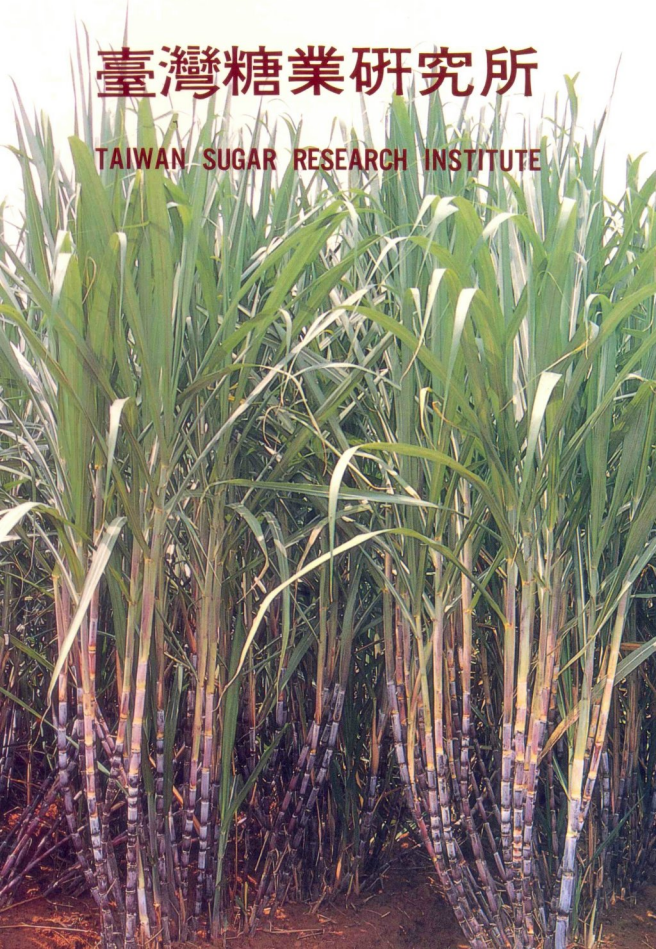


# 臺灣糖業研究所

TAIWAN SUGAR RESEARCH INSTITUTE





行政大樓  
Administration Building

## 沿 革

台灣糖業之研究試驗，始於民國前十一年（1900）在大目降（今台南縣新化鎮）設置之「甘蔗試作場」，該場於民國前六年（1906）七月改稱「糖業試驗場」。民國二十一年（1932）日人鑑於發展糖業之重要將「糖業試驗場」改為「糖業試驗所」直隸於台灣總督府，所址由大目降遷至現址，另在高雄州之萬丹設置甘蔗交配圃，以迄光復為止。

民國三十四年台灣光復，糖業試驗所由台灣省行政長官公署接收，改組為「台灣省糖業試驗所」。民國三十七年元月奉台灣省政府令改隸本公司，改稱為「台灣糖業試驗所」。三十八年二月於台灣糖業試驗所內成立糖業研究評議委員會，為本省農業研究評議制度之創始。民國六十二年五月易名為「台灣糖業研究所」，迄今已屆九十五五年，在這漫長的歲月中，雖然滄海桑田不斷的變遷，仍能延綿不絕，並能發揚光大，使我國糖業經營日益成長。

# HISTORY

Sugar and cane research in Taiwan was initiated in 1900 with the establishment of the Sugarcane Nursery and Trial Farm at Ta-mu-jiang (Hsinhwa) Tainan County. In 1906, it was renamed the Sugarcane Experiment Farm. In 1932, due to the increasing importance of agricultural development and sugar production, it was moved to Tainan City and expanded as the Taiwan Sugar Experiment Station under the jurisdiction of the Taiwan Governor's Office. At the same time, a Sugarcane Crossing Nursery was established at Wantan, Pingtung County.

After the restoration of Taiwan to the Republic of China in 1945, the station became one of the research institutes of the Taiwan Provincial Government. In 1948, the station was transferred to the Taiwan Sugar Corporation. In 1949, the Sugar Research Evaluation and Appraisal Committee was set up at the station, which serves as an initiative in agricultural research management in Taiwan. In 1973, once again the station was renamed, this time the Taiwan Sugar Research Institute (TSRI). Although many events have transpired in its 95-year history, its successive research achievements have produced a steady stream of contributions to the development of the sugar industry in Taiwan.



研究大樓  
Research Building

# 任 務

- 一、培育優良甘蔗及花卉品種，領先國際水準。
- 二、改良甘蔗及花卉栽培技術，提升蔗田生產能力。
- 三、改進砂糖製造方法，提高砂糖製造效率。
- 四、加強副產研究利用，開發多層次新產品。
- 五、配合公司經營轉型，積極發展多角經營，有效提升競爭能力。
- 六、轉移各項研究成果，提升並引導國內產業界生產技術，善盡國營事業之社會責任。

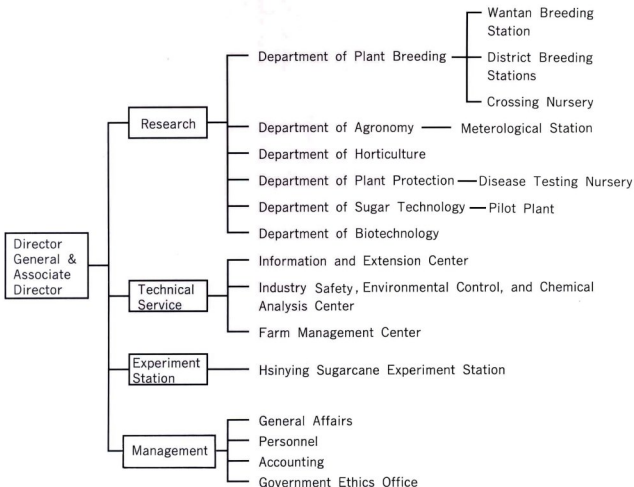
# 組 織



# OBJECTIVES

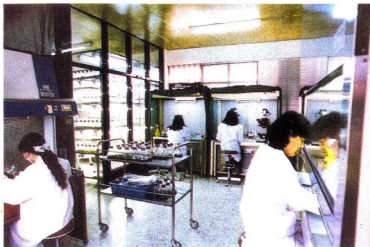
1. Breeding of new sugarcane and *Phalaenopsis* varieties to maintain Taiwan's position as one of the world's leading sugarcane and *Phalaenopsis* producers.
2. Improvement of cultivation techniques to increase cane yield per unit area.
3. Improvement of the technology of sugar manufacturing efficiency.
4. Enhancement of biotechnological research to develop new products.
5. Promoting new research on land utilization commensurate with the TSC diversification policy.
6. Transfer of research achievements to private industry to upgrade production.

