

# 1. GENERAL DESCRIPTION

## Agricultural Environment in Taichung District

Taichung district including the areas of Taichung, Changhua and Nantou prefectures and Taichung city covers a total area of 738,700 hectares. Of which 197,922 hectares are arable lands. The ratio of paddy field to upland field is approximately 6:4. However, this ratio is changing yearly because of the recent governmental policy to increase the acreage of upland crops and reduce the acreage of paddy field.

The favorable climate in this district is suitable to grow different crops the year round. The mean annual temperature of this district is 22.4°C, July and August are the hottest months with a mean temperature of 28°C, while February is the coldest month with mean temperature of 16°C. The mean annual rainfall of this district in the past ten years was 1,740 mm. The distribution of rainfall is rather uneven around the year.

There are five major groups of soils in this district. Slate alluvial soils cover the whole Changhua prefecture where rice yield is the highest in Taichung district. Sandstone and shale alluvial soils are found mostly in Taichung and Nantou prefectures. Soil reaction in these areas ranges from slightly to strongly acid, and hence the yield of rice is usually lower than that in Changhua prefecture. Latritic soils which are very strongly acid and very poor in fertility are scattered in the highland areas. Mixed alluvial soils of sandstone, shale and

slate are located in the west coast of Taichung prefecture. Because of its high sulfur content and poor drainage condition, rice yield in this type of soil is generally low. Red-yellow podzolic soils are mainly distributed in the mountainous areas where the soils are generally strongly acid.

## History

Taichung, Changhua and Nantou Farmers' Associations established their own respective experimental stations in 1920. In 1924, all three stations were merged into one station and renamed as "Taichung Agricultural Experiment Station". The status of the station had been changed several times since then. It was given the present name and was placed under the Department of Agriculture and Forestry, Taiwan Provincial Government in 1960.

This station was formerly located in Taichung city. However, the experimental field was no longer suitable for the purposes of agricultural research due to the rapid urbanization of the city. A plan to move the station to rural area was therefore laid out in 1979. After 5 years of planning and construction, the movement was finally completed in March, 1984 at a total cost of NT\$ 500,000,000. The new site of the station, located at Tatsuen, Changhua, covers approximately fifty hectares of land. The construction of the branch station at Puli, Nantou with an acreage of 17 hectares of slopeland was also completed at the same time.

**Equipment and Facilities**

The experimental farm of the station is properly equipped with irrigation and drainage systems. The main building consists of laboratories, offices, auditorium, and some conference rooms, etc. The agricultural extension building consists of an exhibition hall, offices, mass communication room and a training center.

The training center may accommodate 50 trainees at the same time. It includes an audio-visual classroom, teaching material room, home economics classroom, dining room, recreation room and bedrooms.

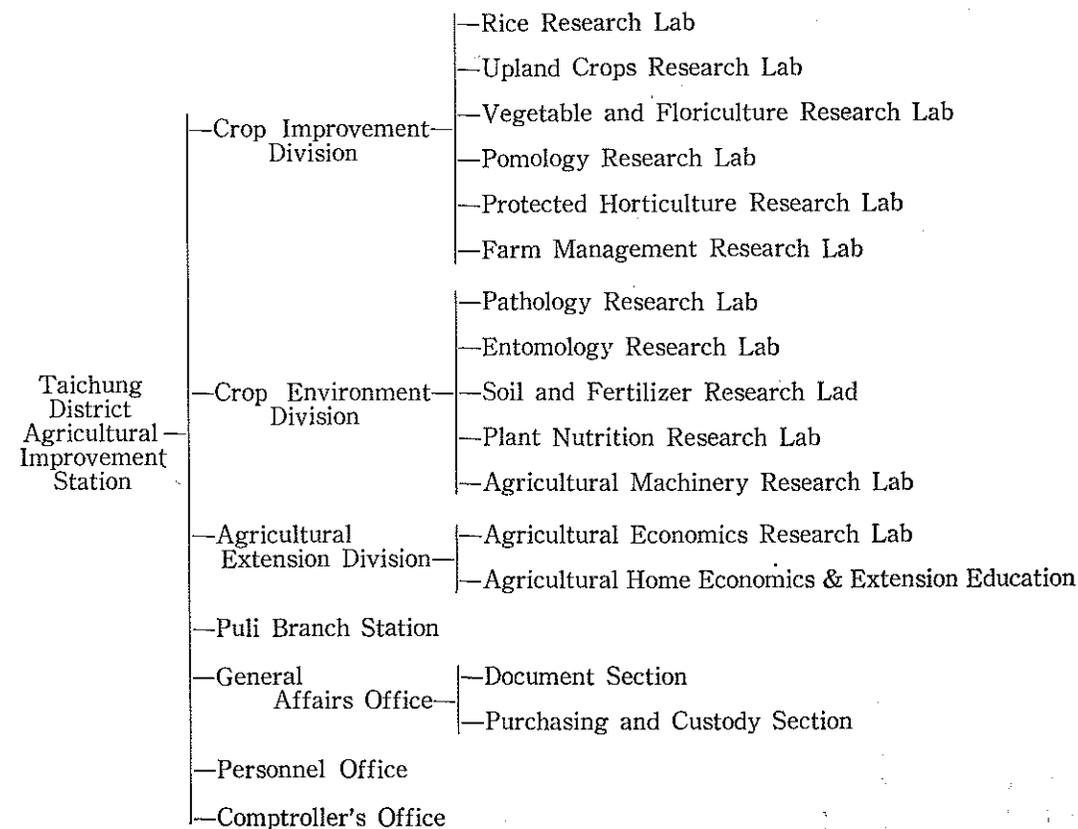
The main facilities of the station are insectary agricultural engineering workshop, cold storage room, agricultural climatological observatory, greenhouses, warehouses, etc.

Dormitories are also available for single and married staff members.

Main laboratory equipments include scanning electron microscope, atomic absorption spectrophotometer, automatic analyzer, gas chromatographer, liquid chromatographer, UV spectrophotometer, microprocessors, ion analyzer, flame photometer, growth chambers, incubators, mini-computer and others.

**Organization**

This station consists of 1 branch station (located at Puli, Nantou prefecture), 3 technical divisions and 3 administrative offices. Each technical division is subdivided into several research labs as shown in the following scheme:



**Staff Members**

There are 78 staff members, including 64 technical (13 senior and associate research fellows, 21 assistant research fellows and 30 research assistants) and 14 administrative personnels in this Station. In addition, the Station has 29 project employees, 69 skilled labors and 85 temporary field labors.

**Functions**

1. To conduct plant breeding work for the major crops of economic importance.
2. To improve the cultural methods of various crops.
3. To propagate and maintain the improved

4. To study the problems of soils, fertilizers and plant nutrition.
5. To solve the problems of pest control, including forecasting the insect and disease epidemics.
6. To improve and design the farm machinery and implements.
7. To study the economy of farming systems in rural areas.
8. To carry out agricultural extension education, through providing technical service, training classes, field demonstrations and other measures to the farmers.
9. To carry out home economics education through training courses and other measures.

## 2. RESEARCH ACHIEVEMENT

### RICE

#### Studies on the Growth Pattern of New Rice Strain

The growth pattern of the new strain of rice "Taichung yu 365" (Fig. 1) was compared with that of Tainung 67 (*japonica* type) and Taichung Sen 10 (*indica* type). The materials were grown at one-month interval from April to August 1987. Sampling and record keeping were made 30 days after transplanting. The data of growth analysis were evaluated by establishing the growth curve as well as growth equation of various traits. The new strain Taichung yu 365 showed an intermediate growth pattern between *indica* and *japonica* type rices. The growth vigor from vegetative growth stage to ripening stage in *indica* type rice was found to be stronger than that of *japonica* type rice. The degree of growth vigour varied under different temperature conditions due to different planting months. Under the high temperature conditions, the *indica* type rice showed a better growth pattern. It was observed that under the high temperature condition, the growth pattern of the new strain Taichung yu 365 appeared to be similar to that of *indica* type variety while under the low temperature condition, it tended to be similar to that of *japonica* type variety. These results indicated that the newly selected line Taichung yu 365 had a wider adaptability under the environment of Taiwan. Further experiment

on yielding capacity, resistance to diseases etc. will be carried out for this particular new line.

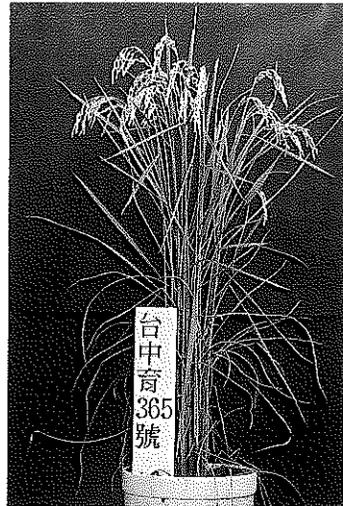


Fig. 1. The maturing stage of new strain of rice—Taichung yu 365.

#### Variation in Agronomic Characters and Harvest Index of Rice by Monthly Planting in Taiwan

Various agronomic characters such as plant weight, tiller number, panicle weight and harvest index of 100 rice varieties were evaluated at monthly planting. The results indicated that all agronomic traits investigated differed according to different months of planting. The values of plant height, tiller number, panicle weight, harvest index were smaller in September because of lower temperature (Fig. 2), but no significant differences in the performance of agronomic characters were observed during the summer season of June, July and August. The growth

duration varied from 75 to 160 days. This was due to the change of monthly temperatures and daylengths at the time of flower bud formation. The values of coefficient of variation (CV), tiller number, panicle weight, harvest index and growth duration were as high as 20% or higher but those of plant weight was 10.0% only. The CV value for harvest index varied from 10.5 to 23.2% due to different months of planting. The smallest CV value of harvest index was found in those planted in July, and those planted in August come to next. The best time for selecting the harvest index should be decided based on the time of the best performance of harvest index.



Fig. 2. The uneven growth of rice plants due to low temperature when transplanted after September.

#### Linkage Analysis of *lhs<sup>a</sup>* Gene of Naked-grain Rice

According to the report of Shao *et al.* (1980), the naked-grain rice was isolated from the progeny of the cross between rice (*Oryza sativa*) and wheat (*Triticum aestivum*). In the contrary, the report of Hsieh (1985) indicated that the naked-grain character of rice seems to be due to mutation, because the chromosome behavior of naked-grain rice was normal. The

zymograms of peroxidase and acid phosphatase of this strain indicated the pattern of *indica* type rice. The purpose of this study is to locate the gene of naked-grain *lhs<sup>a</sup>*, on the linkage map. Crosses were made between the mutant line carrying the naked-grain character with Taichung 65 isogenic line carrying various gene markers (Fig. 3). No clear linkage relation between *lhs<sup>a</sup>* gene and other genes were observed. This was due to the high sterility in both  $F_1$  and  $F_2$  generations in the crosses studied. Because Taichung 65 is a *japonica* type variety while naked-grain rice belongs to *indica* type rice. The naked-grain rice was further crossed with "long hull sterile rice" (Kinoshita *et al.*). The results indicated that the naked-grain gene and the long hull sterile gene was located at the same locus on the linkage group 11. This result was similar to that reported by Khush *et al.* (1986).

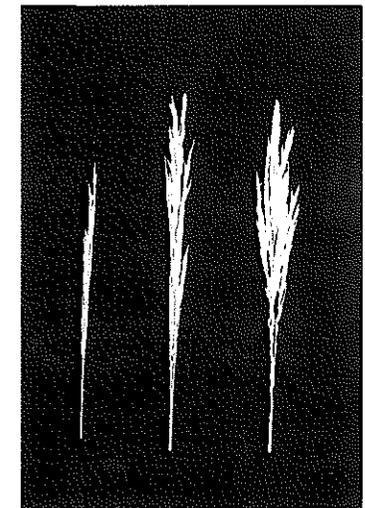


Fig. 3. The panicles of naked-grain rice (NGR) and long hull sterile (*lhs*) and their  $F_1$ 's, left: NGR, right: *lhs*, center:  $F_1$ 's of NGR and *lhs*.

### Breeding of a New *Indica* Rice Variety—Tai Sen 1

Tai Sen 1 (Fig. 4) is a newly developed *indica* rice variety from the crossing of Taichung Sen Yu 358 (♀)/Tainung Sen Yu 107 (♂), and has officially registered and released in 1988. The results of grain quality analysis for Tai Sen 1 indicated that the rate of head rice was 53% and 63% higher than that of Taichung Sen 10 in the first and second crops respectively. The amylose content of the new variety was 14.9% and 19.4% lower than check variety in the first and second crops respectively. Because the rice grain of the variety has lower gelatinization temperature therefore the cooked rice is softer and more sticky in texture. Those characters contributed much to the acceptability of the variety by the consumer in Taiwan. The results of yield trial of this variety during the first crop of 1985 through the second crop of 1987 showed an average yield of 7,298 kg/ha in the first crop, and 4,923 kg/ha in the second crop which are 2.6% and 7.5% higher than the control variety

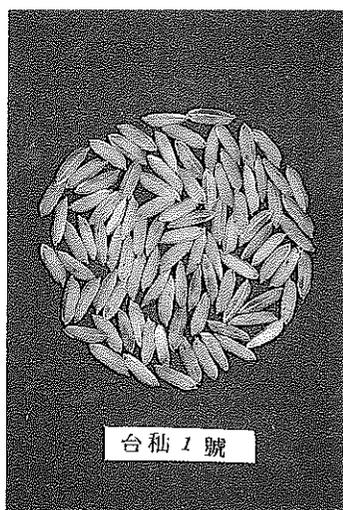


Fig. 4. New *indica* rice variety—Tai Sen 1.

Taichung Sen 10 respectively. The district yield trials conducted at 3 locations from 1986 to 1987 showed that Tai Sen 1 yielded 7,629 and 5,712 kg/ha in the first and second crops respectively, which were 0.3% and 3.3% higher than Taichung Sen 10. The semi-dwarf and high nitrogen response characters of this new variety contributed mostly to the high yield. Further, after the repeated experiments, it was noticed that stability of yield performance was much better than that of the earlier released cultivar Taichung Sen 10.

### UPLAND CROPS

#### Improvement of Cultural Technique for Ratooned Sorghum in the Paddy-converted Dryland

The experiment was conducted to detect the stem-cutting stage, tillering number, ratooning height and method of fertilizer application for ratooned sorghum so that to increase the grain yield. The results of the experiment indicated that the best time of stem-cutting is about 2-12 days after harvesting. Yield will be decreased drastically when stem-cutting delayed over 20 days after the harvesting. A 10 cm height soil banking should be made by cultivator 10 days after stem-cutting, so that to control the growth of the ineffective tillers. One half of the total amount of nitrogen fertilizer should be applied to the ratooned sorghum as a basic fertilizer immediately after the stem-cutting and the remaining amount should be split into two parts and applied to the field 20 and 40 days after the stem-cutting as the top dressing.

### Effect of Sowing Time on Agronomic Characters of Buckwheat

In winter crop, the variety of Sioluk had the same flowering date as Miyazaki however, with the delayed sowing time the maturity of Sioluk will very much prolonged in comparison with that of Miyazaki. The variety of Miyazaki showed that the same growth period even sown at the different sowing times with the exception of that sown on Oct. 15th. In spring crop, both Sioluk and Miyazaki showed the same growth period when sown at different sowing times. In winter crop, both varieties showed higher plant height when they were sown earlier. The plant height become shorter when they were sowed from Nov. 5th to Dec. 25th. In spring crop, from Jan. to April, the later the sowing time, the higher the plant height. In winter crop, the number of branches of more or less similar in these two varieties. In the late sowing at the spring crop, more branch number was obtained. In winter crop, either Sioluk or Miyazaki showed no significant difference in grain yield among the different treatments of sowing time with the exception of those sowing on early November showed lower grain yield than that of old variety Toyodo No. 1, which is widely cultured in Taiwan. It was noticed that the newly introduced varieties Sioluk and Miyazaki, when they were sown in April, no seed harvest was possible. The performance of 1000 grain weight of the variety Sioluk appeared to be better when it was sown from Nov. 5th to Jan. 15th. In case of Miyazaki, it perform better when it was sown from Oct. 5th to Jan. 25th.

### Specification in Starch Component in Job's-tears (*Coix acryma*)

Three varieties of Job's-tears, namely Thailand, A-Li-Shan and Taichung S. No. 1 were evaluated with regard to the grain-starch components. Two rice varieties *i.e.* Taichung 189 (non-sticky) and Taichung Glu-70 (sticky) were also used as checks. The results showed that the crude starch content and starch powder extract of the variety Thailand were found to be 64.2% and 84.7%, which is higher than the others, but 10-20% lesser than those in rice. The amylose content in A-Li-Shan was 15.4% which is 5-7 folds higher than that of varieties Thailand and Taichung S. No. 1. The amylose content in non-glutinous rice (check) "Taichung 189" was 17.9%. Based on the SEM studies (Fig. 5), the starch grain of Job's-tears was found to be ball type and that of rice was found to in polygon shape. The size of starch grain in the variety "Thailand" was  $14.53 \pm 4.70 \mu$  which is the biggest among the varieties studies. It is twice as big as that rice

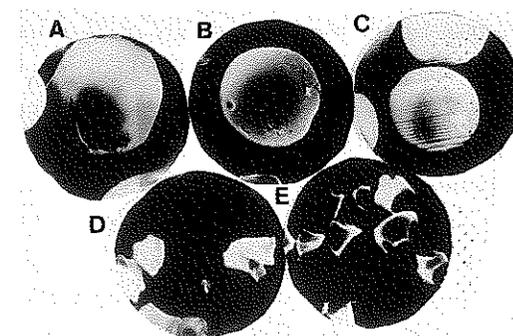


Fig. 5. Scanning electron micrographs of starch grains of Job's-tear and two rice varieties.

