit, Thailand: In Table 1—From where did Taiwan import 201, 191 tons of maize in 1967? How about the price of local and imported corn?

Answer: 1. From Thailand and South America. 2. Imported: 0.065~0.07 U.S.$/kg (2.6~2.8 NT$/kg). Local: 0.075 U.S.$/kg (3.0 NT$/kg).

H. Iwata, Japan: What plant population are applied in Taiwan?

Answer: 55,000 plants/ha (60 cm × 30 cm × 1).

K. Murakami, Japan: In Table 1 it is shown that large quantities of dry grain are imported, especially in 1967. 1. From what countries did you import them? 2. What kernel type is it, flint or dent type?

Answer: 1. From Thailand and South America. 2. Flint type.