# ORGANIZATION





園藝系全景  
A view of the Horticulture Department



組織培養室  
Tissue Culture Laboratory



發酵製程之電腦控制  
Control of the fermentation process  
by computer

# 人 員

現有人員：238人

研究人員：92人（38.7%）

博士：16人

碩士：37人

學士：33人

其他：6人

技術人員：65人（27.3%）

管理人員：31人（13.0%）

評價人員：50人（21.0%）

# STAFF

TSRI has a staff of 238 including (to May 1994):

— Researchers: 92 (38.7%)

— Technicians: 65 (27.3%)

— Managerial staff: 31 (13.0%)

— Assistants: 50 (21.0%)

# 設 備

圖書：51,790餘冊

雜誌：590種

研究設備：2,240件

試驗土地：264公頃（包括實驗場）

# FACILITIES

Collection in the Technical Library: 51,790 volumes

Subscriptions to scientific journals: 590

Research equipment: 2,240 pieces

Land available for experiments: 264 ha.

(including the Hsinying Experiment Station)

圖書館  
The Library



# 近年來重要研究成果

本所各部門歷年來完成之研究成果甚為豐碩，研究報告散見於國內外及本

所之各種刊物，其中大部份已推廣至現場應用，茲擇重要者簡述如下：

## 甘蔗育種

1. 光復以來，本所育成甘蔗新品種計六十四個（F135-F178，ROC1-ROC 20），目前自育品種佔全部栽培面積100%，84/85年期主要栽培品種有F160、ROC1、ROC5、ROC7、ROC9、ROC10、ROC15、ROC16、ROC18、ROC20等。

民國六十八年六月，將新品種冠名由「F」改為「ROC」，並一舉推出ROC1、ROC2、ROC3、ROC4四個新品種，其中以ROC1最為優異，具有特早熟、高糖、豐產、抗病力強及適應性廣等特性。民國六十九年至七十七年，推廣ROC5至ROC12八個品種。ROC5、7、9、10適應性廣；ROC6、8、11耐瘠，宜於地力較差之石礫地種

植；ROC12特別適於機械青採。79年4月命名推廣ROC13號，適於花蓮地區栽培。80年4月命名推廣ROC14號、15號。81年4月命名推廣ROC16號，適應栽培之地區包括虎尾、嘉南、高屏等區域地力中等或中等以上有灌溉之砂壤土、壤土、粘壤土及粘土。82年6月命名推廣ROC17號，適於砂土地栽培。83年4月命名推廣ROC18、ROC19及ROC20。ROC18適應於嘉南平原、屏東平原之壤土、砂壤土。ROC19在花蓮地區之壤土、砂壤土與石礫地特別適應。ROC20則適應於紅土台地及西部濱海平原。由於優良新品種之不斷推出，有助於農業科技之提升。



本所培育之主要甘蔗品種

Major sugarcane varieties bred and released by TSRI

# RESEARCH ACHIEVEMENTS

The research achievements made by each department of TSRI have been abundant and contributory to the development of the sugar industry in Taiwan. Research results and scientific findings have been reported in publications or periodicals, and most of them are extended to TSC's sugar factories and farms as well as to sugarcane growers. The significant accomplishments in recent years are as follows:

## Sugarcane Breeding

1. In Taiwan, a total of 64 sugarcane varieties, including F135-F178 and ROC1-ROC20, have been released by the TSRI breeding programs for sugarcane and sugar production since 1946.

The sugarcane variety census in 1994-95 indicated that 'ROC' and 'F' varieties constitute the major sugarcane varieties involving ROC10, ROC1, ROC9, ROC16, ROC15, F160, ROC7, ROC5, and ROC13, which occupied 49.10%, 12.76%, 9.17%, 8.09%, 5.64%, 4.36%, 4.03%, 2.22%, and 1.57% of total cane hectareage, respectively. From 1979, the varieties released by TSRI were prefixed 'ROC' instead of 'F'. ROC1-ROC4 were released in 1979; ROC1 was characterized as having high sucrose content and early maturing. ROC5-ROC12 were released between 1980 and 1988. ROC5 was noted as a variety with heavy tonnage but poor disease resistance. The adaptability of ROC6, ROC8, and ROC11 were specific to gravelly soil. ROC7, ROC9, and ROC10 were early maturing and had high sugar content with heavy tonnage and wide adaptability.

ROC12 was suited for mechanical harvesting. ROC13, released in 1990, was only adapted to the Hualien area in east Taiwan. In 1991, ROC14 and ROC15 were released; ROC15 was popular in the gravelly soil of southern Taiwan. ROC16 became a widely grown variety soon after it was released in 1992 due to its early maturation, high sugar content, and heavy tonnage. ROC18, ROC19, and ROC20, released in 1994, had a common characteristic of high sugar content. ROC18 was especially adapted to loam and sandy loam in the Chianan and Pingtung plains. ROC19 was only suited for growing in the Hualien area. ROC20 matured earlier and contained higher sugar content than ROC1. It was considered to have good sugar content and cane yield in the red highland soil and coastal plain of western Taiwan. The cultivation of these three new varieties is expected to increase in the near future. TSRI will continue to make sugarcane breeding and the release of new and improved varieties major goals of its breeding programs.