- A: Thailand; B: A-Li-Shan;  
C: Taichung S. No. 1;  
D: Taichung 189;  
E: Taichung Glu-70.

starch (checks). The physical properties, pasting temperature and maximum viscosity of Job's-tears varieties "Taichung S. No. 1 and Thailand" were found to be more or less similar to the glutinous rice, Taichung Glu-70 (check). The absorption spectra of starch-iodine reaction in A-Li-Shan and Taichung 189 showed the similar pattern in A600 and A660. Therefore, Taichung S. No. 1 and Thailand performed to be the sticky Job's-tears varieties.

### Genetic and Breeding Studies on Tannin Characters in Hybrid Sorghum

Tannin is one of the most important phenolic compounds in sorghum, and the content of tannin is not only related to the nutritional values of feed but also affects the seed germinability and its bird-resistant ability. The four isogenic lines *i. e.* TUI-1, TUI-2, TUI-3 and TUI-4 series in tannin acid content were used as male parent to cross with 80B or 2R parents. The agronomic characters of  $F_1$  plants and  $F_1'$  seed characters were studied. The plant height, panicle height and grain weight of  $F_1$  plant were found to be superior to their parents, and days to 50% flowering was observed to be 3-10 days earlier than their parents. The shape and colorness in  $F_1'$  seed were similar to those of their male parent. The peroxidase isozyme patterns (Fig. 6) found in 80B group were similar to their female parent. However, that in  $2R \times TUI-1$  and  $2R \times TUI-3$  showed differences in the bands of  $R_f$  -0.5 and -0.6. The tannin content of  $F_1'$  hybrid seeds was less than the average amount of their parents. However, the germinability of  $F_1$  seeds tended to be increased in accordance with the increase

of tannin content.

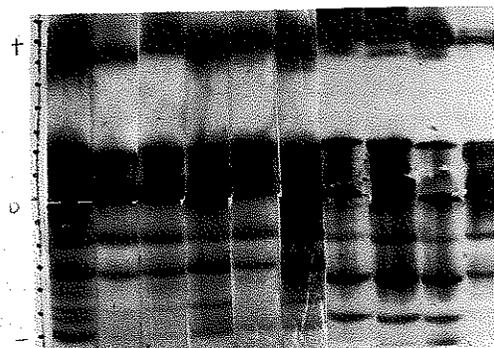


Fig. 6. Zymograms of peroxidase in sorghum seeds of 80B, TUI-1, TUI-2, TUI-3, TUI-4 and their progenies, From left to right: 80B, TUI,  $80B \times TUI-1$ , TUI-2,  $80B \times TUI-2$ , TUI-3,  $80B \times TUI-3$ , TUI-4,  $80B \times TUI-4$ .

## HORTICULTURAL CROPS

### Breeding of Snap Pea

Taichung Ten Shih 3A (TTS 3A) (Fig. 7) snap pea is developed by crossing "Sugar Snap" with "Knight". It will be registered and named as "Taichung No. 13" this year. TTS 3A is a white flower, pole-type snap pea, leaves are small size, and have tender branches. Single flower begin blooming at node 13-15. This lower pod-setting position is favored for trellis cultural practices. The green pod is crispy and sweet, the sugar content is 13-14 Brix well suited to fresh market and processing. Pod shape of TTS 3A is more uniform than "Hsin-Jen". The green pod maturity is about 15-20 days earlier than "Hsin-Jen". Because of the characteristics of lesser branches, the pod yield is lower than "Hsin-Jen". TTS 3A have loose abscission layer which is very easy in picking. This line is tolerant to Fusarium wilting disease, but is

not resistant to damping off, powdery mildew and root rot.

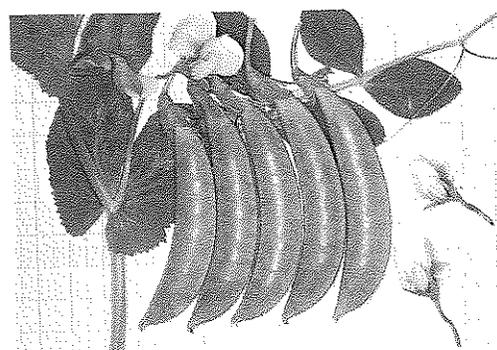


Fig. 7. Taichung Ten Shih 3A snap pea.

### Development of a Rust Resistant Variety of Snap Bean, Taichung 1

Taichung 1 (Fig. 8) is a green-podded pole bean with resistant to rust disease released by Taichung District Agricultural Improvement Station. This variety is developed by using the local cultivar "Black Creaseback", which is susceptible to rust, backcrossed four times to a rust resistant bush bean line "15R-55-BK" introduced from Puerto Rico. It was registered and released in November, 1988. This variety belongs to indeterminate, type IV growth habit. Average days to first harvesting are 53.5 and 55.5 for spring and fall crops respectively. Average days to last harvesting are 92.5 and 90.5 for spring and fall crops respectively. Average pod yield at two years of regional trial are 22.4 and 19.5 tons/ha for spring and fall crops, respectively; of which is 7.1 and 4.8% higher than "Black Creaseback". The degree of rust resistance ranged from "Resistant" to "Highly resistant" and "Highly resistant" for mountain and lowland areas, respectively. Pod have good appearance and quality. The high yielding and wide stability characteri-

tics made it very suitable for spring and fall crops production in central and southern Taiwan.



Fig. 8. Rust resistant variety of snap bean, Taichung 1.

### Studies on Increasing the Healthy Cuttings of Chrysanthemum

The purpose of this study was to compare the effect of rooting hormone, fungicide, liquid fertilizer and hydroponic nutrition to increase the cuttings of chrysanthemum flower under sand, soil and hydroponic cultural conditions. The feasibility of producing healthy seedlings of chrysanthemum was also evaluated. The result indicated that soaking cuttings in 1000 ppm NAA before planting can promote root growth, and increase rooting percentage, but root length was unaffected under soil and sand culture conditions. In hydroponic condition, the concentration of NAA should be lowered than 5 ppm. When its concentration is over 20 ppm it will inhibit the growth of roots, and over 100 ppm it will cause serious damage on the roots. There are no significant differences in prevention

of basal stem rot and root growth by soaking cutting in Benlate (1000 times) and liquid fertilizer (1000 times) for 10 minutes. The hydroponic nutrition can promote the root growth of cutting with the E. C. value lower than 0.95 mmho, while over 1.5 mmho will cause damage on roots. Compared the cultural methods, soil culture has the best result of enhancing root growth, followed by sand culture. The result of hydroponic culture in this study was far from satisfaction. Further experiments with the additional treatments will be conducted next year.

### The Yield Performance of Water Oat (*Zizania latifolia*) Grown under Different Soil Conditions

This experiment was aimed to select the high yielding tiller of water oat for planting. The mother plants of water oat was transplanted on December 30, 1986. The harvesting of spring crop started from the middle of May or 136 days after transplanting, and ended in the late June. The harvesting of fall crop started from late August to early September or 244 days after transplanting, and ended in the middle of October. The average numbers of tiller of spring crop obtained from a mother plant of water oat were: 9.2 tillers per plant from a coarse-textured soil with shallow water (a). 8.6 tillers per plant from a loamy soil with shallow water (b). 2.8 tillers per plant from a coarse-textured soil with deep water (c). 2.4 tillers per plant from a loamy soil with deep water (d). The rate of rhizomes formed from the transplanted tillers were 45.4% from the treatment (c), 45% from the treatment (b), 43% from the treatment (d), 33.9% from the treatment (a). Yield of shoot obtained

were 240 kg/10 a (118.7%) from the treatment (d), 202.2 kg/10 a (100%) from the treatment (b), 199.9 kg/10 a (98.9%) from the treatment (c), 186.3 kg/10 a (92.1%) from the treatment (a). The yield of shoot in the treatment (d) significantly higher than all other treatments. Fall crop are ratooned crop from the spring crop. The rate of rhizomes formed from the ratooned plants are, 72.5% from the treatment (a), 71.6% from the treatment (b), 67.7% from the treatment of (d) and 60.5% from the treatment (c). Yield of shoot, 610 kg/10 a from the treatment (c) (101.3%), 606 kg/10 a from the treatment (a) (100.7%), 602 kg/10 a from the treatment (b) (100%) and 590 kg/10 a from the treatment (d) (98%). The yields of shoot were not significantly different from the four treatments in the fall crop. In the four treatments a significant difference in shoot yield was found only in the spring crop. Under the loamy soil with deep water condition the highest in shoot yield was observed.



Fig. 9. Husking the shoots of water oat (*Zizania latifolia*).

### The Control of Bacterial Wilt Disease by Grafting in Tomato

The tomato cultivar "Senli" is susceptible

to bacteria wilt disease. An attempt was made to graft the scion of "Senli" to the disease resistant stock so that to reduce the incidence of the disease. The results of the experiment indicated that when tomato cultivar "Senli" was grafted with wild tomato stocks "AVRDC-4711" and "BL-166", it can reduce the infection rate of bacterial wilt to below 1.6%. As the result, the grafted tomato increase the yield by 5170-6620 kg/ha and 4610-5330 kg/ha at summer and fall crops, respectively. The average income increase per hectare is estimated to be NT\$ 91,750-128,000 and NT\$ 17,820-26,460 for summer and fall crops, respectively.

### Effects of the Storage Temperature and Cooking Methods on the Quality of Hydroponic Pai-Tsai (*Brassica chinensis* L.)

The experiment is to study the influences of the storage temperature and cooking methods on the quality of hydroponic Pai-Tsai (*Brassica chinensis* L.). The results showed that when Pai-Tsai was stored under 10°C for 4 days, the vegetable appeared to be in fresh condition, though a loss of 2.95% moisture content occurred. When it was stored under 30°C condition for 1 day, a drastic loss (24-32%) of water content occurred. However, it will be recovered after immersed it into running water (Fig. 10). The roots of Pai-Tsai restored their activities which help regain the freshness of the vegetable. The chemical components of boiled Pai-Tsai was subjected to change after 1-3 minutes of heating treatments. The contents of chlorophyll, free amino acid, NO<sub>3</sub>-N and NO<sub>2</sub>-N of boiled leaves were found to be increased with the prolonged period of heating. Free sugar



Fig. 10. Effect of storage temperature and conditions on the quality of Pai-Tsai. A: at 10°C for 4 days. B: at 30°C for 1 days. C: at 30°C for 1 day plus soaking into water.

### Effect of Temperature, Light Intensity and Chemical N on the Quality of Pai-Tsai (*Brassica chinensis* L.)

In order to understand the effect of temperature, light intensity and chemical N on the quality of Pai-Tsai (*Brassica chinensis* L.), the vegetable which grew in the artificial controlled environment by means

was decreased in parallel with the heating time. It was interesting to notice that the NO<sub>3</sub>-N and NO<sub>2</sub>-N were mostly released into soup with the prolongation of heating period. The similar tendency in the change of chemical components was also found when the vegetable was pan-fried at 100°C to 180°C. As compared with boiling treatment, less amount of NO<sub>3</sub>-N and NO<sub>2</sub>-N was detected in pan-fried leaves of Pai-Tsai. It is concluded that the Pai-Tsai should be stored in 10°C, otherwise, it must be soaked into running water within 24 hrs after the harvest. Moreover, shorter heating period during cooking could maintain the good quality of Pai-Tsai.

of hydroponics, were designed for the growth analysis. The results were summarized as follows (Fig. 11): 62.1% of  $\text{NO}_3\text{-N}$  in the Pai-Tsai was accumulated in the leaf stalk, 25.9% in leaf blade and 12.0% in root. But  $\text{NO}_2\text{-N}$  was mostly accumulated in the roots (96.9%). When the amount of applied chemical N were increased, the more  $\text{NO}_3\text{-N}$  will accumulated in the leaf blade and leaf stalk, and a part of  $\text{NO}_2\text{-N}$  in root were moved into the leaf blade. With the increase of light intensity from

16.4 Klux to 45.1 Klux, the amounts of  $\text{NO}_3\text{-N}$  and  $\text{NO}_2\text{-N}$  in the leaf blade increased remarkably. When the temperature increased from 25°C to 35°C, the amount of  $\text{NO}_3\text{-N}$  and  $\text{NO}_2\text{-N}$  were also increased greatly. The amount of protein, chlorophyll, crude fiber and ash were increased, when the amount of applied chemical N in the nutrient were increased. On the other hand, the amount of crude fiber, starch, free-sugar and amino acid were decreased. It is indicated that the combination of the high

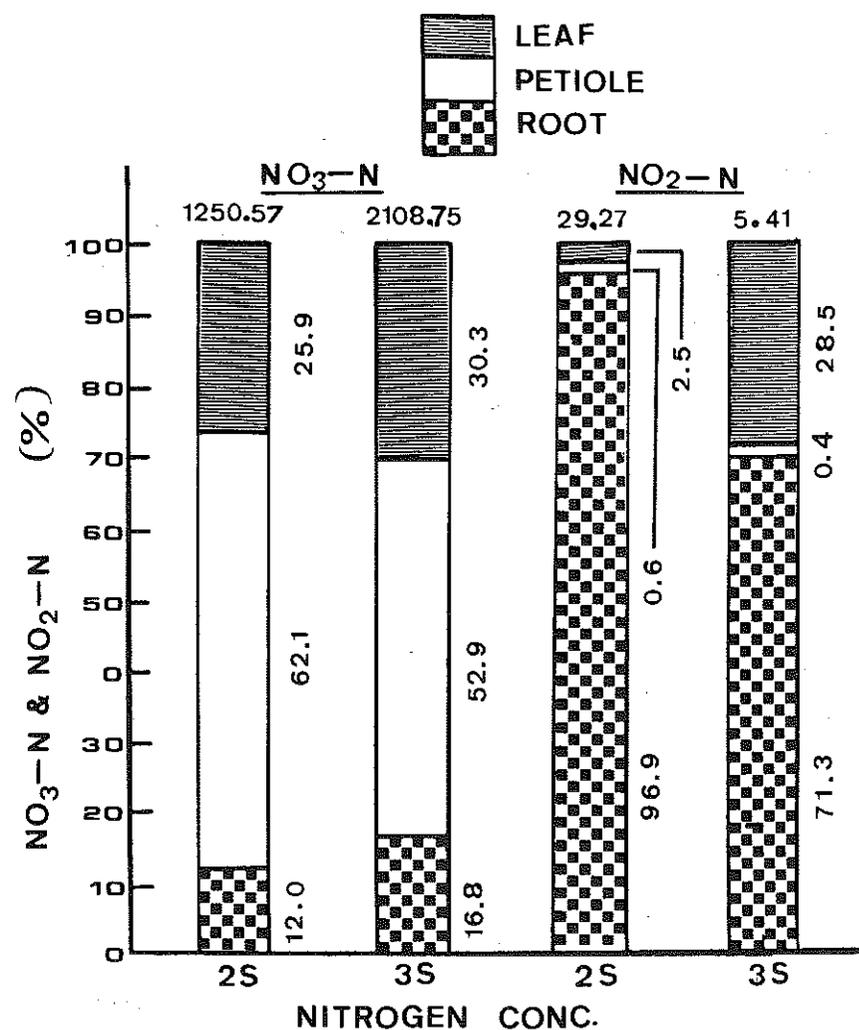


Fig. 11. Increase of  $\text{NO}_3\text{-N}$  and  $\text{NO}_2\text{-N}$  in the leaf as nitrogen concentration increased from 2S to 3S.

temperature, high light intensity and high chemical N will result in the poor quality in terms of chemical composition in Pai-Tsai.

### Effects of DRF Hydroponic Technique on the Yield Potential of Summer Tomato (*Lycopersicon esculentum* mill)

A two-year continuous hydroponic culture of tomato was conducted at Taichung DAIS in 1987. Two tomato varieties San-Li (big fruit size) and Lan-Tuo (mini-tomato) were transplanted at 4-leaf stage in the DRF hydroponic system. The top pinching were done at 7-8 clusters stage. The results indicated that the fruit yield and the growth period were significantly decreased with the increase of air temperature. However, the harvest period was remarkably prolonged. In other words, the numbers of fruit set on the upper clusters were not only reduced but the maturity was also prolonged in the hot summer season. It indicated that the early topping treatment



Fig. 12. Fruit-setting of summer tomato showing 2-3 clusters of fruit per plant at DRF hydroponic system.

at the culture of tomato in 2-3 clusters stage to shorter the growth period might be useful for the hot summer. An advanced experiment with 2-3 clusters (Fig. 12) of hydroponic mini-tomato was conducted at the summer season in 1988. The results revealed that the mini-tomato could be cultivated twice hydroponically at the hot summer with a growth period of 45 days with fruit yield of 52.19 kg/100 m<sup>2</sup>.

### A Method of Promoting Flowering and Berry Growth for Grapevine

Due to previous season grape overproduction, low lignization rate, early defoliation and regrowth of mature branches resulted in deficiency of nutritional accumulation in branches. Many problems occurred on the following fall and winter grape production after pruning: short flower cluster and abnormal shoot development, which will cause short fruit cluster and crowded berries. At maturity, the berry was cracked resulted in yield reduced. In order to solve the above problem, beside to upgrade the management of branches development at previous season, using plant growth regulator to promote the growth of flower cluster is feasible. We have conducted the experiment of GA application ( $\text{GA}_3$  30-50 ppm) on branch of "Himrod Seedless" grape variety at 6 days before and after blooming to promote the length of flower cluster. When 2 ppm of GA was applied on "Kyoho" the similar effect occurred. It increased the percentage of parthenocarp as the GA concentration increased. The recent study indicated that when 0.2% of Cytex (contained 0.1% cytokinin from the extract of seaweed) was mixed with 0.5 ppm of  $\text{GA}_3$  and applied on the branches of

grapevine it could promote the growth of flower cluster and increase the fruit weight and fruit size, without affecting the seed number of berry (Fig 13).