2. 為擴大甘蔗種源及優良遺傳因子之利用，本所曾在台灣各地採集野生甘蔗及芒數百株系，並與甘蔗雜交，俾能將耐瘠、耐旱、多蘗、抗病等遺傳因子導入甘蔗血統中，並已培育成功野生甘蔗第三代後裔，具抗露菌病、黑穗病、銹病、嵌紋病之特早熟高糖品種ROC16。此外，歷年來曾向二十三個國家引進了二千餘個品種，先後選拔優良遺傳特性，以雜交方法導入新品種（系）中。

3. 本所自民國五十八年開始，進行應用甘蔗組織及細胞懸浮培養，以增加遺傳變異，迄止目前已建立培養之技術與方法。此外，已成功地分離出甘蔗組織原生質體，並建立以已分化之綠芽包圍原生質體材料，導入分化因子，促使甘蔗原生質體分化成植株技術，此技術為世界上目前將甘蔗原生質體分化成植株重複試驗成功之首例。

甘蔗於雜交溫室雜交情形  
Sugarcane crossing in greenhouse



利用光期調節室促進甘蔗開花  
Photoperiodic house for induction of  
sugarcane flowering

2. In order to increase TSRI's sugarcane germplasm collection, more than 200 clones of *Saccharum spontaneum* and *Miscanthus* were collected from different localities in Taiwan. Some of them were selected and crossed with sugarcane to introduce the genes for adaptability to sterile soils, drought resistance, heavy tillering, and disease resistance into new varieties. Selection from the nobilized hybrids of *Saccharum spontaneum* was very successful. ROC16 is a progeny of F171 and 74-575, which were derivatives of *Saccharum spontaneum* indigenous to Taiwan. It matures very early and is high in sugar content. It is resistant to downy mildew, smut, mosaic and leaf bright diseases. More

than 2,000 varieties have been introduced from 23 countries in order to select desirable characteristics for breeding new varieties.

3. Continuous research on sugarcane tissue culture and cell suspension culture has been done since 1969 to increase the genetic variation in sugarcane. This has enabled division and regeneration of sugarcane protoplast isolated from suspension cells. After inoculation, the protoplast callus onto a solid medium. Then the callus disk is surrounded by callus pieces having small, green differentiated buds which are transferred to a differentiation medium where green buds are produced. The buds then grow into plantlets.



在細胞座墊上的再生綠芽

Green buds grown on a cell-pad



原生質體植株種於田間

Protoplast-regenerates planted in the field

由甘蔗原生質體再生植株

Sugarcane plants regenerated from protoplasts

# 甘蔗農業技術

1. 利用暗管排水方法改良鹽分地及鹽斑地，已完成自營農場2,500公頃鹽分地改良工作，單位面積產蔗量平均增加30%以上，績效極為明顯。此外並協助農民設置2,000餘公頃暗管系統，增加各種作物產量達40%以上，對沿海居民生活之改善，助益甚大。
2. 最近完成之地下管路畦溝灌溉及施肥方法，效果優異，除可節省用水及灌溉工資外，又可節省施肥費用。根據經濟效益評估，可節省灌溉用水30 mm/次、灌溉工資400 元/次/公頃及施肥費用1,500 元/公頃，如一年灌溉五次，其節省之用水、人工及肥料成本即高達2,400 元/公頃。
3. 開發完成水井管理電腦化程式軟體建構，能簡便而直接分析水井性能、抽水效率及給水經濟效率，並可標示水井性能之變化趨勢，作為更新及修護

之依據。此外並製作完成全公司地層圖電腦查詢系統，將地層資料圖形化，可供快速查閱及對照，對新建或更新水井，甚具應用價值。

4. 發展完成蔗田土壤熱水可溶性氮分析法，當為評估土壤氮素供應能力之指標，並建立本省蔗田氮素肥力評級標準，作為改進蔗作肥培管理及增進地力之依據。據本研究顯示，自營農場蔗田土壤熱水可溶性氮 ( $N_{hws}$ ) 之頻度分佈，屬於  $N_{hws} \geq 34$  ppm 高量範圍，可暫免施用氮肥者佔18.7%。以全公司自營農場每年期種蔗33,000公頃，平均施氮量約為190 kg/ha，氮肥造價以尿素之14.95 元/kg N (6,280 元/噸) 計，共可節省氮肥款約一千七百五十萬元（以暫免施用氮肥之部份計算效益）。



鹽分地改良前(上)及改良後(下)甘蔗生長情形

Growth of sugarcane before (top) and after (bottom) reclamation of saline soil



緩效性有機肥料

Slow-release granular fertilizer developed by TSR I

# Improvement of Sugarcane Agronomy

1. Some 2,500 hectares of saline soil of TSC's farms were reclaimed using a subsurface tile drainage technique which resulted in a cane yield increase of more than 30%. When farmers applied the technique to about 2,000 hectares there was a 40% yield increase, which resulted in an improvement in their living standards.
2. Water and fertilizer are applied simultaneously to a sugarcane field through an underground pipe system developed at TSRI. It facilitates more economical use of water and decreases labor cost. For each hectare of land, the cost of water and labor associated with irrigation and fertilization can be reduced by NT\$2,400 (approximately US\$90) per annum.
3. With the TSRI-developed well water management system data on qualification, water pumping efficiency and the economic effi-

ciency of a water supply can be analyzed. The changing tendency of those wells can also be analyzed as a reference for well maintenance or renovation. In addition, a well-log inquiry system has been developed. It consists of 24 patterns, representing different soil textures, ranging from clay to cobble. An aquifer graph can also be referred to for more detail.

4. Soil nitrogen extracted with hot water may now be used as an index for nitrogen application in sugarcane fields. It was found that about 18.7% of TSC's 33,000 ha contained hot-water-soluble N greater than 34 ppm. It is suggested that N would not be needed for those soil in that crop year. Based on the rates of 190 kg N/ha and NT\$14.95/kg N, around NT\$17.5 million (or US\$650,000) could be saved per year on TSC's cane fields.



挖溝 Ditch digging



埋管 Pipe installation



施肥桶 Tank for fertigation

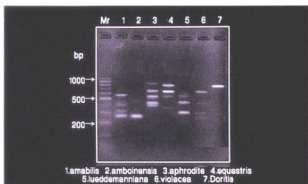


施灌 Irrigation



台糖小紅花 *Phal.* (*Sophie Hausermann* × *equestris*) 'TSC33' 獲得1994年日本東京巨蛋蘭展銅牌獎

*Phal.* (*Sophie Hausermann* × *equestris*) 'TSC33' won the Bronze Medal at the Japan Grand Prix International Orchid Festival in 1994



利用DNA增幅指紋分析蝴蝶蘭種間的差異，可幫助蝴蝶蘭品種的鑑定

Application of DNA amplification polymorphisms in different species to identify the important varieties of *Phalaenopsis*



台糖噴點花 *Phal.* *Stone Pinto* 'TSC32' 獲得1994年日本東京巨蛋蘭展銅牌獎

*Phal.* *Stone Pinto* 'TSC32' won the Bronze Medal at the Japan Grand Prix International Orchid Festival in 1994

1. 本所於民國七十七年四月一日成立園藝系，積極從事蝴蝶蘭品種改良工作。迄今除搜集保存29種原生種及891個優良雜交品種，分別將其植株生長性狀及開花特性存入電腦編號建檔外，已育成68個優良品種，經英國皇家園藝協會核准以Taisuco為命名首字登錄。

2. 本所育成之蝴蝶蘭優良品種，由於花色出眾，廣受好評，參加國內外蘭展屢獲大獎。八十二年度計日本東京巨蛋國際蘭展TSC20得到大會銅牌獎，台灣第7屆國際蘭展17個品種獲得20面獎牌（其中TSC8及TSC19得到美國蘭協會銀牌獎），英國第14屆世界蘭展10個品種獲得13面獎牌（其中大白花品種 *Phal.* Taisuco Kaaladian "TSC27" 獨得大會銀牌獎、分組冠軍獎、優良品種第一獎及大自然分組第一獎）。另外，在台北華南銀行春季蘭展及台南蘭協全國蘭展亦分別有一品種得到優等獎及二個品種得到佳獎。

3. 一般使用的培養基對不同品種的效果不一，尤其對原生種交配之品系，往往無法誘導發芽或發育。本所研發之G7培養基，可使多數蝴蝶蘭組合種子發芽發育成為原球體，尤其對原生種品系可使原球體發育良好，在G7培養基中經過六個月後仍有90%以上的存活率。此外，G7培養基亦可作為短期貯存原球體之培養基，以縮短育苗期限。

# Quality Agriculture

1. The Horticulture Department was established on April 1, 1988 at TSRI to undertake research and development of *Phalaenopsis*. There were 29 wild species and 891 varieties with excellent characteristics being collected and selected as parental materials. Their characteristics were computerized for the convenience of the hybridization programming to produce commercial seedlings and to improve the qualities of this orchid. During the past years, 68 excellent hybrids were bred at TSRI and registered with the denomination of 'Taisuco' (an abbreviation for Taiwan Sugar Corporation) at the Royal Horticulture Society (RHS), England.

2. Many excellent clones were awarded prizes at international orchid shows on several occasions in 1993. The *Phal.* Stone Pinto 'TSC20' won the Bronze Medal (BM) in the Japan Grand Prix International Orchid Festival. At the 7th International Orchid Show of Taiwan (IOSOT), 17 TSC clones won 20 prizes, in particular the *Phal.* Atien Kaala 'TSC8' and *Phal.* Stone Pinto 'TSC19' won the Award of Merit (AM) of the American Orchid Society (AOS). At the 14th World Orchid Conference and Show in Glasgow, 10 TSC clones won 13 prizes, especially the *Phal.* Taisuco Kaaladian 'TSC27' which won the silver award, the trophy, and first place in excellence in the white *Phalaenopsis* hybrid category. Another clone won the prize at the Spring Orchid Show of Hwa Nan Bank held at Taipei, and two clones won the excellent prize at the National Orchid Show held at Tainan.

3. The germination rate of *Phalaenopsis* seeds of different crosses sown on common medium varied a lot, especially seeds derived from hybridization of the wild species which did not effectively develop on such medium.

The G7 medium developed by TSRI proved to be highly effective for seed germination and protocorm development, especially for the crosses of wild species. For example, on G7 medium, the rate of germination and survival maintained at more than 90% and lasted for more than six months. The G7 sowing medium could also be used as a short-term preservative medium for protocorms in order to shorten the seedling-raising period.



台糖大白花品種 *Phal.* Taisuco Kaaladian 'TSC27' 獨得英國第14屆世界蘭展銀牌獎、分組冠軍獎、優良品種第一獎及大自然分組第一獎

*Phal.* Taisuco Kaaladian 'TSC27' won the silver award, the trophy, and first place in the excellent white *Phalaenopsis* hybrid category at the 14th World Orchid Conference and Show in Glasgow

4. 研發完成之DAF增幅指紋生物技術，可用來鑑定蝴蝶蘭品種，做為新品種申請專利之有效依據，亦可做為育種上分析各種性狀遺傳行為之高解析度分析工具。

5. 本所開發完成之簡易栽培箱，獲經濟部中央標準局新型專利10年（81年9月20日至91年9月20日），已籌設生產線推廣上市。

6. 發展蝴蝶蘭花期調節設施，本設施具有降溫及加溫功能，可視蝴蝶蘭需要量及價格調節花期，生產盆花及切花供應市場。在大林糖廠1,000平方公尺

蘭房使用結果，一次可處理17,000株蝴蝶蘭，使其週年生產切花及盆花，增加收益達300萬元。本設施已獲得中央標準局第 69590 號新型專利十年（80年11月21日至90年11月21日），並移轉花農應用。