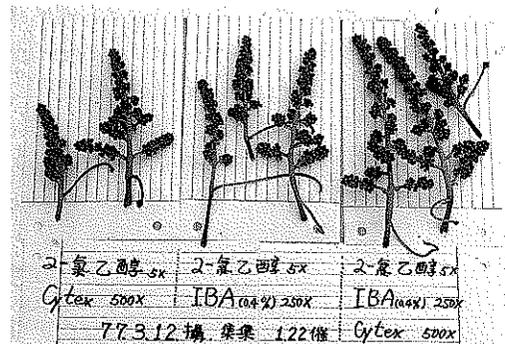


Fig. 13. Application of plant growth regulators on promotion of flower cluster in grape.  
Left: 2-chloroethanol + Cytex,  
Center: 2-chloroethanol + IBA,  
Right: 2-chloroethanol + Cytex + IBA.

### The Development of the Technique for Production of High Chilling Requirement Pears under the High Temperature Condition of Lowland Areas

The top-grafting method is popular in "Henshan" pear production in Taiwan. But this cultural practices needs large amount of expensive imported scions and intensive labors. We have conducted the experiment on using manual technique to promote the formation of flower buds of scions under the local condition. The top-grafting practices has to be done each year also. The present experiment is to explore the possibility of reutilized the high chilling requirement scions that have been top-grafted on the "Henshan" pears at previous year. The technique is now developed through the application of Hydrogen Cyanamide (0.75-1  $\mu$ ) on the shoots (Fig. 14). Hydrogen

Cyanamide application has been proven to be an effective method for breaking dormancy and to promote flower buds formation at the following spring season. This labor saving method is expected to be able to produce high-quality temperate pears at lowland area.



Fig. 14. Promotion of fruit-setting of top-grafted scion on "Henshan" pear.

### Studies on Shoot Growth and Promoting Fruit-setting of Grapevine

Under the current cultural practices of high population density and over supply of fertilizer, the grape trees need strong pruning to limit the expansion of tree canopy during winter season. And at the high temperature and humid conditions the shoots tend to be outgrewed and the flower cluster cannot have enough nutrition resulted in poor pollination, fruit dropping and parthenocarpy. The proper pruning during grape dormancy stage can adjust the amount of branches, followed by bud thinning after sprouting and trimming of weak basal branches will balance the growth

of fruit bearing shoots. The tree will have better response to the application of plant growth regulator and adequate leaf-fruit ratio during fruit development stage. Application of Alar and C.C.C. before blooming will control the growth of new shoots, prevent the competition between new shoots and fruits and thus increase the rate of fruit setting. The new shoot with length within 30-60 cm at blooming stage have the better fruit setting rate. The growth length of shoot between 40-50 cm after flowering could increase the fruit size and quality of berry (Fig. 15).

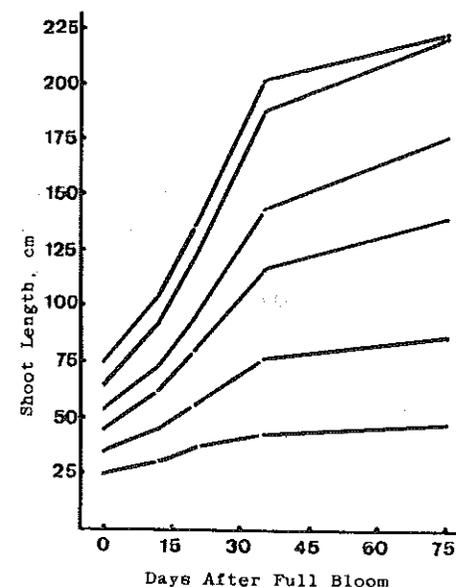


Fig. 15. Effect of different shoot lengths at blooming stage on the growth of fruiting shoot of Kyoho grape. Shoot length at blooming stage:  
A, 20-29 cm; B, 30-39 cm;  
C, 40-49 cm; D, 50-59 cm;  
E, 60-69 cm; F, 70-80 cm.

## PLANT PROTECTION

### Effects of the Stripe Virus on Rice Yield and Yield Components

Tainung 67 (a *japonica*-type rice) was single-plant transplanted and inoculated with rice stripe virus (RSV) at different growth stages to study the effect of virus infection on rice yield. The experiments were conducted in pot under greenhouse conditions in the 2nd crop season of 1984 and the 1st crop season of 1985 at the old site of Taichung District Agricultural Improvement Station (TDAIS) in Taichung city as well as in the 2nd crop season of 1985 and the 1st crop season of 1986 at the Taichung DAIS, at its present site in Changhua. Similar experiments conducted in field were taken at Taichung city in the same crop seasons of previous experiments. In the 1st crop season inoculation with RSV at 10 to 30 days after sowing (DAS) resulted in 100% losses of the rice yield for both pot and field tests. When test plants were inoculated at tillering stage (60 DAS), the yield losses were 90 and 84% for the pot and field tests, respectively, and at sound panicle formation stage (100 DAS), the yield losses were 30 and 23% for these test conditions, respectively. However, there was no yield reduction when inoculation was done after booting stage (110 DAS). In the 2nd crop season, inoculation at seedling stage (from 10 to 20 DAS) resulted in 100% yield losses for both pot and field tests. The yield losses were 55 and 28%, respectively, for the two test conditions, when inoculation was at tillering stage (50 DAS). However, there was no yield reduction observed when inoculation was made at early booting stage (70 DAS). Apparently, the rice growth period for RSV infection which would cause substantial yield reduction was shorter in the 2nd crop than in the 1st crop. Under field conditions, the effect of rice stripe

disease on the yield of naturally infected plants was studied. Tainung 67 was planted at 5 plants per hill and infected plants were tagged individually when symptoms appeared. In the 1st crop, the yield losses of infected plants with first symptoms appearing from tilling (50 days after transplanting, DAT) to booting stages (80 DAT) were from 54 to 63%. When symptoms appeared at heading (90 DAT) and milk stages (100 DAT), the losses were 32 and 22%, respectively. There were no significant yield losses for those plants with symptoms appearing after dough stage (110 DAT). In the 2nd crop, the yield reduction was 41-66% when symptoms appeared booting stage (60 DAT). However, symptoms were not observed after milk stage (80 DAT). Analysis of the effect of RSV infection on the yield and yield components showed as the following. The yield reduction in the 1st crop was mainly due to a reduced number of panicles and to a lesser extent a reduced number of spikelets per panicle. In the 2nd crop, the yield loss was caused by a reduction of panicle number, the 1000-grains weight, the percentage of filled spikelets and spikelet number per panicle in order of importance.

#### Some Epidemiological Studies on Rice Stripe Virus Disease

The rice stripe virus disease (RSVD) has become a most destructive insect transmitted virus disease of the first rice crop in Taiwan in recent years. In central Taiwan, the insect vector, small brown planthopper (SBPH) (*Laodelphax striatellus*) could propagate two generations in ratooned rice or wheats during the winter season. Both the stripe infected plants and the

insect vectors survive during winter seasons will become the virus source of infection in the next year. In the paddy field SBPH could be detected throughout the year and its population reached a peak during early June and October for first and second crops, respectively. During the period of 1984-1987, about 13,546 SBPH were collected in 138 collection attempts (2 collections per month) in Tatsuen, Changhua Hsien and Paituen, Taichung city and test individually. The results revealed the active transmitter of RSV were detected almost all attempts and about 6.7% in average of the insects were RSV-transmitter. The active transmitters reached a peak during early May to later June in the 1st crop and during later September and early October in the 2nd crop. The analysis data of diseased plants appearance revealed that there were two infection periods of RSV observed in the 1st rice crop. The 1st infection period occurred during seedling stage until 20 days after transplanting and the major sources of transmitter were the overwintering insects and it caused about 1-10% of the total infection rate of the 1st crop which varied from year to year and location to location. The second infection occurred during 40-60 days after transplanting and the major source of transmitters were the 1st generation of SBPH which multiplied in the paddy field. The infection rate were estimated over 80% of the total infection of 1st crop. The infection rate of RSV in the first crop can be forecasted as  $Y = 12.46X - 0.143$  ( $R^2 = 0.9988^{**}$ ) (where Y means estimation of percentage of products value of natural population and active transmitter during March to April).

#### Purification and Serology of Echinochloa Ragged Stunt Virus

*Echinochloa* ragged stunt virus (ERSV) was purified from infected *Echinochloa crus-galli* var. *oryticola* by homogenizing fresh leaves or roots in 0.25 M phosphate buffer, pH 7.2, containing 0.01 M  $MgCl_2$  and 1% 2-mercaptoethanol. Sap was clarified by adding carbon tetrachloride to a final concentration of 20% and stirred for 10 mins. After centrifugation at 10,000 g for 15 mins the supernatant was saved and treated with 1% Triton X-100. It was centrifuged again at 10,000 g for 15 mins. The supernatant was centrifuged through a 5 ml pad of 20% sucrose at 55,000 g for 1 hr. The sediment thus obtained was suspended, layered on 20-50% linear sucrose gradients and centrifuged for 90 mins at 85,000 g. The virus band was drawn and concentrated by centrifugation for 1 hr at 55,000 g. The purified preparation was dominated by spherical virus particles about 55-58 nm in diameter and had a UV absorbance ratio of 260/280 in the range of 1.8-2.16. Contaminating host material was not evident when the preparation was examined in an electron microscope. The serological relationship of ERSV with rice ragged stunt virus (RRSV), maize rough dwarf virus, oat sterile dwarf virus and rice black-streaked dwarf virus was tested by immune electron-microscopy and by protein. A gold labelling, using purified ERSV as antigen. The results indicate a close relationship serologically between ERSV and RRSV, but a lack of it between ERSV and other plant reoviruses tested.

#### Four New Recorded Agricultural Insect Pests from Taiwan

*Heterococcus rehmii* Lindinger was discovered at Taichung area in 1988, while as it was the new record for Taiwan and Mainland China. *H. rehmii* damaged the inner part of leaf sheath of rice plant in booting stage. *Cataphrodium rubripenne* Hope was the new insect pest for pear, and damage the stem of pear. *Maruca testulatus* Geyer (Fig. 16) and *Cryptophlebia ombrodelta* (Lower) (Fig. 17) damaged the pods of snap bean. However, it was the new insect pests of bean. Above four new insect pests were subjected for their classification and characterization

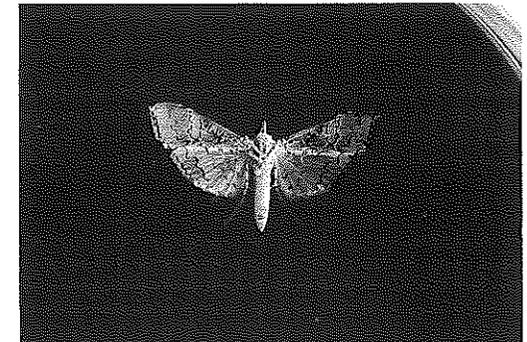


Fig. 16. New record of insect pest in snap bean, *Maruca testulatus* Geyer.

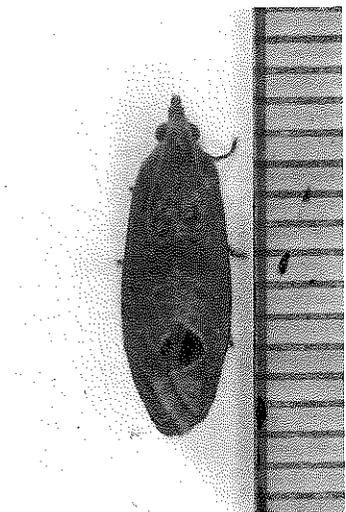


Fig. 17. New insect pest of snap bean, *Cryptophlebia ombrodelta*.

### The Occurrence and Improvement of Control Method for Scarab Beetle of Vineyard

Six species of scarab beetle (Fig. 18) have been recorded as the pests of grape, i. e. *Anomala cupripes* Hope, *Anomala expansa* Bates, *Protaetia orientalis* Govy and Percheron, *Anomala castaneiventris* Bates, *Protaetia Cultra* Waterhouse, *Calopotisia formosana* Moser etc. The results showed that the population density in *Anomala Cupripes* was the highest, *Anomala expansa* and *Protaetia orientalis* was the second ones. *Anomala expansa* and *Anomala cupripes* damaged the leaves, fruits and buds, while *Protaetia orientalis* damaged the mature fruits. The population peak of these beetles was during June to July. For the bioassay, we decide the sex by the end of abdomen of these beetle. *Protaetia orientalis*, *Calopotisia formosana*, *Protaetia culta* were tested by banana, and had a good effectiveness, the laboratory test by Y-type tube was the same. Insecticide tests in the field indicated that 2.8% Deltamethrin E. C. at a rate of



Fig. 18. Damage of grape leaves by scarab beetle.

2000-fold, or 24% Methomyl S. at a rate of 1000-fold, and 46.84% Carbofuran F. P. at a rate of 1200-fold were more effective for controlling these beetles than any other chemicals tested. Injecting the Methomyl or applied the granulated Temik around the stem also have good control of beetle larva.

### The Occurrence and Improvement of Control Method for *Bradybaena similaris* of Vineyard

*Bradybaena similaris* belongs to Gastropoda, which feeds and damages the flowers, fruits, buds and leaves and excretes the excreta mucous membrane, which affects the quality and quantity of grape. The population peak is during May to September. The pattern of spatial distribution of this snail in the vineyard appear to be the uniform type of distribution. The optimum sampling size for this snail observation on grape vine indicated that at the snail density of 1/plant, sample sizes of 259 and 1,597 plants were need to fulfill precision levels of 0.25 and 0.1, and the density of 5/plant, sample sizes of 41 and 256 were estimated. PET bottle, black PE cloth, PE plate, PE cloth, slime, tooth paste, vanslin, metaldehyde, metaldehyde (weeding before application), metaldehyde paste were tested. The results showed PET bottle, black PE cloth, PE plate had the best efficiency of control, the percent control was over 90%. The percent control of metaldehyde granule, metaldehyde paste and PE plate was ca. 80%. Metaldehyde under weeding before application, the percent control was from 40 to 60%. Slime, tooth paste, metaldehyde, metaldehyde paste was 2-3 weeks for the residue, whileas 6 weeks for black PE cloth. For all tests indicated that PET bottle

method (Fig. 19) was best effective, and it was available to recommend to the grape grower.

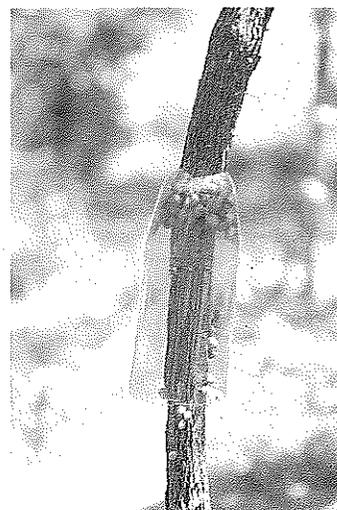


Fig. 19. Control of *Bradybaena similaris* by PET bottle.

### Occurrence and Control of Blackleg of Cabbage

Among 21 cabbage varieties screening for blackleg resistance, Ho-feng, Tsuen-chu #1, Chu-tung, Nung-shi 2335 and Tsuen-yang showed slight resistance, which only forming brown spots on the surface of stem. The germination rate of spores decreased as the decrease of relative humidity. Under 100 and 98% of relative humidity, the germination rate of spores was 92.3% and 80.1%, respectively, and no germination below 92% of R. H. Result of chemicals screening test indicated that Fungaflor and other 12 chemicals could inhibited the growth of mycelium in the lab condition. Pot experiment indicated that Fungaflor, Fenarimol and Mertect have the best control of blackleg. The survival test of pathogen showed that the soil contained pathogen at 3 months after harvest didn't produce any symptom.

Soil treatments of urea, CaCN<sub>2</sub>, lime dust and S. H. mixture have no effect on the control of blackleg.

### Economical Evaluation of Using Different Bagging Materials for Control Melon Fly on Bitter Gourd and Sponge Gourd

The results of using different bagging materials for control melon fly on bitter gourd and sponge gourd indicated that all materials have control effect on melon fly. On the fruit development of bitter gourd 10 days after bagging the brown PP bag have the best effect, next is the double-layer paper bag. On the appearance of bitter gourd, the double-layer paper bag and black PE bag have the whitest color. The cost of bagging materials for black PE bag and brown PP bag are NT\$ 0.07, double-layer bag is NT\$ 0.1. From the above result, it is recommended that at early vining stage use double-layer bag, and at fruit-stage use black PE bag, brown PP bag or newspaper. Among five bagging materials, white paper bag have the best control effect, which is water-proof. On the effect of sponge gourd fruit development 7 days after bagging, the reinforced water-proof bag have the best result, next is newspaper bags. The cost of the PP bag is NT\$ 0.07, the reinforced water-proof bag is NT\$ 0.01 per bag.