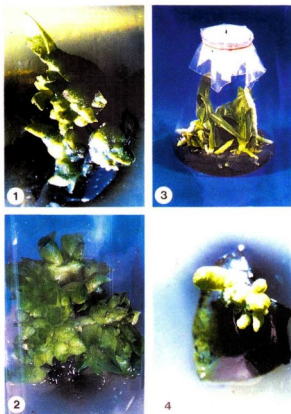
7. 開發完成之移動式植床自動化生產設施，可在作業室中自動進行灌溉（噴灌與淹灌）、施肥、噴藥、燻蒸、育苗等工作，除可大量提高作業效率與效果，減免人員參與，減少溫室淋濕與環境污染外，且能達到水、肥、農藥等資源之回收利用，值得推展。



栽培於簡易栽培箱之石竹盛開美麗的花朵

Good flowering of dianthus cultivated in a simple hydroponic box

4. DNA amplification fingerprinting (DAF) was developed by TSRI. It has been used to identify varieties of *Phalaenopsis* and to protect the patent right of new varieties bred at TSRI. It could also be a useful tool for genetic behavior analysis in *Phalaenopsis*.
5. A simple nutriculture box for growing vegetables and flowers was developed at TSRI and awarded ROC patent no.76379. This convenient kit can be placed on a rooftop or terrace for growing greens at home. It has been transferred to the Extension Service.
6. A microclimatic control tunnel with cooling and heating systems has been developed to control flowering in *Phalaenopsis* and has made the year-round flowering of *Phalaenopsis* possible. Use of the facility in the 1,000 m<sup>2</sup> greenhouse at Da-lin Sugar Factory for flowering regulation of *Phalaenopsis* was very successful. Some 17,000 plants under such treatment produced cut and pot flowers year-around, producing NT\$3 million in revenue. This facility was awarded ROC patent no. 69590.
7. For the automation of cultivation in *Phalaenopsis*, a portable bench system was developed in accord with all cultivation practices, including watering, fertilizer application, pesticide spraying, seedling raising, etc. It has proved to be highly effective in reducing labor and environmental pollution and in the recycling of resources such as water, fertilizer, and pesticides.



利用微體繁殖技術大量生產蝴蝶蘭苗

- ①：自花梗芽誘生之不定芽
- ②：分生繁殖之不定芽
- ③：誘生根系之組培苗
- ④：葉片誘生之擬原球體

#### Mass production of *Phalaenopsis* plantlets via micropropagation

- ①：Adventitious shoots induced from flower stem
- ②：Rapid multiplication of adventitious shoots
- ③：Healthy plantlets rooting on medium
- ④：Protocorm-like-bodies developed from a leaf explant

# 植物保護

1. 台灣地處亞熱帶，最宜病害發生，治本之方法仍為選育抗病品種。本所育成之甘蔗新品種均於新品系區域試驗時，使其經過對露菌病、嵌紋病、葉枯病、白葉病、黑穗病、葉燒病、赤腐病等重要病害之抗病性測定，再選拔抗性較強之品種供作經濟栽培或育種材料，此一辦法實施以來對系統性病害之防除收效甚大。此外，對抗病性測定技術之改進，諸如田間排列、對照品種之選用及接種方法等，亦不斷改進，以提高測定結果之正確性。
2. 本公司自營農場砂土蔗園普遍發生根瘤、根腐及螺旋等寄生性線蟲為害，影響甘蔗產量甚鉅。早期以D-D及EDB等藥劑行土壤消毒，防除效果甚佳。近年來研究改用Thimet, Ter-

racur P, Counter等新藥劑，甘蔗增產率平均達20%以上。又以蔗園休閒或種植抵抗作物（太陽麻、落花生）措施後，再施用Counter粒劑，亦可提升甘蔗增產率達29%以上。

3. 本公司自營農場每年因螟蟲為害所損失之糖量平均約5,000噸。用藥劑防治效果不彰，且易引起環境污染，嗣經研究採行生物防治，以人工大量繁殖蔗螟赤眼卵蜂（*Trichogramma chilonis*）釋放於田間，可使原料莖節間螟害率較以往減少50%。此外，為配合政府稻田轉作政策，接受農業委員會委託，代為大量繁殖玉米螟赤眼卵蜂（*Trichogramma ostriniae*），提供農民釋放，防治玉米螟蟲。



蔗螟赤眼卵寄生蜂

*Trichogramma chilonis*, an egg parasitoid of sugarcane borers

# Plant Protection

1. Taiwan is located in the subtropical region with plenty of rainfall which favors the development of various sugarcane diseases. Disease-resistance tests on all new clones at the Regional Test stage have led to the release of new varieties resistant to major diseases of sugarcane such as downy mildew, mosaic, leaf blight, leaf scald, smut, leaf scorch, rust, etc. This has reduced the incidence and damage caused by these diseases. Furthermore, improvements have been made on the areas of evaluation, experimental design, and in choosing check varieties, and the method of artificial inoculation to obtain more accurate results.
2. The root-knot nematode, root-lesion nematode, and spiral nematode are commonly found in sandy soil sugarcane fields. Formerly, D-D and EDB were used for their control. Recently, the application of Thimet, Terracur P, and Counter has been recommended and has resulted in a 20% increase in sugarcane yield.
3. On the average, sugarcane borer infestation reduced sugar yield in TSC farms by 5,000 tons. Artificial release of *Trichogramma chilonis* in cane fields resulted in more than 50% decrease in borer infestation on the internodes of cane stalks. In accordance with the agricultural policy of converting from rice cultivation to other crops, the mass production of *Trichogramma ostriniae* was carried out under the aegis of the ROC Council of Agriculture. The egg parasitoid has been released to farmers for the control of corn borers.



釋放赤眼卵寄生蜂防治蔗螟

Release of *Trichogramma chilonis* for control of sugarcane borers

4. 對蔗龜、金針蟲、白蟻及鋸天牛等地下害蟲，早期施用 BHC, Aldrin, Heptachlor等藥劑防治，甚具效果，頗有助於宿根栽培。後因上列各藥劑有殘留物之不良影響，禁止使用，遂逐漸引進低毒性藥劑如Thimet, Teracur P, Counter以及逸散控制殺蟲劑等，經數年來之試驗，無論新植、宿根均有15%以上之增產。

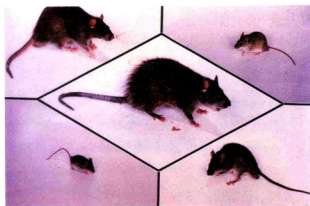
5. 為大量生產無嵌紋病毒（SCMV）及矮化病菌之紅甘蔗（Badila）健康種苗，俾能為農民改進生食紅甘蔗之品質與產量，並增加本公司之收益，已建立莖頂快速培養技術，可使一支莖頂於2年3個月獲得150萬支雙芽苗，供50公頃土地種植。目前已應埔里及二水農會要求，將培育完成之健康種苗，送至該地進行示範栽培。



葉燒病（左）及根莖基部乾腐病（右）病徵

Symptoms of leaf scorch (left) and root and basal stem rots (right)

4. Since use of persistent insecticides like BHC, Aldrin, and Heptachlor has been banned, nonpersistent insecticides such as Thimet, Terracur P, Counter, and the controlled-release insecticides such as CR Terbufos and CR-Chlorpyrifas are recommended for the control of soil insects, including white grubs, wireworms, and longhorn beetles. Sugarcane yield of either planted or ratoon cane increased by 15% after the application of these insecticides.
5. For the mass production of healthy seed canes devoid of sugarcane mosaic virus (SCMV) and ratoon-stunting disease, a rapid multiplication technique was developed by shoot tip culture at TSRI. One and a half million two-bud seed canes can be obtained from a single shoot tip within 27 months, sufficient to plant 50 hectares. Certified seed canes have been distributed to farmers through the Puli and Urshui Farmers' Association for cultivation demonstration in these areas.



蔗園五種野鼠

Five species of wild rats in Taiwan sugarcane fields

利用固定毒餌站防除野鼠

A permanent bait station for wild rat control



# 環境保護

1. 以豬糞尿廢水處理之兼曝氣系統，應用於糖廠廢水處理，採自然接種，不需添加人工微生物製劑，既省錢又安全可靠。試驗結果，COD 30,000 ppm之廢水，經30天之兼曝氣處理，放流水之COD降至120 ppm以下，去除率超過99.6%。本系統已推廣應用於糖廠，今年度計有虎尾、溪湖、蒜頭、南靖、善化、仁德、旗山、屏東、南州及花蓮等十個糖廠興建兼曝氣處理系統，本所有關人員參與規劃、設計、監督及訓練等工作，並積極協助現場人員完成試車與運轉。
2. 由本所開發之豬糞尿廢水兼曝氣處理系統處理效果優異，其出流水可符合放流標準。由於運轉操作簡便，造價便宜，已為公司畜殖處全面推廣應用，並節省二億六千九百萬元建造費用。
3. 酒精膠為有機廢水，含有豐富氮、鉀，

利用土壤自淨能力適量（以不超過250噸/公頃為宜）灌溉，不但濾液之BOD<sub>5</sub>、COD、SS及透視度皆能達到環保規定標準，而且可以補充蔗田有機質，有效維持地力，減低肥料施用量，節省耕作成本。

4. 由豬糞尿處理池分離之光合成細菌與除氮細菌具有明顯去除惡臭性硫化物之效果，可開發為除臭菌劑或魚池淨劑。光合成細菌為各種除臭微生物中最具應用價值之菌種，以稀釋酒精廢膠（Bx 3°）培養基在30°C通風培養二天即可達到最高產量，對豬糞尿之適應力亦極強，甚具開發價值。
5. 本公司製糖工場鍋爐以蔗渣為能源，煙道氣含塵高，經發展高差壓雙層濕式篩板除塵器，處理蔗渣鍋爐煙道氣，除塵率達99%以上，已符合目前管制標準。



養豬廢水之兼曝氣處理

Treatment of wastewater from a pig farm by a facultative-aerobic system



糖廠廢水之兼曝氣處理

Treatment of wastewater from sugar mill by a facultative-aerobic system

# Environmental Protection

1. A lagoon and forced-aeration system for the treatment of sugar refinery wastewater was developed and deployed at a TSC sugar refinery.

In this system, no biological agent was introduced, and the microorganisms grew naturally without inoculation. Tests showed that COD in wastewater as high as 30,000 ppm, after 30 days of hydraulic-retention time, was reduced to 120 ppm. Percentage removal of COD in wastewater reached 99.6%. This system has been extended to many TSC sugar factories, e.g., Huwei, Chihu, Suantow, Nantsing, Shanhua, Renteh, Chishan, Pingtung, Nanchow, and Hualien through the assistance of TSRI.

2. Pig waste was separated into two parts: solid and slurry. The solid waste was turned so that it would compost satisfactorily through ventilation fermentation. The slurry waste was biologically treated by lagoon and forced-aeration systems. This infrastructure-simple system is effective, convenient, and low-cost in operation. In terms of construction cost alone, the pollution-control facilities of all the TSC pig farms could save NT\$269 million (equivalent to US\$10 million).

3. Based on the hydraulic loading capacity of soil, alcoholic slops were found able to be disposed of in sandy loam when 250-300 t/ha of it was applied in cane fields. The BOD<sub>5</sub>, COD, SS, and transparency of leaching water can meet EPA standards.

No soil deterioration or groundwater pollution were found after application. Neither cane growth nor cane yield were found

suppressed in lysimeter and field experiments.

4. Several strains of photosynthetic bacteria isolate showed excellent deodorizing activity in the wastewater of piggeries. These microbes were selected for the production of deodorizing microbial agents or clarifying agents for fishponds. The microbes were cultivated with diluted alcohol slops (Bx 3°) medium at 30°C in the fermentor. The cell growth reached the maximum within two days. These microbial agents showed good adaptability to the pig wastewater and are worthy of development.
5. Bagasse is widely used as an alternative source of energy in TSC sugar mills. In order to remove the dense dusts from the flue gas of bagasse boilers, a double-layer sieve plate scrubber was developed. The percentage removal of dust from the flue gas reached 99%, meeting government standards for exhausted flue gas.