### The Utilization of Sex Pheromones for the Monitoring of Pest Population

Some noctuid moths pheromones were tested. Dry type and wet type traps were applied to monitor the population fluctuation of their moths. The results showed that the

synthetic sex pheromone had a good attractance (Fig. 20). Large number of moths could be attracted in the field using synthetic sex pheromone while only few were trapped by light. Preliminary studies indicated that the peak of number of *Chilo suppressalis* was at late-August, early-October in 1987, early-February, early-March, late-July and early-September in 1988. The population peak of *Spodoptera exigua* was at early-November in 1987, mid-January and late-March in 1988, the second peak of this insect was at late-July and mid-August. The population peak of *S. exigua* in Tanwei was at late-January, late-February, late-March, mid-April, early-June, late-July, early-September, mid-October, and mid-November. The population peak of *Spodoptera litura* in Fongyen was at late-January, mid-February, mid-April, late-May, late-July and late-October.



Fig. 20. Monitoring the population of *Spodoptera exigua* by insect sex pheromone trap.

### The Population Density and Efficacy Assessment for Control of Rodent in Taichung Area

Field rat is one of the wide range and important pests in the farming land. Thirteen species of rats have been recorded

as the rodent pests of agricultural crops from the present observation. The annual peak of population density and occurrence rates for five major pests are as follows: *Bandicota nemorivaga*, from March to October, 2.9%; *Rattus losea* and *Apodemus agrarius*, from July to October, 32.7% and 10.6%, respectively; *Mus formosanus*, from December to January, 51.4%; *Rattus norvegicus*, September, 2.4%. Extermination percentage of rats for Taichung, Changhua, Nantou county and Taichung city was 65.5%, 91.5%, 84.3% and 58.6%, respectively. The sex ratio for male and female is 56.7% and 43% before extermination, while 63.9 and 36.1% after extermination. Baiting acreage in Taichung areas for farming land and public land are 133,795 and 16,390 ha, respectively. The control cost is NT\$14,524,767.

### The Sampling and Analysis of Pesticide Residue before Harvesting in Vegetable

The survey of residual level of pesticide on vegetables before harvesting collected from Taichung area was carried out from July 1987 to Oct. 1988. All samples (Fig. 21) were examined by bioassay and biochemical methods. If pesticide residue on the examined samples were beyond tolerance level, then traced procedure and educated program will execute for the farmers and advised them to delay the harvest time on those high residue vegetables. This survey indicated that 86.7% of 2474 of the tested samples collected from July 1987 to June 1988 were evaluated to be safe. The 92.5% of 871 tested samples collected from July to Oct. 1988 also were considered safe. Further studies showed that the high residual

samples were found about 19.1% in beans and peas; 12.6% in small leafy vegetable; 12.2% in fruit vegetable; and 10.9% in large leafy vegetable. The sample contained high residue of pesticide were found in root vegetables and cucurbita vegetable. Comparing the tested vegetable samples, strawberry, celery, cabbage, leek, mustard and eggplant had higher pesticide residue than other samples. However, bitter melon, luffa, carrot, water oat and kohlrabi didn't find and pesticide residue.

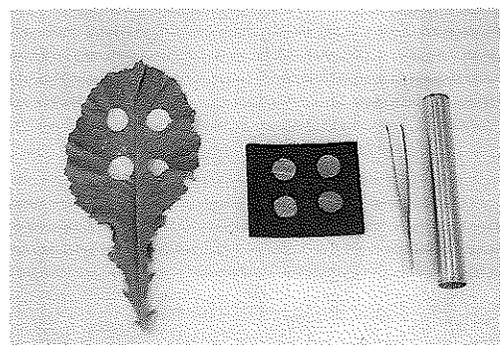


Fig. 21. Leaf-disks sampling method of vegetable crop for residue analysis.

## SOIL AND FERTILIZER

### An Experiment of Monitoring Air Pollution by Indicator Plants

This experiment is designed to test the feasibility to use indicator plants to monitor air pollution. Its final objective is to establish an economical, simple and effective air pollution monitoring system for protecting the air quality of our country or communities. Two monitoring spots has been established at each of the 5 townships, Huatan (brick factory area), Homei, Senkang, Lungching, and Tatu (Taichung Power Station area) in 1987. In 1988, two additional

monitoring spots has been established at the two townships, Tali, and Tanzi. Eight species of indicator plants, gladiolus, peanut, banana, guava, yon-tsai (water convolvulus), cowpea, sesame, and rice were selected to join the experiment. Among the 12 monitoring spots, two of them at Huatan had 4 kinds of plants, gladiolus, peanut, banana, and rice showing the injury symptoms of fluorides, and the fluoride contents of the plants were higher in the two spots than those in the other 10 spots. However, only four of them, gladiolus, peanut, banana, and rice showed typical and easily identified symptoms that were suitable to be used as indicator plants for detecting fluoride pollution. Generally, these symptoms were more severe in the second crop season than in the first crop season. Although sulfur oxides is the most prevalent air pollutant in this experiment, only the plants at Tanzi displayed the injury symptoms of sulfur oxides, and sesame and gladiolus (Fig. 22) were the two plants showed severe, typical, and easily identified symptoms that may be used as indicator plants for detecting



Fig. 22. Gladiolus, indicator plant for pollution of fluoride.

sulfur oxides pollution. It was apparent that the two plants, guava and rice required higher concentration of sulfur oxides to make them show more severe symptoms, that seemed to be used as the indicator plants for higher concentration of sulfur oxides. Though cowpea showed serious injury symptoms of sulfur oxides, however its symptoms were easily confused with the symptoms of some diseases in the later part of growing stage (Fig. 23).



Fig. 23. White-flower Ipomea, indicator plant for pollution of sulfur oxides.

### Study on the Effect of Liming on Acidic Ponkan Orchard

In order to understand the effect of liming on soil fertility maintaining, nutritional status, fruit yield and qualities of Ponkan citrus. A 3-year field experiment was carried out at Tungshi, Taichung county. The soil pH was 4.9. Lime and dolomite with 1.5 and 3.0 ton/ha were used. Results showed that the application of liming materials *i.e.* lime or dolomite increased soil pH, exchangeable Ca and Mg, and leaf Ca and Mg. The yield as well as the qualities *i.e.* juice rate of acids (sweetness) and solid/acidity of Ponkan were increased significantly by the application of liming (Fig. 24). Statistical analysis showed a slight antagonistic relation-

ship between leaf Ca or Mg and leaf K. Solids and acid content of fruit were closely related to leaf K and P. Thus, the improvement of fruit qualities by the application of liming materials was to increase Ca, Mg, P and K content in leaves. In order to maintain soil exchangeable Ca and Mg and to neutralize soil acidity, an amount of 1.5 t/ha of liming material is recommended to use annually in Tungshi area.

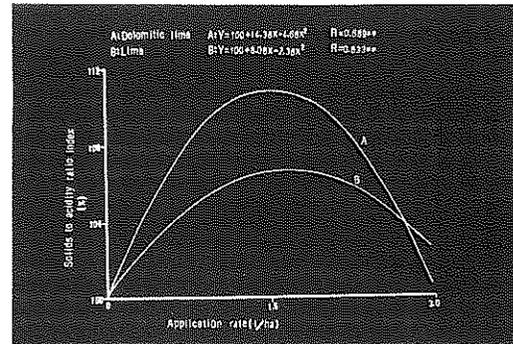


Fig. 24. Relationships of the rate of dolomitic lime and lime with the index of ratio of solid to acidity in Ponkan fruit.

### Evaluation for the Suitability of Growing Corn on the Upland Converted Paddy Field in Taichung Area

In order to determine whether the upland converted paddy fields are suitable for cultivation of corn. A series of field experiments was held in different soils of Taichung district in 1987. In the spring crop, paddy soils of Taichung and Nantou, except hilly areas, had a higher yielding capacity than that in Changhua and its coastal areas. On the contrary, paddy soils of Changhua showed a higher yielding capacity than Taichung and Nantou in the fall crop, except coastal areas. The hilly and coastal areas are influenced by the

cold temperature and strong monsoon wind, thus caused low yield of corn. Corn yield was also influenced by planting dates. From early February to late April in the spring and from early July to middle September in the fall are planting periods of corn in Taichung area. The highest yield was obtained when planted in the middle February (spring crop) and late August (fall crop). Among soil groups, the well-drained latosol showed the highest yield potential for corn. Medium textural sandstone-shale alluvials and slate alluvials also give a high yield of corn. Calcareous soils with higher pH showed a better performance in the fall than those of noncalcareous soils. Soils with higher level of available phosphate (higher than 50 ppm) and potassium (higher than 67 ppm) gave a higher corn yield than the soils with low available phosphate and potassium (Fig. 25).

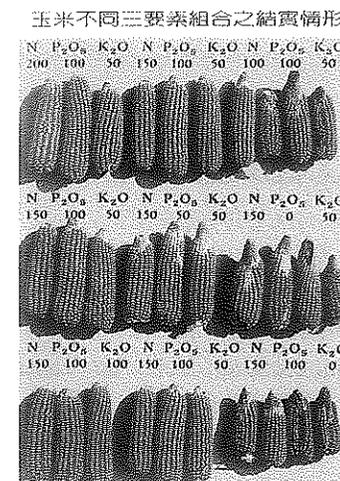


Fig. 25. Comparison of corn ears at different rates of N-P-K fertilizer treatment.

## AGRICULTURAL MACHINERY

### Performance Test of Front and Rear Mounted Plow

The plowing system includes a front mounted reversible plow and a rear mounted reversible plow. The plows (Fig. 26) are mounted on the FORD 7610.86 hp front wheel assist (FWA) tractor. The instrumentation system was designed for collecting dynamic force distribution on tractor's front and rear three point linkages. Components of the instrumentation system include an onboard Apple II Computer, an analog to digital (A/D) converter and 15 channels of sensors. In each run, when the forward speed and plowing conditions were steady, the data collection routine was executed for 50 seconds. Total number of data collected by each run is 7500. All collecting data was saved in disk file, then converted to actual force data by another computer. The performance of the system was evaluated statistically. In general, the specific drawbar power increased as the ground speed increased. When at the same speed, plowing at clay soil needs about 100% to 120% more specific power than plowing at sand soil. Although the field conditions appeared to be the same and the plowing system was equally adjusted for left plowing and right plowing, the specific force requirements for right and left are different in most results. Apparently the adjustment



Fig. 26. Performance test of front and rear mounted plow.

differences were relatively sufficient and these plows were very sensitive to adjustment.

### Experiment on Subsoil Cultivation and Fertilization Machine of Grape

A multipurpose pneumatic cultivator (Fig. 27) which can blow high pressure air and liquid into deep soil has many functions such as cultivating, fertilizing and pest controlling. Experiments were conducted in grape orchard to investigate the different cultivation and fertilization effects among the subsoil fertilizing and traditional fertilizing areas. The results showed that the distribution radius of injected liquid was 55 cm and the depth was 70 cm. The growth of the grape veins in subsoil fertilizing area was better than that of the traditional fertilizing area. The soil fertility in subsoil fertilizing area was higher than that of the traditional fertilizing area, and so was the nutrient concentrations in grape leaves. The average grape weight and sugar contents was not significantly different between each treatments, but the fertilizer usage of the subsoil fertilizing area is 1/4-1/2 lower than the traditional fertilizing area.

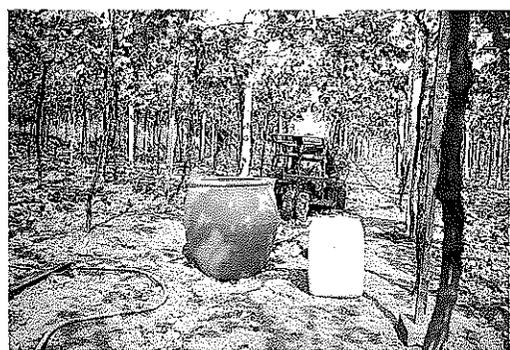


Fig. 27. Subsoil cultivation and fertilization machine of grape.

## AGRICULTURAL EXTENSION EDUCATION

### Survey on Land Utilization and of Agricultural Production Planning in Changhua County

Changhua is one of the most important agricultural areas located on the central part of Taiwan. The major agricultural production include rice, upland crops, vegetables, fruits, flowers and animal husbandary which are especially suitable to the natural condition of this area (Table 1). According to the future development plan made by the Taichung DAIS and Changhua county, the cultivation of rice and grain crops must be carried out through the rice-seedling centers and the upland-crop cultivation centers by the system of contracted farming so that to increase the management scale. For horticultural crops, a high technology and investment and intensive farming system combined with the establishment of special crop zones should be employed. The production of animals already attained the economic scale. The future work must concentrate on the treatment and control of the animal wastes. For the fishery production, the near-by seashore will be the center for future development. The soil conservation and sightseeing farming could be carried out on the slope land in Changhua. Agriculture in Taiwan faces with the problems of rapid industrialization and imported foreign agriculture products. The government's agricultural protection policy is still needed to help increase the income of farmers. The agriculture structure, farming technology and rural integrated development, especially the welfare of farmers in Changhua area should be further improved.

Table 1. Total acreage, total production and average yield of selected crops in Changhua county.

Crop	Total Acreage (ha)	Yield (kg/ha)	Total production (ton)
Rice	71,815	5,559	393,083
Peanut	7,737	1,751	13,551
Barley	395	4,192	16,558
Sorghum	798	3,156	2,518
Fruit trees	7,905	13,429	106,157
Vegetables	17,171	12,713	218,290

### A Survey on the Fruit Tree Production Trainees in Taichung DAIS

A total of 317 trainees who completed the fruit production courses organized by this Station in 1986-1987 were surveyed with regard to the post-training farming situations. Only 103 of the questionnaires were useful for analysis. The SPSS (Statistical Package for the Social Science) was employed for this study. The results indicated that the majority of the trainees are younger than 35 in age and received a higher education. They are now still engaged in the agricultural business. Most of them still keep the traditional thinking on the farmland *i.e.* rather to buy instead of to sell the land. They feel the agriculture is very hopeful even if they are facing many difficulties. A follow up training programs are welcomed. When they face some problems in farm management, they seek help from other farmers, then the extension workers of Farmers' Association, and the specialists of DAIS. Very few trainees had the experience of applying agriculture loans offered by government because of the complex procedures of application. About half of the trainees do not know the detail

of contract farming system which is strongly encouraged by the government (Fig. 28).

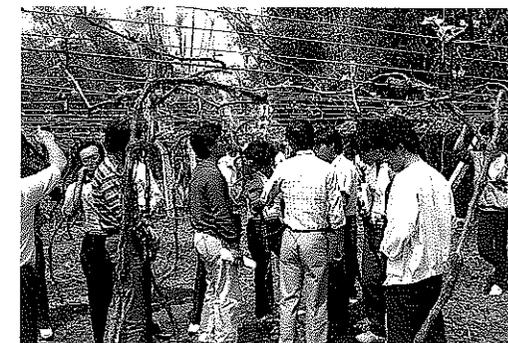


Fig. 28. Field day of grape production training course for youth farmer.

## AGRICULTURAL ECONOMICS

### An Analysis of Production Cost and Return for Tunnel-cultivated Water Convolvulus in Taichung City

In this study, 10 farmers for tunnel-cultivated water convolvulus in Taichung city were randomly taken as the sample farmers for investigation. The original data was taken by visiting the farmers with survey questionnaire. The results of analysis were as the follows. The average first production cost of tunnel-cultivated water convolvulus was NT\$ 87,607 per 1,000 m<sup>2</sup> and the second production cost was NT\$ 90,969 per 1,000 m<sup>2</sup>. Based on the cost for NT\$/kg, it was NT\$ 8.8 and NT\$ 9.1 for the first and second production cost, respectively. Labor cost was the major input for the production of tunnel-cultivated water convolvulus which was around 70.5% of the total cost. The rest were facilities cost of 6.0%; fertilizer cost of 5.7%; and pesticides cost of 4.8%, respectively. The gross return for production of tunnel-cultivated

water convolvulus was NT\$ 140,286 per 1,000m<sup>2</sup>. The production cost, the profit, the return of family labor and the farm earning were NT\$ 90,969, 49,317, 109,634 and 111,632 per 1,000m<sup>2</sup>, respectively. Based on the annual cropping system (1st tunnel-cultivated water convolvulus—2nd rice), the gross return per 1,000 m<sup>2</sup> was NT\$ 147,271. The production cost, the profit, the return of family labor and the farm earning were NT\$ 98,545, 48,726, 109,873 and 113,224 per 1,000 m<sup>2</sup>, respectively.

### An Analysis of the Production Cost and Return for Vegetables Produced by Water Culture in Taiwan

There are only two private hydroponic farms with comparable size and economic cultivation in Taiwan. These two farms were chosen for analysis of the production cost and revenue for leafy vegetables. The results are as the following: The average production cost per 1000 m<sup>2</sup> for hydroponic leafy vegetables in these two farms were almost the same, NT\$ 1,143,704 and 1,167,785 for farm on Miaoli and Tainan, respectively. However, the structure of production cost were not exactly the same especially for the detailed cost of current inputs. The average first production cost of these two farms were NT\$ 35.4 and 39.3 per kg and the second production cost were NT\$ 38.1 and 42.7 per kg for No. 1 and No. 2 farms, respectively. The fixed cost in No. 1 farm was counted for 44% of the total production cost and the variable cost was counted for the rest 56%. The total sale at the break-even point in No. 1 farm was NT\$ 3,601,187, which was higher than its actual total sale of NT\$ 2,940,000. The quantity of sale at the break-even

point was 102,857 kg which was more than its actual sale quantity of 84,000 kg. The fixed cost in No. 2 farm was counted for 37% of the total and the variable cost was counted for the rest 63%. The total sale at the break-even point in No. 2 farm was NT\$ 2,147,735 which was lower than its actual total sale of NT\$ 2,463,750. The sale quantity at the break-even point was 47,724 kg which was less than the actual sale quantity of 54,750 kg. The total annual loss for No. 1 farm was NT\$ 260,084 and the loss per 1000 m<sup>2</sup> was NT\$ 92,953. Therefore, the payback period of facilities would be 4.5 years with the interest of capital not considered. If the interest was counted, the time for capital return would become 5.5-6.2 years. For No. 2 farm, the total annual profit was NT\$ 128,182 and profit per 1,000 m<sup>2</sup> was NT\$ 64,090. If the interest of capital was not counted, the payback period of facilities would be about 4 years. However, if the interest was counted, the payback period would become 4.8-5.4 years.

## HOME ECONOMICS

### Survey on the Lunch Eating Habit and Working Performance for the Farmer's Household in Taiwan

A total of 2012 households from the western district of Taiwan were surveyed with regard to the lunch eating habit as well as working performance in 1987. The average size of the farm household sampled was 6.63 persons, 75% of the farmers and their wives surveyed. were around the age of 41 years old. The results of the survey indicated that the breakfast was considered by most farmers to be the most important

among the three meals a day. 43% of family surveyed indicated their strong will to do their housework together as a team, and 73% of them satisfied with this kind of housework. 47% of family take lunch together with family members and 62% of them satisfied with this manner (Table 2). Economy factor, deliciousness, nutrition, sanitation and the simplicity of serving lunches are the major concern for the members of household. However, nutrition of food is regarded to be the most important by the housewives. Most housewives spent 31-60 minutes to prepare foods. The equal time is usually used to have their lunches. The families which use about 30 minutes time for dish-washing consisted of 79% of the total household surveyed. The persons older than 50 years of age were found to prefer eating rice

as the main food. The younger person with higher education and those with higher income tended to be keep away from this eating habit. More farm families in the northern Taiwan take their lunches out of home, in comparison with those in central and southern Taiwan.

### Studies on the Relationship Between Taste and Quality of Kyoho Grape

This is a preliminary study trying to find the relationship between the chemical quality and acceptability of Kyoho grape. A total of 281 grape samples were collected from Tatsuen, Tungshih, Cholan, Hsinshe, Tienleng and Hsinyi. The grape collected from six places were used for quality analysis as well as for eating test by different consumers. About 58% of the consumers participated in the eating quality test preferred the grape with high sugar content, but 41% of them preferred the taste of sweet mixed with a little bit sour. Most consumers like to choose the fruits with large size, darker color and good appearance as the best quality of grape. Based on the fruit appearance and eating quality, the taste of grapes produced in Shinyih and Shinshe or Tsuolan were the most excellent ones. The grapes from Shinyih had larger fruit size, darker color, harder in texture, higher in the ratio of sweetness and sourness. The grape from Tatsuen showed a very high sugar content. The consumer showed a significant difference on the standard of like or dislike on the bases of sugar content, color, hardness aroma and sweet/sour ratio, etc. Therefore, it is very difficult to draw a conclusion as to what quality of the grape is the best one.

Table 2. The frequency and satisfaction with that did housework and had meals with their families.

Character	Did housework with their families		Had meals with their families	
	No. <sup>1)</sup>	%	No.	%
Frequency				
Always	431	21.4	940	46.7
Usually	862	42.8	872	43.3
Rarely	536	26.6	147	7.3
Never	150	7.5	22	1.1
Missing value	35	1.7	33	1.6
Satisfaction				
Very satisfied	329	16.3	599	29.7
Satisfied	1477	73.3	1250	62.1
Dissatisfied	99	4.9	43	2.1
Very dissatisfied	7	0.4	2	0.1
Missing value	102	5.1	120	6.0

1. Total number=2012.

## ACTIVITIES OF AGRICULTURAL EXTENSION EDUCATION IN 1988

### Strengthened Assistance to Farmers' Associations

The main purpose is to strengthen the assistance for Farmers' Association in Taichung areas to accelerate its business development. Besides, promoting production conditions, developing available resources as well as guiding the strategies including the improvement of marketing system providing production materials, developing rural communities and promoting farmer's welfare are the major functions of Farmers' Association. From July 1, 1987 to June 30, 1988, expenses for agricultural extension

Table 3. The amount of expenses and number of members in Taichung areas.

County & City	Farmers' Associations	Full members	Associated members	Business profit	Expense for agri. extension
Taichung County	21	59,418	44,835	246,081,000	129,537,000
Taichung City	1	11,227	14,653	27,261,000	16,407,000
Changhua County	26	107,395	25,272	257,490,000	140,251,000
Nantou County	13	61,052	19,261	173,278,000	99,480,000
Total	61	239,092	104,021	704,110,000	385,675,000

### Organization and Guidance for Core Farmers

Integration of primary extension organizations and activities were carried out in township Farmers' Associations. During this year through the assistance of the Station to those Associations have organized 1,841 agricultural study groups with 20,206 participating farmers, 265 4-H club groups with 2,037 rural youths, and 1,515 home economic groups with 15,385 participating

(Table 3) to a total amount of NT\$ 385 million had been extended to 61 township Farmers' Associations in Taichung areas. The expenses were used to help these Associations to provide better services and to improve the incomes of their members.



Fig. 29. Director Dr. Hsieh briefing to the foreign visitors of this Station.

farm women. The cumulated record for such groups organized is 3,621 with a total of 37,898 participants (Table 4). Meanwhile, the Station also helped those Associations to design extension programs and communication for agricultural information, and a mail box for agricultural services was provided to answer questions from farmers and instructors were provided for training courses held by Farmers' Association (Table 5). Besides these guidances, the Station also offered instructors on some special

Table 4. The grouping for the 80,000 core farmers program in Taichung area.

County & City	Agric. study groups		Home economic study groups		4-H Club		Total	
	No. of groups	No. of persons	No. of groups	No. of persons	No. of groups	No. of persons	No. of groups	No. of persons
Taichung City	48	360	44	339	13	124	105	823
Taichung County	491	5,123	323	3,158	96	730	910	9,011
Nantou County	507	5,921	419	4,220	77	738	1,003	10,879
Changhua County	795	8,802	720	7,668	79	715	1,603	17,185
Total	1,841	20,206	1,515	15,385	265	2,307	3,621	37,898

Table 5. The accomplishments of agricultural extension education of Farmers' Associations in Taichung areas for 1988.

Item	Farm extension	4-H extension	Home economics extension	Total
No. of extension programs	7,494	4,560	6,572	18,626
No. of interviewed households	87,089	33,824	41,419	162,062
No. of participating trainees	100,270	41,726	99,730	241,726
No. of participants of meetings	46,141	16,388	30,401	92,930
No. of persons participated extension activities	143,165	64,289	123,192	330,946
Number of extension agents	327	80	82	489
Number of groups	4,502	1,679	669	6,850
No. of group members	25,310	16,417	20,572	62,299

subjects for the on-job training courses for staff of Farmers' Associations or foreign trainees.

were held: training classes for 310 agricultural instructors and 4 symposiums for core

### Agricultural Training Center

The agricultural training center of Taichung DAIS was set up in 1985, is aimed to provide training courses for farmers and agricultural extension personnel. Its purpose is to improve farming methods and techniques, increase production efficiency and income, bettering levels of living, and lifting the social and educational standards of rural life. The following training activities



Fig. 30. The demonstration meeting of those involved in agricultural communication.

farmer leaders, with a total of 173 participants; and 10 seminars for agricultural extension personnel of the level of township and county, with a total of 268 participants. 21 training courses have been conducted in 1988, with a total of 751 participants.

### Agricultural Consultation Services

In the past, the consultation services is a diffusive strategy of agricultural extension but it had a poor effectiveness in past experiences with the traditional model. So we took a innovative strategy for consultation service to further persuade farmers to adopt a new information and technology through the unilateral consultation model. First example of this consultation model which was held in 1985, recognized that the new model was more efficient than ever. Therefore, in the following years, the new model was adopted by this Station. In 1988 this Station, under this model, the consultation services included five subjects such as hogs, rice, vegetable, hydroponic culture and parental education have been carried out. A total of 720 participating farmers, 92 present specialists, 72 townships



Fig. 31. Farmers from Farmers' Association visiting the hydroponic farm of the Station.

participated and the range of percentage increased over the traditional model in a year basis is 12-44% (Table 6).

Table 6. A comparison between the traditional and unilateral models of agricultural consultation meeting.

Consulta-tion model	Average No. of farmers attended each meeting	Average No. of specialists attended each meeting	Average No. of townships participated at each meeting
Traditional	57.83	7.88	1.17
Unilateral	104.00	12.50	7.10

### Agricultural Communication

Agricultural news and technological know-how are transferred to the farmers through the media such as TV, radio newspapers and magazines (Table 7). Recently, emphasis has been put on the small-scale communications.

#### 1. Agricultural TV Programs

A total of 17 five-minute agricultural TV programs were planned and produced by the Station during this year. It is contributed to the "Farm Report" and "Agriculture Column" shows broadcast each noontime from Monday through Saturday on Taiwan Television and China Television Stations, respectively. The Station also produced a total of 14 titles of educational taped materials for the training of the 80,000 core farmers.

#### 2. Agricultural Broadcasting Programs

A 60-minute agricultural program entitled "Agricultural World" is broadcast at 1:00 P. M. every Sunday on the second channel (1,242 AM) of the Broadcasting Corporation of China (BCC). The agricultural programs of local radio station were

produced by this Station in cooperation with BCC.

### 3. Agricultural News

According to the ideas of Loomis and Buezele (1975), expressed in their strategy for rural improvement (or development) whether they are governmental organizations or non-governmental institutions should not wait for things to happen by themselves, but bring about change through planning. Our Station, following this "make things happen" strategy, has tried its best to cooperate with all the concerned media institutions. As a result, the Station and the news media coordinated on the distribution of agricultural news, prepared by Taichung DAIS as Table 7.

Table 7. Media coverage of agricultural news prepared by Taichung DAIS in 1988.

Media	News releases
TV	48
Radio	78
Newspapers	114
Magazines	44

### 4. Agricultural Extension Publications

Agricultural information and technological know-how transmitted to farmers through publications can be one of the most efficient agricultural communication activities. During 1988, the followings were the main publications carrying out this activity:

#### (1) Research Bulletin:

Its contents consist the results of research findings at this Station in 1988. This bulletin may provide the best evidence of our contributions, and serve as the basis for future development of the research activities at this Station. 21 issues have

been published up to date.

#### (2) Special Publications:

It is a proceedings of a symposium on various topics that is organized and published by this Station. The Special Publications has reached No. 14. The last three issues were published during this year.

#### (3) Agricultural Newsletters (Quarterly):

This publication has a circulation of approximately 25,000, and is aimed mainly at core farmers, young farmers and agricultural extension personnel. Its contents include the agricultural technology, agricultural laws and administrative orders, new agricultural know-how, farm life, extension activities, etc. The Quarterly has reached Vol. 10, No. 4.

#### (4) Extension Bulletins (Monthly):

It is published monthly and sent to concerned agricultural organizations and core farmers. 85 issues have been published.

### 5. Agricultural Taped Materials Library

A total of 589 pieces of video-tape covering agricultural extension, business administration, home economics, and other educational video-tapes have been collected in the library from areas all over Taiwan. During 1988, they have been lent out to



Fig. 32. Camping activity of the youth farmers from 4-H group.

the township Farmers' Associations to a total of 1,015 times. Moreover, Farmers' Associations have obtained 407 copies of these video-tapes.

### Promoting the Model of Joint Farming

The Second-Stage Farmland Reform program is one of the most important agricultural policies that will sustain growth in agricultural sector and ensure coordination with overall economic development needed in the 1990's. This program includes: (1) financial support for the purchase of farmland to expand the farming scale; (2) joint, entrusted and cooperative farming; (3) land consolidation; (4) farm mechanization; and (5) other supporting activities. Joint, entrusted and cooperative farming is considered to be the major step for enlarging the farming scale without affecting the existing land ownership. Due to some limitation factors caused by existing conditions, the progress is not very successful. A new adjusted model which can solve some of limited factors was

released by the Station and welcomed by farmers. This model is encouraged by the Government. In central part of Taiwan, a total of 1347 ha. or 53% of total extended acreage were carried out under this new model.

### Promoting Rural Development and Construction

In coordination with local Farmers' Associations and in consideration of the farmers' desire and rural developmental trends, a total of 83 supervisory personnel and 1520 farming family housewives received training in various courses. In addition, 5 nutrition cookbooks were published in accordance with the production of seasonal vegetables. In respect to enriching cultural facilities, preserving good social tradition, cultivating mutual assistance and promoting social harmony, the "I Love My Village" movement was carried out in 132 villages during this fiscal year. A total of 29,118 farm families benefited from this effort.

## 3. PUBLICATIONS

### A. Scientific Papers: Published on Bulletin of Taichung DAIS Nos. 18-21.

1. Development of Taichung 12 Pea with Powdery Mildew Resistance (photos illustration) ..... J. Y. Kuo
2. Improvement of Cultural Technique for Sorghum in the Paddy-converted Dryland... S. S. Tseng, S. Song and F. F. Hou
3. Effects of Fertilizers on the Grain Yield and Leaf Nutrient of Sorghum..... Y. F. Tsai and S. C. Huang
4. Mechanization of Seed Harvesting Technique for Hybrid Sorghum, Taichung 5 ..... J. H. Ho, T. C. Kao, G. J. Lin and C. L. Liang
5. Studies on Correlations between Palatability Evaluation and Physicochemical Properties of Rice..... A. N. Hsu and S. Song
6. Effect of Cultivated Locations on the Milling Quality and Physicochemical Properties of Rice..... S. Lu, S. Song and S. C. Wu
7. Development of an Early Maturing Variety of *japonica* Rice, Taichung 190..... S. S. Huang and S. J. Chang
8. Spatial Distribution of *Zeuzera coffeae* Nietner on the Grapevine ..... C. P. Chang
9. *Echinochloa* Ragged Stunt: Symptomatology, Host Range, Transmission and Properties of Virions ..... C. C. Chen
10. Studies on Stability of Rust Resistant Bean Lines in Different Locations..... J. W. Guu
11. Studies on the Genetic and Breeding Behavior of Green Beans (*Phaseolus vulgaris* L.) II. Number of Minimum Gene and Gene Action of Pod Shape ..... W. J. Chung
12. *Aphid fauna* of Taiwan with Comparison of Other Provinces of Mainland China..... C. C. Tao
13. Improving the Technique for Purification of Sugarcane Mosaic Virus ..... C. R. Yang
14. The Control Timing of Sorghum Aphid on Grain Sorghum-Taichung 3 ..... M. N. Fang, C. P. Chang and H. Huang
15. Occurrence and Control of *Alternaria* Leaf Spot Disease of Grape ..... Y. Z. Yang, E. S. Wang and M. C. Cheng
16. The Effect of Soil Texture on Rice Quality..... F. F. Hou, M. C. Hong and S. Song
17. New Rust Resistant Snap Bean Variety-Taichung 1 (photo illustration)..... J. W. Guu
18. Effects of the Nitrogen, Phosphate and Potassium Fertilizers on Job's Tears (*Coix lacryma-jobi* L.) ..... C. T. Wang and K. N. Tsi
19. Studies on Rainshelter Cultivation for Summer Vegetable Production ..... F. Y. Kuo, T. C. Lin and S. H. Juang
20. Study on the Effect of Liming on Acidic Ponkan Orchard ..... H. C. Huang and Y. F. Tsai

21. Study on the Relationship between the Morphological Characteristics of the Grain and Grain Chalkiness in Rice ..... T. F. Lin
22. Effect of Different Fertilizers, Different Fertilization Methods on the Growth of Spinach in a Slightly Alkaling Slate Alluvial Soil in Central Taiwan.....C. F. Hsieh
23. Development of a Powdery Mildew Resistance Variety of Edible-podded Pea, Taichung 12 .....J. Y. Kuo
24. An Unrecorded Rice Mealybug of Taiwan .....T. S. Liu and C. C. Tao
25. The Occurrence and Control of *Brady-beana similaris* (Ferussac) (photo illustration) ..... C. P. Chang
26. Breeding of a New *indica* Rice Variety-Tai Sen 1 ..... T. F. Lin
27. Studies on Yielding Potential of Rice for Single Cropping Culture in Taichung Area ..... S. J. Chang and C. Y. Sheu
28. The Occurrence of Maize Stripe Virus in Taiwan ..... C. H. Chao, C. C. Chen, H. W. Chiang and E. S. Wang
29. Investigation on Morphology and Damage of Greenhouse Whitefly, *Trialeurodes vaporariorum* (Westwood) and Chemical Control ..... T. S. Liu

#### B. Special Publications:

1. Proceedings of a Symposium on "The application of plant growth regulators on horticultural crops." 1988. Lin, J. H. and L. R. Chang (ed.). English summary. Taichung DAIS. Special publication No. 12. pp. 339.
2. Proceedings of a Symposium on "Rice grain quality." 1988. Song, S. and M. C. Hong (ed.). English summary. Taichung DAIS. Special publication No. 13. pp. 379.
3. Proceedings of a workshop on "Technology of grape production." 1988. Lin, J. H. and L. R. Chang. (ed.) Taichung DAIS. Special publication No. 14. pp. 259.