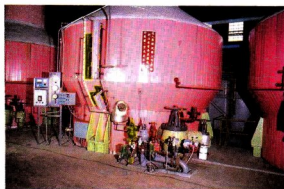


酒精醪灑施田間

Alcoholic slops sprinkled on a sugarcane field

1. 發展結晶程序電腦監控系統，本軟體已獲內政部核准三十年著作權（80年9月30日至110年9月30日），可適用於包括煮糖之所有結晶程序，具有靈活之操作性，深受現場工作人員歡迎。如各罐每一種糖膏均可建立其各自之煮糖曲線，操作員可以輸入一數值，將此曲線任意平移，在煮糖中途因材料或真空等發生重大變異時，可隨時調整控制曲線。
2. 開發清淨程序電腦監控系統，本軟體已獲內政部核准著作權五十年（82年6月25日至132年6月25日），蒸發罐操作由手動轉換為自動後，30分鐘內各效罐之液位，即可達動態平衡，變動

範圍 $\pm 4\%$ 。而糖漿濃度則當壓榨量變化在20%以內時，可維持在 $62 \pm 2Bx$ 。



電腦煮糖

Automatic pan boiling controlled by  
a personal computer

## 新產品開發

1. 利用石膏及廢紙纖維製造高品質耐火之石膏纖維板已開發完成，其強度高達  $96 \text{ kg/cm}^2$ ，較國產之  $51 \text{ kg/cm}^2$ 、美國之  $52 \text{ kg/cm}^2$  及德國之  $59 \text{ kg/cm}^2$  優異。
2. 利用新塑合劑、新製程、去髓蔗渣、熱機械漿等可製成各種密度之建材塑合板，其品質符合國家標準，適合傢俱製造之用。由本公司設廠生產，甚具競爭潛力。
3. 以蔗渣為原料製造代用水草及蛇木植材，供園藝系機械栽培蝴蝶蘭試用結

果，效果良好，可廣為推銷應用。

4. 以蔗漿為主原料，配合食品級添加劑，製成完全無公害紙餐具。採用濕法者，一體成型紙餐具，適合深碗類之製造；採用乾法者，先製成可塑性紙板後，以類似保麗龍加工法熱壓成型，適合淺盤類之加工。本產品於室溫可耐水七日以上， $100^\circ\text{C}$ 沸水可耐10分鐘以上。
5. 代用保利龍作為無公害包裝用之可分解蔗渣墊材，已完成研究，俟市場調查後，即可生產。

1. An automatic control system for the entire crystallization procedure, including pan-boiling control was developed. It was quite feasible for use by sugar mill operators. The software for this system was registered for 30 years, providing copyright protection from 1991 to 2021.

In this system, one industrial personal computer handles the complete cycles of the pans in the boiling station. The operator need only choose the working massecuite then the relative sequence and parameters are automatically set. The boiling curve can be moved upward or downward together just by setting one value.

2. An automatic control system for multiple-effect evaporator set was developed. The

system could adjust the set points of some critical loops adequately to handle the different situations appertaining to milling and evaporation stations. The system's software was registered for 50 years, providing copyright protection from 1993 to 2043.

It proved that the system could have a tighter control than the original single-loop control system. The evaporator-set level could be maintained at set points  $\pm 4\%$  and the thick juice density of the last effect could be maintained at set point  $62 \pm 2$  Bx, provided that the milling capacity did not exceed its 20% nominal value nor last for 2 hours.

## Exploration of New Products

1. Using bagasse and wastepaper fiber to make gypsum fiber fireproof board was developed. Bending-strength test of the board required  $96 \text{ kg/cm}^2$ , higher than that of locally made ( $51 \text{ kg/cm}^2$ ) and imported products ( $52\text{-}59 \text{ kg/cm}^2$ ).
2. Improved particle board of various density was developed. Using depithed bagasse and different synthetic resins, the products produced had superior quality and met national standards. It could be used for furniture manufacturing and as construction material.
3. A planting medium made from bagasse to replace sphagnum moss and natural fern in the cultivation of *Phalaenopsis* was devel-

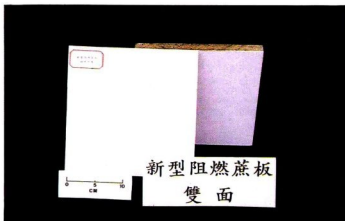
oped. It proved to be very effective and could be used in large-scale operations.

4. Moulded eating utensils made from bagasse pulp and biodegradable waterproofing agents were developed. The wet-moulding process produced deeper-shaped utensils while dry-moulding was used to prepare the paper boards which could be moulded into shallow food trays. The products resisted water permeation up to seven days at room temperature or more than 10 minutes at  $100^\circ \text{C}$ .
5. Nonpolluting, biodegradable padding made from bagasse fiber was developed. This product could replace polystyrene foam used in (EPS) packing.



酒精廢醪有機肥料  
Organic fertilizer from ethanol distillery slops

新型阻燃蔗板  
A modern fireproof bagasse board



6. 以自行選育之菌株 *Brevibacterium* sp. P1-13 在小槽饋料批式醱酵，使用粗砂加糖蜜培養基，醱酵37小時堆積10%離胺酸，醱酵43小時堆積11%離胺酸，已達國際水準。

7. 酒精廢醪產量為酒精產量之10倍，且為含高BOD物質，未經處理排放，嚴重污染環境。將酒精廢醪濃縮後，與化學肥料配合，製成酒精廢醪液體有機肥料，或將廢醪濃縮液固化為廢醪粉後，配合化學肥料，製成酒精廢醪固體有機肥料，經作物栽培試驗，證實肥效極為優異。

8. 本所分離之耐高溫菌株T-17，經工場規模試驗，證實其醱酵效率比目前使用菌株（花蓮株）高2.5%。

以5-KL醱酵槽進行饋料批式醱酵試驗，於60小時可生產14%酒精，比目前之批式醱酵僅生產10%以下酒精增加不少，且可節省蒸餾費用。

此外，將酒精廢醪於配製醱酵醪時，取代用水40%，亦即回用40%，對酒精醱酵無影響，可大幅減少廢醪濃縮費用。



生物完全分解  
無公害紙餐盒

生物完全分解無二次公害蔗漿紙餐盒  
A completely biodegradable paper meal  
box from bleached bagasse pulp