#### C. Extension Bulletins (Monthly):

1. No. 74 DRF hydroponic culture system for leafy vegetable production.
2. No. 75 Cooking menu for yellow Chinese chive.
3. No. 76 An overall review of development of facilitated horticulture in Taiwan.
4. No. 77 A report on consulting service of facilitated culture on vegetable crops.
5. No. 78 A report on consulting service of hog raising.
6. No. 79 A report on consulting service of vegetable production.
7. No. 80 Cultural practices of water oat (*Zizania latifolia*)
8. No. 81 Cooking menu for bitter gourd.
9. No. 82 Experiment on subsoil cultivation and fertilization-machine.
10. No. 83 A report on consulting service of parent-career education in rural area.
11. No. 84 Special reports on agricultural marketing.
12. No. 85 Future prospects of agricultural communication in Taiwan.

#### D. Agricultural Newsletters (Quarterly):

1. Vol. 10:1. A special report on protected horticulture.
2. Vol. 10:2. A special report on home economics.
3. Vol. 10:3. A special report on production of summer vegetable.
4. Vol. 10:4. A special report on agricultural marketing.

### 4. SEMINARS

1. Kuo, J. Y. The development of powdery mildew resistance pea—Taichung Jya Shih 15.
2. Yang, Y. C. Occurrence and control of blackleg of cabbage.
3. Chiu, C. C. The action mechanism of herbicide.
4. Sheu, C. S. Linkage analysis of *lms* gene of naked-grain rice.
5. Guu, J. W. The observation of scarlet runner bean.
6. Feng, M. N. The ecology and control of major insect pests of cruciferae.
7. Chen, C. C. Tomato wilting spot virus.
8. Chang, S. T. The new dangerous paddy field weed.
9. Chang, C. P. Plant growth regulator of insect.
10. Wang, C. T. Effect of fertilizer and soil fertility on the yield and quality of grape.
11. Lin, T. F. Breeding of Tai Sen 1.
12. Cheng, C. H. The organized function of remote Farmer's Association in Taiwan.
13. Hsu, A. N. The physicochemical properties and eating quality of the major released rice varieties.
14. Sheu, C. S. Isozyme research in rice.
15. Ho, R. S. Sorghum ratooned treatment and deep fertilization machine.
16. Sheu, C. S. The physical properties of potting material.
17. Hsu, M. T. Observation of new introduced melon varieties.
18. Chang, L. R. Observation of flower initiation of selected fruit trees.
19. Liu, T. S. Long distance migration of brown hopper.
20. Huang, H. C. Effect of liquid fertilizer on crops.
21. Lin, C. S. The effect of pruning and inhibitor on the fruit quality of loquat.
22. Lin, K. C. The design of machine for subsoil cultivation and fertilization.
23. Chung, W. J. Flower and pod distribution patterns in bush bean.

## 5. SYMPOSIUM

1. The Application of Plant Growth Regulators on Horticultural Crops. The symposium is organized by Taichung DAIS and held at Hualien DAIS from 8 to 10 Feb. 1988 with 261 participants.
2. Rice Grain Quality. The symposium is organized by Taichung DAIS and held at Taichung DAIS on 7-9 April, 1988 with 150 participants.
3. Technology of Grape Production. The symposium is organized by Taichung DAIS and held at Chi-tou, Nantou County on 24-26 March, 1988 with 81 participants.

## 6. STAFF SENT ABROAD

Name	Period	Country	Purpose
Lin, S. S.	Feb. 26-Mar. 26	Paraguay	To investigate sorghum production.
Lin, T. C.	Mar. 11-24	Japan	To study the management of small-scale food processing.
Kao, T. C.	May 8-21	Japan	To study the technique of protected horticulture.
Chiu, C. C.	June 25-July 8	Holland, West Germany, Swiss, France	To study the agricultural marketing and extension.
Tseng, S. S.	June 30-Sept. 27	Japan	To study the paddy-converted upland crop production.
Lin, S. S.	July 23-Aug. 1	Canada	To participate the 6th international conference on plant growth regulators and fruit tree production.
Hsieh, S. C.	Aug. 10-29	Canada, USA	To participate the 16th international congress on genetic held at Toronto and to study rice research program at UC, Davis.
Chen, C. C.	Aug. 20-27	Japan	To participate the 5th international conference on plant pathology.
Hsieh, S. C.	Sept. 17-28	USA	To participate the international conference on sustainable agricultural system.
Hong, M. C.	Nov. 14-Dec. 13	Japan	To study the rice grain quality and rice grading system.

## 一、研究成果

### 稻米

#### 水稻新品系生長型式之探討

利用硬型稻臺農 67 號及籼型稻臺中秈 10 號為參考品種，測試臺中育 365 號之生長型式。於 4 月至 8 月不同月份種植，並於種植後不同時期取樣測其株高、分蘖、莖乾重、葉乾重及葉面積，當穗形成時亦調查其穗數及穗乾重。一般籼型稻適宜熱帶氣候生長，生長型式常為前期較旺盛，而硬型稻適宜亞熱帶氣候生長，生長型式則為中間期較旺盛，本試驗結果顯示臺中育 365 號之生長型式介於臺農 67 號與臺中秈 10 號之間，即介於硬型稻與籼型稻之間；但亦隨溫度之變化，偏向程度亦有所不同，4 月份種植偏向臺中秈 10 號，5 月份以後則偏向臺農 67 號。

#### 本省水稻品種在不同月份種植下農藝特性之變異

一百個水稻品種在六、七、八及九月份種植，其株高、穗數及生育日數變異分布不同，株高愈高，穗數有較多的趨勢，且溫度較高時期有株高較高及穗數較多現象，九月份株高及穗數均有顯著減少。全生育日數在六、七、八月份種植分布情形相似，全生育日數變異在 75~115 天；但九月份全生育日數則有顯著增長，其變異在 85~160 天。其中株高分布趨向常態分布（尚未經測定），分蘖數分布則偏歪，全生育日數除九月份種植有偏歪外，六、七、八月分布則趨向常態分布，穗重及收穫指數亦除九月份表現與六、七、八月不同，九月種植因氣溫降低，導致株高較矮，穗重及收穫指數減少。在不同種植時期當中，除株高變異係數較小外（ $\leq 10.2$ ），分蘖、穗重、收穫指數及全生育日數變異係數均有超過 20% 者。其中值得注意為收穫指數在七、八月變異係數較小，七月份為 10.5%，八月份為 11.5%，此暗示在七、八月種植若以收穫指數為選拔指標，可能不易進行選拔工作。

#### 裸粒水稻裸粒基因之連鎖分析

據 Shao *et al.* (1980) 之報告，裸粒水稻乃是由水稻與小麥雜交，從其後代中分離出來，而謝 (1985) 的研究却指出裸粒稻之裸粒特性乃是由於穗部形態變異而來，其染色體行為與水稻相同，染色體數為 24 條，而以同功酶檢定之結果，無論在過氧化酶，酸性磷酸酶的譜上均屬於籼型稻，本研究旨在探求裸粒水稻其裸粒基因 1hs 之連鎖群歸屬。藉由具臺中 65 號遺傳背景之各項同質基因系與裸粒稻雜交之後代，無法清楚分析出裸粒稻裸粒基因之連鎖群歸屬，此可能與籼、粳雜交之稔性基因、連鎖群長度有關。但若由木下等人 (1977) 所發現之『長穎不稔稻』(long hull sterile rice) 與裸粒稻雜交進行互補性測驗 (complementary test)，得知裸粒基因與長穎不稔稻之基因位於同一基因座上，即是位於第 11 連鎖群，此結果與 Khush *et al.* (1986) 之研究相同。

#### 臺秈 1 號之育成

臺秈 1 號是由臺中秈育 358 號 (♀) 與臺農秈育 107 號 (♂) 雜交而育成之秈稻新品種，於民國 77 年經審查通過，准予推廣。臺秈 1 號之白米品質，完整米率為 68.2%，比臺中秈 10 號稍高，直鏈性澱粉含量為 21.1%，比臺中秈 10 號稍低，而且容易膠化，飯質軟並且有黏彈性，食味性佳，這些特性將會為本省消費者所接受。高級產量比較試驗結果，臺秈 1 號平均稻穀產量，第一期作每公頃 7,298 公斤，第二期作 4,923 公斤，分別比臺中秈 10 號增產 2.6% 及 7.5%；全省秈稻品種區域試驗結果，第一期作每公頃為 7,629 公斤，第二期作 5,712 公斤，各比臺中秈 10 號增產 0.3% 及 3.3%，並且在全省稻穀產量之穩定性比較佳，其米粒比臺中 10 號稍短，秈稻之高產潛力似由於半矮性與耐肥性。

### 雜糧作物

#### 稻田轉作高粱宿根栽培技術之改良

為提高稻田轉作高粱宿根栽培之單位面積產

量，於民國 76 年秋作進行切莖時期，留茬高度，留芽多寡及施肥法等試驗，試驗結果如下：宿根高粱之切莖適期為收穫後 2~12 天，若超過 22 天才切莖時，對產量即有明顯影響。切莖時宜齊地面切起，並於切莖後 10 天利用中耕培土機進行 10 公分深之培土作業，抑制部份分蘖，以節省去藥所費之勞力。其氮肥施用方法為基肥 50%，餘 50% 氮肥於切莖後 20 及 40 天分兩次施用。

### 蕎麥不同播種期對農藝性狀之影響

冬作常陸在來與宮崎大粒在各播種期有相同之開花期及成熟期，宮崎大粒於 10 月 5 日播種者稍早外，其餘各播種期差異均不大，約在 100 天左右，常陸在來則有愈遲播種者成熟期愈慢的現象。最早播與最遲播者，成熟期相差 37 天。春作各播種期無論宮崎大粒或常陸在來生育日數均無差異，約在 60~66 天之間，但與冬作比較則提早 30~40 天，冬作早播種者（10 月 5 日~10 月 25 日）兩品種株高較高，自 11 月 5 日至 12 月 25 日播種者，株高顯著降低，相差約 35 cm 左右。春作自 1 月起播種至 4 月 5 日止，愈遲播種株高愈高，最多相差 90 cm 以上。分枝情形冬作各播種期之間兩大粒型品種均無甚差異，春作愈遲播者分枝愈多。冬作除 10 月 5 日播種者，宮崎大粒 11 月 5 日，常陸在來產量較低，12 月 15 日宮崎大粒較高外，其餘各播種期無論宮崎大粒或常陸在來均無明顯差異。但與豐田一號相較，兩大粒型品種約低 20~70%。春作除了播種期 1 月 5 日稍可外，其餘自 1 月 15 日至 3 月 25 日播種者，此參試品種產量均甚低，4 月 5 日起播種者，只開少數花而不結實。常陸在來自 11 月 5 日至 1 月 15 日播種者，千粒重較重，宮崎大粒自 10 月 5 日至 1 月 25 日播種者較重，自 2 月 5 日以後顯著較低。

### 薏苡品種間之分類與鑑定

#### Ⅲ 澱粉特性之區分

爲了區分不同來源（泰國種、阿里山白殼種、及本場自行雜交育種之臺中選育一號）薏苡品

種間之特性，本試驗進一步由精白薏苡仁之澱粉特性來判別諸品種間之異同，試驗中並藉由糯米（臺中糯 70 號）及蓬來米（臺中 189 號）之參試來了解薏苡仁與白米間之差別。茲將試驗成果分述如下：粗澱粉含量以泰國種薏苡仁之 64.2% 最多，其次爲白殼種之 62.0% 及臺中選育一號之 60.2%，而白米臺中 189 號爲 78.4% 及臺中糯 70 號爲 82.8%。精製澱粉則以泰國種薏苡仁之 84.7% 及臺中選育一號之 83.5% 較高，白殼種之 78.3% 殿後，在白米方面臺中 189 號爲 89.8% 及臺中糯 70 號爲 91.2%。直鏈性澱粉含量以白殼種之 15.4% 居冠，其次爲臺中選育一號之 3.6% 及泰國種之 2.2%，而白米臺中 189 號爲 17.9% 及臺中糯 70 號爲 0.6%。就澱粉粒徑大小而言，以泰國種之  $14.53 \pm 4.70 \mu$  最大，其次爲臺中選育一號之  $13.75 \pm 5.08 \mu$  及白殼種之  $11.60 \pm 3.33 \mu$ ，而白米臺中 189 號爲  $7.03 \pm 1.73 \mu$ ，臺中糯 70 號爲  $6.10 \pm 1.55 \mu$ 。依 Brabender amylogram 之物化特性而言，糊化起溫 (To) 在薏苡泰國種、白殼種，臺中選育一號及白米臺中 189 號、臺中糯 70 號分別爲 67.5、70.3、66.0、65.5 及 62.8 °C。糊化最高溫度 (Tmax) 則分別爲 80.5、93.8、76.7、85.7 及 71.5 °C，而最大黏度則分別爲 550、295、780、500 及 587.5 Bu。依澱粉-碘反應之吸收光譜而言，白殼種在 A600 及 A660 與臺中 189 號之反應最強，其餘諸品種則反應較弱。

### 雜交高粱單寧性狀之遺傳育種行爲

#### Ⅱ F<sub>1</sub> 株植及 F<sub>1</sub> 種子之表現

單寧爲種實重要酚類物質，其含量高低影響高粱種實之營養效果，發芽率及受鳥害程度。本試驗乃利用 TUI-1、TUI-2、TUI-3、TUI-4 等四個不同單寧含量之同源系爲父本，與爲母本之 80B、2R 進行雜交，調查其後代 F<sub>1</sub> 植株株高、穗長等農藝性狀，及以澱粉膠電泳法分析葉片過氧化酶之酶譜；在 F<sub>1</sub> 種子方面，則調查其百粒重、種皮顏色、發芽率及單寧含量分析，以了解單寧含量在雜交高粱之變化，及其農藝性狀之表現。茲將試驗結果分析如下：雜交後代 F<sub>1</sub> 植株之穗長、穗頸長度、種實百粒重，除 80B ×

TUI-3 及 2R × TUI-3 組合無顯著增加外，其餘的雜交組合皆有顯著增加；穗形方面，各雜交組合皆近似於父本，種皮顏色則有比父本加深之趨向，在 50% 開花期性狀方面，各雜交組合有縮短現象。過氧化酶之酶譜分析結果，80B 爲父本的組合其酶譜近似於 80B。2R 爲父本的雜交組合則與親本差異較大，尤其是 2R × TUI-1、2R × TUI-3 兩組合，其 Rf 值在負極 0.5、0.6 的兩條條帶未出現。各雜交組合 F<sub>1</sub> 種子單寧分析顯示，其含量仍低於兩個親本單寧含量的平均值，此現象與 F<sub>1</sub> 世代相同，但含量增加；發芽率方面以 TUI-1 爲父本之雜交組合高於其親本，其餘各雜交組合則介於兩親本之間；而罹病率除 TUI-1 爲父本雜交組合外，各組合有隨單寧含量增加，而罹病率降低之傾向。

### 園藝作物

#### 甜豌豆臺中甜系 3A 號之育成

臺中甜系 3A 號是由 Sugar Snap 與 Knight 雜交而育成之甜豌豆新品系，將於 77 年 12 月提出申請命名登記，預定命名爲臺中 13 號。本品系屬蔓性種，莖葉小，分枝性弱，自第 13~15 節起開始開花，花白色，每花梗多數著生一朵花，其結莢節位較低，有利於立支柱栽培。嫩莢甜脆，糖度 13~14 度，適於鮮食或冷凍加工。莢形較『新珍』大而整齊，深受市場所歡迎。採收期較『新珍』早 15~20 天，又果梗離層較鬆，採莢容易。因分枝少，嫩莢產量低於『新珍』，需提高播種量以克服之。本品系耐萎凋病，但不抗苗腐病、白粉病及根腐病，故生育期間需注意防治。

#### 菜豆新品種『臺中 1 號』之育成經過及展望

本試驗使用亞蔬中心引入之波多黎各抗銹病矮性菜豆，利用回交育種方法，將其抗銹病因子導入栽培品種黑仁衣笠，以改進其極易感染銹病之缺點。試驗於民國 66 年起進行引入抗銹病親

本篩選，並進行回交及系統選拔、品系試驗、品種比較試驗、區域試驗及抗銹病性檢定、嫩莢品質檢定、採種試驗等。其結果如下：臺中 1 號在平地銹病抵抗力檢定結果爲『極抗』，在靠山區檢定結果爲『抗』級。嫩莢比栽培品種黑仁衣笠較圓，直而略長，外觀優美，適宜裝箱運輸，鮮食品質優良。新品種嫩莢產量穩定，銹病發生不顯著時，產量與黑仁衣笠近似；在銹病發生嚴重時，可以增產 13~16%。新品種之產量比本省現有栽培品種——黑仁衣笠、泰國種及肯州萬大更爲豐產穩定。

### 健康菊苗培育技術之研究

本試驗藉由砂耕、土耕及水耕等栽培方式，並對菊苗插穗施以發根劑、殺菌劑、液肥與水耕養液作不同之處理，初步探討培育健康菊苗之可行性。結果發現：苯乙酸 ( $\alpha$ -naphthalene acetic acid, NAA) 1000 ppm 於土耕與砂耕栽培方式，能促進插穗根系之發展，可促進發根，增加根數二倍左右或更多，但對根長則影響不大。而水耕方面，其加之於養液中之 NAA 濃度應低於 5 ppm，若高於 20 ppm 對根系之生育則有抑制之情形，超過 1000 ppm 則對插穗有嚴重傷害之情形。插穗用殺菌劑（免賴得 50% Benlate）1000 倍與液肥（N:P:K = 7:5:3）1000 倍浸漬 10 分鐘，對苗腐病（Basal Stem Rot）之防止及根系之生長均無顯著之差異。而水耕養液則對插穗之生育有促進之效應；其 EC 值應小於 0.95 mmho，高於 1.5 mmho 則有肥害情形發生，並隨濃度增加益形嚴重。三種培育方式，以土耕最宜，砂耕次之，而水耕則不臻理想，其水質、養液成分、濃度、添加物之加入及栽培結構方式，均需作詳細之考量與合理的設計，乃有待日後再探討之。

### 茭白母莖分生芽對茭白產量之影響試驗

爲確立茭白優良種苗材料之取決標準，供輔導農民育成健康優良種苗，是爲試驗之目的。茭白母莖苗於十二月底定植，定植後 136 天開始採收春筍，春筍採收期長約爲 37 天左右。秋筍於

定植後 244 天左右開採收，其採收期長約為 40~42 天。試驗結果如下：春作母莖取苗量以淺水礫質母莖取苗 9.2 苗最多，而以深水軟質土取苗 2.4 苗為最少。茭白成莖率以深礫苗的 45.4% 最高，而以淺礫苗 33.9% 最差。嫩筍產量每十公畝產量以深軟苗 240 公斤最多，淺礫苗 186.3 公斤為最差，處理產量差異呈極顯著。秋作種苗由春作採收後宿根再萌芽生長而成，茭白成莖率以淺礫苗 72.5% 最多，嫩筍產量以深礫苗為最多，處理間茭白嫩筍產量不顯著。由以上春、秋兩作試驗結果顯示，從不同來源挖取的母莖苗，經栽植後對春、秋嫩筍產量以深水軟質土母莖苗表現較佳，而淺水礫土苗則較差，而秋作則四種母莖苗對產量差異不顯著，但取苗量則淺水區為深水區的三倍，此可能與深水區氧氣量不足，根部容易腐爛有關。取苗量多成為目前培育者競向淺水區採苗的誘因，但淺水區生產的嫩筍容易呈現綠色或纖維老化，影響品質與售價，目前已逐漸改用深水栽培管理。

### 夏季番茄嫁接抗青枯病試驗

利用野生番茄亞蔬-4711 號及 BL-166 號當砧木，以農友神力當接穗，經嫁接栽培後，使青枯病發病率降至 1.6% 以下，也使產量比對照無嫁接區每十公畝夏作增加產量 517~662 公斤，農民增加收益 9,175~12,800 元。秋作增產 461~533 公斤，農民增加收益 1,782~2,646 元，嫁接效果顯著，對於夏作番茄生產有很大助益，值得推廣給農民採用。

### 收穫後貯藏溫度及烹調方式對水耕蔬菜品質之影響

本試驗探討貯藏溫度及水煮、油炒等烹調方式對水耕白菜 (*Brassica chinensis* L.) 品質之影響。試驗結果顯示，當採收後之白菜置 10°C 時，經 4 天之貯藏，其含水量僅損失 2.95%，外貌正常；若採收後置於 30°C 下，於 6 小時後，含水量即損失 15.69%，24 小時後已損失達 24.32%，而不具經濟性，唯採收 12 小時或 24 小時後，仍浸回清水中，則再經 12 小時，其含水量

即恢復。如此可證明採收後 24 小時或 24 小時內水耕白菜之根系仍具相當之活力，又白菜經 100°C 水煮 1~3 分鐘後，隨著時間之延長，葉片之葉綠素逐漸增高，蛋白質及澱粉，游離糖成分變少；游離胺基酸， $\text{NO}_3\text{-N}$  及  $\text{NO}_2\text{-N}$  變多，尤其是湯中之  $\text{NO}_3\text{-N}$  及  $\text{NO}_2\text{-N}$  會隨水煮時間之延長而增多。至於油炒溫度處理 (100°C、140°C 及 180°C) 均會減少葉綠素之含量；但與水煮相比，油炒處理其含  $\text{NO}_3\text{-N}$  及  $\text{NO}_2\text{-N}$  較低。因之，水耕蔬菜採收後，以放置於 10°C 為宜，否則在採收後 24 小時內浸水仍能保持新鮮度。又烹煮方式對白菜品質之影響乃以減少烹調加熱時間最能保持品質。

### 不同光質塑膠布對設施蔬菜生育之影響

光對於生物之生長、生殖及活動行為是為一相當重要之因子。除光週期、光強度會有影響之外，不同光質之波長及能量影響亦很大。在本研究中發現無紫外線情形下，可促進作物之伸長。因此不論在小白菜、芥藍、番茄、甜椒，在紫外線斷除型塑膠布覆蓋下，其株高、株重、葉數均較在其他材料覆蓋下生長快速、產量增加；但藍色增光型則無顯著差異。而不同光質對蟲害之影響，經調查菜心螟、小菜蛾、黃條葉蚤及蚜蟲有減少危害情形，而在甜椒之薊馬、蟎類及番茄夜蛾則差異極顯著。

### 溫度、光照及氮肥對青梗白菜品質之影響

為了探討氣溫、光照度及氮肥等因素對青梗白菜 (*Brassica chinensis* L.) 生育之影響，藉由水耕栽培技術，在人工環境控制室內進行生長分析。茲將試驗結果分析如下：青梗白菜體內  $\text{NO}_3\text{-N}$  之分佈大致上在葉柄最多 (62.1%)，其次為葉片 (25.9%) 及根部 (12.0%)，而  $\text{NO}_2\text{-N}$  之含量則大部分集中於根部 (96.9%)。當氮素濃度提高時，則較多之  $\text{NO}_3\text{-N}$  將蓄積於葉片及葉柄，但  $\text{NO}_2\text{-N}$  則顯著地在葉片中蓄積。隨入射光照度由 16.4 Klux 增加至 45.1 Klux，葉片上之  $\text{NO}_3\text{-N}$  及  $\text{NO}_2\text{-N}$  含量均顯著增加。當氣溫在 25°C 時，葉片中  $\text{NO}_3\text{-N}$  及  $\text{NO}_2\text{-N}$

之含量亦大幅增加。隨水耕液中氮素濃度之增加，青梗白菜葉片之蛋白質、葉綠素、纖維及灰分含量亦增之；而澱粉、游離糖及游離胺基酸之含量則下降。因之，高溫、高光照及高氮肥均導致青梗白菜品質之劣變。

### 動態浮根式水耕技術對夏季番茄生產潛力之影響

為了探討盛夏氣溫超過 30°C 時在平地生產番茄之可能性，本試驗乃以動態浮根式水耕系統來栽培鮮食番茄，供試品種依果型分為大果及小果，栽培管理採一般慣行管理 (單幹整枝)，平均保留 7~8 段花。茲將試驗結果敘述如下：經四次栽培，各品種之 100 m<sup>2</sup> 產量為：聯珠 (小果)：566 kg、309 kg、504 kg 及 270 kg，神力 (大果)：490 kg、178 kg、458 kg 及 261 kg。種植日期愈近夏季，因氣溫增高至盛夏之際導致生育期間變短，但採收期間變長；相對於產量方面則有隨氣溫之增而減產之趨勢。因此於夏季欲種植番茄時，若利用高溫時生育期會縮短之現象，而將留穗數減少，使採收期集中，捨去後期生育日數較長之果穗。換言之，以縮減每次栽培時間而改以增加年栽植次數，或許將可以突破夏季番茄開花不結果之瓶頸。依此假設，乃進一步以聯珠品種，採雙段花管理，每株僅留兩穗花。栽種期間於 77 年 8 月 2 日起至 77 年 9 月 15 日，生育日數僅 45 天即可採收，每百平方公尺產量為 52.19 kg，試驗結果顯示寡段花栽培技術確有克服高溫引起番茄開花不結果之障礙。

### 促進葡萄花穗生長及果實肥大之研究

本省秋冬果葡萄，由於前作結果量過高、木質化比例低、早期落葉或成熟期枝條末端再生長，枝梢養分蓄積不足，因此修剪後萌發之新梢花穗短小或發育不良而有萎縮現象，使開花期花穗無法生長至適當長度，結果後穗軸短、果粒密集，成熟時期果粒互擠而裂果並影響果穗外觀及產量。為解決上述花穗短小造成管理上的困難，除須加強前期作的枝條生育管理之外，在開花前利用生長調節劑處理具有促進花穗生長的效果。本

場於 1972 年以無子喜樂 (Himrod seedless) 品種在開花前及開花後 6 天各噴施一次 GA<sub>3</sub> 30-50 ppm，有拉長花穗的效果；之後濃度降低至 2 ppm 處理巨峰亦得到相同效果，目前已經廣泛地使用於葡萄栽培。但巨峰葡萄處理 GA 後單為結果率高，無籽果出現率有隨著 GA 濃度提高而增加的傾向。為減少巨峰葡萄單為結果及無籽果率，提高外銷葡萄的商品價值，本場自去年起嘗試以 cytokinin 混合 GA 處理，結果以 0.2% Cytex (含 0.1% cytokinin 之海藻提取物) 及 GA<sub>3</sub> 0.5 ppm 混合液處理對花穗生長的效果最顯著，不會影響果實之種子數，並且可增加果重及促進果粒肥大。

### 平地生產低溫需求高之梨

本省中低海拔地區，已可利用橫山梨徒長枝以高接法生產低溫需求高之高品質梨。此種高接作業需購買昂貴之接穗外，並需每年耗費大量人力進行高接工作。本場已完成在中低海拔地區，以人為方式促進花芽形成，而生產接穗之方法，已可降低生產成本。但每年還需進行高接工作，近年來農村勞力已感缺乏，故極需尋求省工之生產方式。橫山梨高接低溫需求高之梨後，以其徒長之新梢於經人為促其花芽形成後，翌年春以休眠打破劑處理此枝條，則可使枝條萌芽開花，而生產高品質梨，達到省工之目的。

### 葡萄新梢生育與促進著果之研究

目前葡萄多採密植及多肥栽培方式，冬季必須強修剪以限制樹冠的擴張，生育期間在高溫多濕的環境下，新梢容易徒長，花穗因而無法獲得充足的養分，影響花器發育、授粉過程及受精後退化，而引起落花落及單為結果。葡萄休眠期利用修剪技術可調整枝條的生長量，萌芽後以疏芽方法將生長過強及基部弱小枝梢摘除，使結果母枝上的新梢能均衡生長，便於開花前的生育調節及果實生長期的葉果比例。開花前利用 Alar、CCC 等生長調節劑控制新梢生長，以人為手段形成營養轉換谷，防止新梢與果實競爭養分，可健全胚珠發育以提高著果率。巨峰葡萄開花期新梢長度

在 30~60 公分之間結果率最佳，開花期新梢的適當生長量以 40~50 公分為最佳，開花期及果實生育後期之停心率最高，有助於提高著果率、果粒肥大及果實之品質。

## 植物保護

### 縞葉枯病對水稻產量及產量構成因素之影響

水稻臺農 67 號第一期作播種後 30 日（秧苗期）內接種者於盆栽及田間試驗情況下均引起 100% 之產量損失；播種後 60 日（分蘗期）接種者分別引起 90% 及 94% 產量損失；播種後 100 日（幼穗形成期）接種者兩種情況下分別引起 30% 及 23% 產量損失；播種後 110 日（孕穗期）接種者產量不再受到影響。第二期播種後 10 及 20 日（秧苗期）接種者不論盆栽或田間試驗均引起 100% 的產量損失；播種後 50 日（分蘗期）接種者分別引起 55% 及 28% 產量損失；播種後 70 日（孕穗初期）接種者不論盆栽或田間試驗均不引起明顯之稻谷損失。顯然第二期作感染縞葉枯病引起產量損失之水稻生育期較第一期作為短。自然發病田調查病徵出現時期與產量的關係。民國 74 及 75 年在彰化大村插秧後 50 日（分蘗期）至 80 日（孕穗期）出現病徵者產量損失為 54~63%；插秧後 90 及 100 日（抽穗期及乳熟期）出現病徵者分別引起 32 及 22% 產量損失；插秧後 110 日（糊熟期）出現病徵者對產量無顯著影響，第二期作該病徵不復出現。利用田間單本植接種試驗資料分析不同產量構成因素對水稻產量的影響程度，第一期作以穗數減少為產量最主要限制因素，其次為每穗平均粒數；第二期作亦以穗數的減少為產量最主要限制因素，其次依序為千粒重>稔實粒率>每穗平均粒數。

### 水稻縞葉枯病流行學研究

縞葉枯病為近年來本省最重要之蟲媒病毒病害，以第一期作受害較為嚴重。在中部地區越冬

期斑飛蝨可在再生稻或小麥等作物寄主繁殖二個世代；縞葉枯病毒則可藉斑飛蝨 (*Laodelphax striatellus*) 或感染之寄主植物越冬而成為翌年第一期稻作第一次傳染源。在田間終年均可採集到斑飛蝨，並於 6 月上旬（第一期作）及 10 月（第二期作）各出現一個高峰期。民國 73 年 7 月至 76 年 6 月於臺中市北屯及彰化縣大村分二次採集媒介昆蟲，總共採集斑飛蝨 13,546 隻。以稻苗接穗種法測定其帶毒情形，結果計有 918 隻能傳播縞葉枯病毒，帶毒蟲率約 6.7%，除少數月份外，幾乎終年均可測到帶毒蟲。以大村為例，第一期作之帶毒蟲高峰期於 5 月上旬出現；第二期作之帶毒蟲高峰期於 9 月下旬至 10 月上旬出現。在田間第一期作縞葉枯病主要有二個感染期，第一個感染期發生在秧苗期及本田初期（插秧後 20 日止），主要感染蟲源為越冬蟲，其感染比例因年度、地點而異，約全期作總罹病率之 1~19%；第二次感染蟲源為在本田繁殖之第一代斑飛蝨，主要感染期在插秧後 40~60 日間，其感染比例佔全期作總罹病率之 80% 以上。第一期作田間縞葉枯病發病率可由  $Y=12.46X-0.143$  ( $R^2=0.9986^{**}$ ) 簡單迴歸方程式加予預測（式中 Y=第一期作縞葉枯病總罹病株率，X=3、4 月份斑飛蝨自然棲群密度與該期間帶毒蟲率之乘積）。

### 稗草皺縮矮化病毒之純化及血清學研究

稗草皺縮矮化病毒 (*Echinochloa ragged stunt virus*, ERSV) 純化步驟如下：罹病水稗 (*Echinochloa crus-galli* var. *oryzicola*) 0.25 M, pH 7.2 磷酸緩衝液（內含 0.01M  $MgCl_2$ , 1% 2-mercaptoethanol）研磨萃取，抽出液以 10%  $CCl_4$  淨化後，於 10,000 g 轉速下離心 15 分，上層液以 20% 蔗糖溶液墊底，於 55,000g 轉速下離心 1 小時，將沈降物加予懸浮。懸浮液以 20~50% 蔗糖梯度於 85,000 g 離心 90 分，抽取病毒沈降層後再於 55,000 g 轉速下離心 1 小時。所得沈降加予懸浮即為純化病毒樣品。前述樣品紫外光 260/280 之吸收值為 1.8~2.16。在電子顯微鏡下觀察純化物主要為 55~58nm 之球形病毒，並無寄主物質污染。利用免疫電子

顯微鏡法 (Immune electronmicroscopy) 及蛋白質-A 標金法 (protein-A gold labelling) 以電子顯微鏡觀察發現 ERSV 與水稻皺縮矮化病毒 (rice ragged stunt virus) 具有血清類緣關係。但 ERSV 與其他植物 Reovirus 則無血清類關係。

### 本省新發現之四種農業害蟲

1988 年在臺中區農業改良場轄區下新發現臺灣新記錄之農業害蟲有水稻粉紅介殼蟲 (*Heterococcus rehni* Lindinger) 為本省及中國之新記錄，該蟲係在水稻葉鞘內側及孕穗中吸汁為害；枇杷紅翅擬柄天牛 (*Cataphrodium rubripenne* Hope) 為本省梨樹新害蟲，為害梨樹之莖幹；豆野螟蛾 (*Pyrausta varcalis* Bremer) 及粗脛捲葉蛾 (*Cryptophlebia ombrodelta* (Lower)) 二種新害蟲為害敏豆莢，以上四種新害蟲之分類地位及其所屬種之特徵均有簡要說明。

### 葡萄園金龜子發生及防治方法改進

葡萄園金龜子種類由調查結果得知有赤腳青銅金龜 (*Anomala cupripes* Hope)、臺灣青銅金龜 (*Anomala expansa* Bates)、白點花金龜 (*Protaetia orientalis* Govy and Percheron)、赤腹金龜 (*Anomala castaneiventris* Bates)、白點土金龜 (*Protaetia culta* Waterhouse)、白點綠金龜 (*Calopototia formosana* Moser) 等六種，其中以赤腳青銅金龜發生最多，其次為臺灣青銅金龜及白點花金龜，其他三種則較少發現。赤腳青銅金龜及臺灣青銅金龜主要為害葉片、幼果、芽；白點花金龜主要為害成熟果實。該類金龜子以 6~7 月份族群密度最高，為了易於做生物檢定以簡易方法從腹部末端來判別雌雄，以香蕉誘殺葡萄園金龜子可誘殺到白點花金龜、白點綠金龜、白點土金龜，而且效果甚佳，另以 Y 型管做室內檢定效果亦佳。田間防治藥劑試驗，目前無推薦藥劑，以已經推薦在葡萄上而防治其他害蟲的藥劑來做防治試驗，噴佈 Deltamethrin、Methomyl、Carbofuran 效果均佳。防