生物可分解蔗渣墊板  
Biodegradable padding materials from bagasse fiber

6. Studies on fed-batch fermentation for L-lysine production by *Brevibacterium* sp. PI-13 in a raw sugar medium were completed. A 10% L-lysine · HCl broth produced within 37 hr, then increased to 11% within 43 hr, met the international standard.
7. Alcohol distillery stillage, a high BOD wastewater, was concentrated by vacuum evaporator. The concentrated stillage mixed with chemical fertilizer could be applied to fields as organic fertilizer. Solid fertilizer could also be formulated with the concentrated stillage. Field experiments indicated that the effectiveness of this organic fertilizer was very significant.
8. A powerful new yeast for ethanol fermentation, T-17, was isolated at TSRI. Being a rapid fermentation, low pH, and highly tolerant strain, it produced 2.5%, v/v, more ethanol than that of the Hualien strain under the industrial trial.

Moreover, the production of highly concentrated ethanol could be achieved at reduced cost. Results obtained from tests at a pilot plant by the fed-batch process with a 5-KL fermentor showed that the fermentation finished within 60 hr and the ethanol concentration reached 14%, v/v, much higher than that of the batch fermentation (less than 10%, v/v).

In order to minimize the volume of processing water required and the stillage generated in alcohol fermentation, the recycling of stillage instead of processing water in the mashing was very promising. Results obtained from batch experiments showed that alcohol fermentation remained fairly constant when up to 40% stillage was recycled for mashing. Therefore, the cost of stillage evaporation could be greatly reduced.

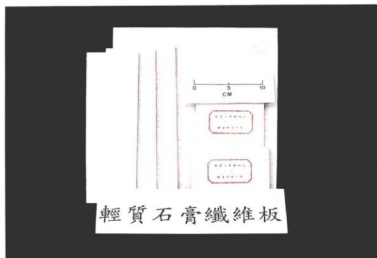
9. 偶合糖為低蛀牙性、不產酸之麥芽飴樣糖漿，可抑制砂糖之再結晶，改善糖果之口感及咬感，並使食品表面光澤豔麗。台灣麥芽糖工場很多，但尚無生產偶合糖工場。本所已完成環狀糊精糖苷轉移酶生產之研究，並於實驗室製成偶合糖及環狀糊精。

10. 酵母核酸經磷酸二酯酶分解後，成為四種核苷酸（5'-CMP, 5'-UMP, 5'-GMP及5'-AMP），為價格昂貴之製藥原料。本所已完成從含多量雜質之深褐色液體中分離精製 5'-UMP，並將製程提供公司生產應市。



無公害蔗渣盆栽材料  
Nonpolluting planting medium  
from bagasse

輕質石膏纖維板  
Lightweight gypsum fiber board



輕質石膏纖維板

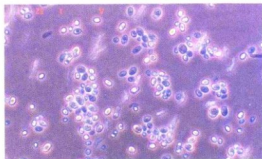
9. The production of  $\beta$ -cyclodextrin and coupling sugar by a cyclodextrin glucanotransferase (CGTase) produced by an alkalophilic *Bacillus* sp. mutant No.35 was developed at TSRI.

CGTase with a multiple-reaction mechanism is a vital enzyme to generate cyclodextrins and coupling sugar.

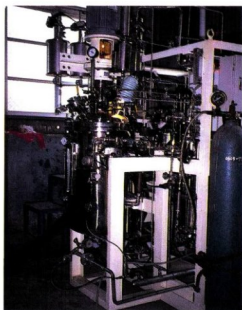


利用環狀糊精糖苷轉移酶生產環狀糊精及偶合糖  
Production of  $\beta$ -cyclodextrin and coupling sugar by cyclodextrin glucanotransferase

10. A simple and inexpensive pretreatment of the 5'-UMP solution was developed to remove 51% of the total impurities and up to 98% of the color from a dark-brown solution. Studies on more economical and effective methods of producing pure 5'-monophosphate nucleotides at a pilot plant are underway.



T-17株為高效率耐高溫酒精酵母  
T-17 is a thermotolerant yeast with high yield of ethanol from molasses



離胺酸鹽酸鹽晶體 (左) , 100公升醱酵槽擴大培養 (右)  
L-Lysine  $\cdot$  HCl crystal (left) ; A scale-up culture with a 100-L fermentor (right)

## 今後研究方向及調適

1. 培育適應當前及今後環境特性之甘蔗及花卉品種，繼續維持領先國際育種水準。
2. 發展精緻農業及農產種苗生產自動化系統，以配合政府農業國際化與自由化之政策。
3. 研究經濟糖量之生產技術及管理方法。
4. 研發生物科技發展新產品，大幅提高產值。
5. 繼續製糖程序自動化及糖品多元化之研究。
6. 加強副產利用，資源回收，以提高其附加價值產品之研究。
7. 繼續環境保護技術之研究。
8. 調整砂糖與甘蔗研究之結構比重，進行土地開發之配合研究。



糖業博物館  
Taiwan Sugar Industry Museum

## MAJOR ASPECTS OF FUTURE RESEARCH

1. Breeding new varieties of sugarcane and flowers adaptable to the changing environment and maintaining the international reputation in plant breeding.
2. Automation of seedling production of high-value crops and quality agriculture in compliance with national policy towards international agriculture.
3. Improvement of the cultivation and management effectiveness to enhance cost-effective sugar production.
4. Development of new products and to expand total production value by biotechnology.
5. Automation of the sugar-manufacturing processes and development of a wide variety of sugar products.
6. Strengthening the utilization of by-products and recycling of resources in order to develop high-value products.
7. Strengthening research on pollution control and environmental protection.
8. Adjustment of the research on sugar and sugarcane to investigate the scope on land exploitation and utilization in accord with TSC's diversification policy.



蔗農館  
Sugarcane Farmers Hall



本所庭園

A view of the front yard at TSRI. The sugar crystal is the symbol of our industry



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