治金龜子幼蟲，用灌注器將藥液打入葡萄根部附近，以 Methomyl 防治效果較佳。粒劑撒佈以 Temik 效果較佳。

### 葡萄扁蝸牛發生及防治方法改進

扁蝸牛 (*Bradybaena similaris* Ferussac) 屬腹足綱，取食及為害葡萄花、果、芽及葉，並排出糞便、黏膜，影響葡萄質量。本試驗結果田間族群密度以 5~9 月為最高；空間分布趨向均勻型。田間取樣數估計，扁蝸牛密度設定為 1 隻/棵，精密度為 0.25 及 0.1 時，取樣數分別為 1,597 棵及 259 棵；密度設定為 5 隻/棵，取樣數分別為 256 棵及 41 棵。防治方法係利用寶特瓶法、黑膠布法、塑膠片法、塑膠布法、石灰法、牙膏法、凡士林法、聚乙醛法 (除草)、聚乙醛法 (不除草)、蝸牛膏法及對照。試驗結果以寶特瓶、黑膠布及塑膠片阻蝸法效果最佳，阻蝸效果達 90% 以上；聚乙醛粒劑在不除草的情況下阻蝸率僅 40~60% 之間。在連續 10 週的調查，石灰法、牙膏法、聚乙醛及蝸牛膏法均在二、三週後無效；黑膠布法亦在第六週後無效；在第七週後，剩寶特瓶法及塑膠片法，由於塑膠片花錢，且效果不及寶特瓶法，在此不擬推薦。在所有防治方法中以寶特瓶阻蝸法最理想，防治效果高達百分之九十五以上。選擇不花錢且廢物利用的寶特瓶為推薦之參考。

### 甘藍黑腳病發生與防治

甘藍品種抗病性檢定，供試 21 品種 (系) 中，以和風、春秋一號、秋冬蔘、農試 2335 及春陽等五個品系較具抵抗力，僅在塊莖表皮形成黑褐色病斑。病原菌分生孢子發芽率隨著相對濕度的降低而降低，在 100% RH 下發芽率為 92.3%；98% RH 時為 80.1%；在 92% RH 以下時不發芽。室內藥劑篩選試驗共計有 44 個處理，結果依滅列乳劑 (200 倍) 等十三種藥劑能完全抑制菌絲生長。以此十三種藥劑再行溫室盆栽防治試驗，結果以依滅列乳劑 (2,000 倍)、芬瑞莫乳劑 (5,000 倍)、腐絕可濕性粉劑 (2,000 倍) 及克熱淨溶液 (800 倍) 等效果最優

。病原菌存活力試驗，以病土栽培甘藍，在收穫時及收穫後1月、2月的栽培試驗中，有病株發生，3月以後不發生。而置於有病莖的栽培土中，從收穫時及收穫後1月、2月、3月、4月、5月及6月栽植甘藍，均可發現病株，收穫後7月的則沒有病株發生。以尿素、氫氧化鈣、石灰石粉及S-H添加物處理土壤加入土中，均無法減輕甘藍黑腳病的發生。

### 不同套袋材質防治瓜實蠅危害苦瓜絲瓜之效益評估

苦瓜以黑色美果袋、硬牛皮紙袋、雙層紙袋、雙層舊報紙袋、黑色PE袋、褐色PP袋及綠色尼龍網袋等7種不同材質試驗結果，各種不同套袋材質對瓜實蠅均具有防治效果；對苦瓜果發育之影響，套袋10天後增加長度以褐色PP袋15.52公分最好，雙層紙袋14.99公分次之。瓜果外觀色澤以雙層紙袋及黑色PE袋最爲雪白。每次套袋成本以黑色PE袋及褐色PP袋0.07元最低，雙層紙袋0.1元次之。綜合上述結果，建議苦瓜藤未爬滿瓜架時採用雙層紙袋實施套袋，瓜藤爬滿瓜架後可採用黑色PE袋或褐色PP袋或舊報紙袋，以降低防治成本。絲瓜以白色美果袋、白色高抗力耐濕紙袋、單層舊報紙袋、透明PP袋及白色尼龍網袋等5種不同材質試驗結果，防治效果以白色美果袋、高抗力耐濕紙袋及單層舊報紙袋最好。對絲瓜果發育之影響，套袋7天後增加長度以高抗力耐濕紙袋15.24公分最好，單層舊報紙袋14.76公分次之。每次套袋成本以透明PP袋0.07元最低，高抗力耐濕紙袋及單層舊報紙袋同爲0.1元次之。綜合上述結果建議採用高抗力耐濕紙袋實施套袋，若舊報紙容易取得，可以自己製作替代高抗力耐濕紙袋，可以降低防治成本。

### 昆蟲性費洛蒙在害蟲族群之偵測利用

本場自76年8月起利用數種夜蛾類昆蟲性費洛蒙，終年應用乾式及濕式誘蟲盒，在田間誘

殺雄蛾，以便偵測各該害蟲年中族群消長及其密度。一年多來偵測結果證實，性費洛蒙誘引雄蛾之能力相當強。二化螟蟲性費洛蒙之誘蟲量，比燈光誘集爲優，分別在76年8月下旬、10月上旬、77年2月上旬、3月上旬、7月下旬及9月上旬爲其發生高峰期；本場內甜菜夜蛾族群以76年11月上旬、77年1月中旬及3月下旬較高，77年5月至9月誘蛾量較少，但在7月下旬及8月中旬仍有二次高峰期。田尾蔬菜混作區之甜菜夜蛾族群消長較平穩，在77年1月下旬、2月下旬、3月下旬、4月中旬、6月上旬、7月下旬、9月上旬、10月中旬及11月中旬各有數次高峰期；斜紋夜盜誘蟲數常較多，尤其芳苑鄉雜作區之族群顯然比田尾蔬菜區爲高，年中消長以77年1月下旬、2月中旬、4月中旬、5月下旬、7月下旬及10月下旬爲高峰期，而9月上中旬誘蟲數極低；二種切根蟲利用性費洛蒙誘引結果，以蕪菁夜蛾誘引效果較理想，該蟲之年終消長以2月至4月較高，5~8月幾無所獲。

### 臺中區野鼠族群密度測定與防除效益評估

野鼠是本省農田中有害動物之一，野鼠分佈極廣，種類繁多，田間調查有記錄者十三種，經常於田間爲害者有五種，佔有率鬼鼠(*Bandicota nemorivaga* Hodgson)爲2.9%，週年以七月爲高峰期；小黃腹鼠(*Rattus losea* Swinhoe)爲32.7%，以九月爲高峰期；月鼠(*Mus formosanus* Kuroda)爲51.4%，以一月爲高峰期；赤背條鼠(*Apodemus agrarius* Pallas)爲10.6%，以九月爲高峰期；溝條鼠(*Rattus norvegicus* Erxleben)爲2.4%，週年密度不高以九月爲高峰期。經密度測定結果，防除率臺中縣65.5%，彰化縣91.5%，南投縣83.4%，臺中市58.6%，全區防治率達88.3%。以性比例調查結果，防除前雌鼠佔43.3%，雄鼠佔56.7%，防除後雌鼠36.1%，雄鼠63.9%。臺中區下防除面積一般耕地133,795公頃，公共地16,370公頃，防除面積150,165公頃，防除經費14,524,767元。

混淆不清。

### 椪柑石灰試驗之研究

爲瞭解施用白雲石灰或石灰等土壤改良劑對椪柑果園土壤肥力，樹體營養狀況及果實品質之影響。在東勢地區強酸性果園經過連續三年試驗結果顯示，施用白雲石灰或石灰可提高土壤pH值及增加土壤交換性鈣、鎂含量，並增加椪柑葉片鈣及鎂含量，且白雲石灰或石灰對椪柑果實的果汁率、糖度及糖酸比之提高亦有顯著效果。經由相關分析顯示，椪柑葉片中鉀與鈣及鎂，似有互爲拮抗現象，而且椪柑果實糖度、酸度與葉片鉀、磷含量之間有顯著相關性。因此，施用白雲石灰或石灰對椪柑品質之影響是經由葉片鈣及鎂含量之增加而影響葉片鉀及磷之含量，進而間接影響椪柑果實糖及酸度含量。爲使椪柑果實果汁率及糖酸比達到較高水準，白雲石灰或石灰施用量以1.5 t/ha左右爲宜；但爲維持較高的土壤pH值及交換性鈣及鎂含量，每年連續施用較爲適當。

### 臺中地區玉米適栽區簡介

臺中地區玉米生產因受其地域區位與栽培時期影響，春作以臺中、南投(山區除外)玉米子實產量較高，彰化及其沿海產量較低。秋作以彰化(沿海地區除外)產量較高，臺中及南投產量較低，亦即山區及沿海各受低溫及季風的影響而使產量降低。雨量(包括梅雨、颱風雨)在5至9月間較多而日照率春作較低。季風自10月下旬開始到12月及1、2月達最盛期，沿海3月以後逐漸減弱而入於季風轉換期，故春秋作分別注意，並避開不利氣候因素。由臺中、彰化及南投地區播種期對玉米產量之效應，顯示2月21日爲春作最高效應期，8月26日爲秋作最高效應期，雖然2月上旬至4月下旬及7月上旬至9月中旬均可播種。適合玉米的土壤種類以排水良好之紅壤土產量最高，但砂頁岩或粘板岩沖積土均可。表底土爲中質地的土壤，如壤土、粉質壤土產量比較容易達較高水準，pH值較高者較好，有石灰反應土壤秋作表現良好；土壤中有有效磷配合

### 蔬菜農藥殘留量的抽測

76年7月至77年10月從臺中地區蔬菜栽培區採回即將採收之蔬菜，利用生物檢定法及生化測定法，檢驗各樣品中農藥之殘留量是否在容許範圍內，若有超量立即通知該農民延期採收，並追蹤教育農民。76年7月~77年6月共取樣2,474件，殘留農藥在容許範圍內的佔86.7%；77年7月~10月夏季蔬菜共抽測871件，在容許範圍內的佔92.5%，比去年減少甚多。就不同菜類中農藥殘留超量較嚴重者爲豆菜類，超過容許範圍者19.1%，小葉菜類爲12.6%，花果菜類爲12.2%，包葉類爲10.9%，最安全者爲根莖類及瓜果類，樣品中均無超量者。各種蔬菜類別中以草莓、芹菜、豌豆、甘藍、萵菜、芥藍菜及茄子等之農藥殘留量較高，而苦瓜、絲瓜、蘿蔔、茭白筍及球莖甘藍等則未發現含有農藥殘留量。

### 土壤與肥料

#### 指標作物監測空氣污染試驗

本試驗之目的是要探測利用指標作物以監測空氣污染之可行性，其最後目標是要建立一個既經濟而又簡單有效之空氣污染監測系統，以達到保護國家社會空氣品質之目的。76年度選擇彰化縣花壇鄉窯業區及和美、伸港、龍井、大肚等臺中火力發電廠附近鄉鎮，於各鄉鎮設置二個監測點；77年度再增加大里和潭子兩鄉有空氣污染糾紛之地方兩處。主要之指標作物有唐菖蒲、落花生、香蕉、番石榴、萵菜、豇豆、胡麻和水稻等八種。12個監測點當中只有花壇兩個監測點之四種作物唐菖蒲、落花生、香蕉和水稻有明顯之氣害症狀，植物體之含氮量也較其他10個監測點之同種作物爲高，但其中以唐菖蒲、落花生和香蕉等三種之症狀較爲嚴重典型而易於鑑別，可做爲理想之硫氧化物指標作物。至於番石榴、萵菜和水稻雖然也有症狀，但似乎需要更高濃度，才會產生較嚴重之症狀。豇豆之葉片症狀也相當嚴重，但到生長後期其症狀容易與病害症狀

量高者較好，尤其高於 290 公斤/公頃 (500ppm) 者。土壤中有效鉀亦以高者較好，尤其高於 200 公斤/公頃 (67 ppm) 者。

## 農業機械

### 前後掛載式雙向犁系統及其動力性能試驗

前後掛載式雙向犁系統使用福特 7610，86 馬力，前輪輔助傳動曳引機，於前後各掛一具有三個 14 吋犁座的雙向犁，試驗進行收集動態的車速及各部位力量分佈資料，儀器系統為一具獨立電源的 Apple II 電腦及類比/數位轉換器及共 15 個分佈於全車體如前後三點連接桿及車輪、引擎之感應器與信號；試驗分別於不同條件狀況下（不同車速，不同土壤，不同三點鏈接幾何位置等）於田間犁田，每組試驗於車速穩定後將儀器系統開動並以每 0.1 秒為一週期，反覆接收各類信號進入電腦，共計 50 秒時間。即每組試驗共計 7,500 個動態 data，儲存於磁片中，返回後再由電腦程式將田間數據轉換成實際之力量大小並計算分析出水平、垂直分力、車速及扭矩等資料以為分析依據。分析的結果大致上來說，隨著車速的增加，單位面積所需拖曳能量（specific drawbar power）會增加，尤其在黏重土壤中最為明顯。而相同車速下，於黏重土壤中需要的單位拖曳能量較於沙質土壤中高出約 100~120%；較為有趣的結果是多組試驗中，前掛犁時與向右犁時，單位面積所需的力不相同，總是一邊較高，一邊較低，理論上應該相同，且試驗中設定的左右擺距相同，却出現此意外結果，顯然是因為些微的差異造成的結果，因此可知前掛犁對於擺距（左右角度）與水平對地角度的調整是相當敏感的。

### 高粱宿根處理與深層施肥機研製

本場於七十六年以自行研製之高粱宿根處理機及現有作業方式共六種：A. 人工，B. 背負式割草機，C. 中耕機，D. 聯合收穫機加裝 2 次切割刀，E. 曳引機承載迴轉式宿根處理器，F. 耕耘機。其試驗結果如下：作業效率以曳引機承載迴轉式宿根處理器最高，殘莖處理效果最佳，但

機具購置成本亦達 12 萬元，且需以曳引機為動力源方能進行作業。聯合收穫機加裝 2 次處理切割刀改裝成本約 6,000 元，機具購置成本最低，但只能用於平畦栽培。中耕機則適合於個別農戶使用。

### 葡萄園利用機械深層中耕施肥之試驗研究

本試驗擬使用深層鬆土施肥（藥）機連續進行葡萄深層中耕施肥以瞭解地下施肥作業時，肥料用量及作物生長性狀與產量之關係，以建立深層中耕施肥作業之最佳操作模式，俾使深根性作物之管理作業能邁向機械化作業。田間試驗結果顯示：深層中耕施肥氣壓迫使液肥流量深度達 55 公分，半徑達 70 公分。地下施肥試驗區之生長情形較地表施化學肥料區旺盛，尤其在生育初期，新芽發育強。葡萄園試驗，地下施肥區的土壤肥力含量不論表土或底土均較地表對照區多，植體肥力含量亦較地表施肥區稍多。肥料使用量可節省 1/4~1/2 量，即可達到對照區之產量水準。葡萄平均粒重和甜度，各處理區則類似。

## 農業推廣教育

### 彰化縣農業發展與農地利用調查

彰化縣位於本省中西部，地勢平坦，適合農業生產，盛產稻米、果疏、花卉、畜牧業發達，是本省的主要農業區之一。依據目前規劃發展，大宗谷物類以水稻育苗中心、雜糧代耕中心、共同經營班隊與合作農場實施委託代耕作業，以擴大經營規模。蔬花果樹類作物則採集約式栽培，改善經營方式，設置生產專業區，以提高產量與品質。畜牧生產有豬、牛、雞、鴨等，已具企業化經營的規模，頗具競爭力，唯需改善廢棄物處理，以維護環境品質。漁業以養殖業為主，發展已近飽和，今後朝沿岸及近海漁業發展。林業發展以朝觀光休閒利用為主，兼及水土保育。彰化縣農業發展雖然已有相當成效，但面臨自由化的衝擊，仍屬弱勢產業，在政策上尚需採取保護政策，逐步改善農業生產結構，如灌排設施的改善、產銷系統的建立、農民組織功能的調整、農業

科技的推廣、農村文化福利設施的加強等，均屬必要，以改善彰化縣的農業體質，增強本縣的農業競爭能力。

### 臺中場果樹栽培專業訓練學員追蹤調查研究

本場為瞭解結訓學員的農場經營現況，特就民國七十五~七十六年間所辦理的『果樹栽培專業訓練班』六班，計 317 位結訓學員做為追蹤調查對象，以問卷表為工具，利用郵寄方式搜集資料，共獲得 103 份有效問卷，資料經由編碼分類，過錄電腦，透過社會科學套裝程式（SPSS）統計分析的結果，獲得之研究發現：結訓學員大都屬於素質較高的青年農民，且目前絕大部分都繼續從農。這批青年農民對於土地的觀念仍極為保守，雖願購地但不願賣地。大半結訓學員在農場經營上都發生負債，但對農業前途仍深具信心，且表示願意再來場接受更多的農業專業訓練。農業經營上若有任何疑難，結訓學員會先請教有經驗的親友鄰居與長輩，其次才是同行人士和農會推廣人員。結訓學員中僅有少數曾經申請農村青年創業貸款，同時有半數以上反應這種貸款條件不合理且手續繁雜。有半數以上的結訓學員對於目前極力推行的委託經營，並不清楚『委託經營不受三七五減租條例之限制』。

## 農業經營

### 臺中市隧道式蔬菜之生產成本及收益分析

本研究對臺中隧道式 菜栽培農戶隨機抽取 10 戶樣本戶，利用調查表進行調查訪問以獲取原始資料。分析結果摘述如下：隧道式 菜平均 1000 m<sup>2</sup> 第 1 次生產費用 87,607 元，第 2 次生產費用 90,969 元；平均每公斤第 1 次生產費用 8.8 元，第 2 次生產費用 9.1 元。隧道式 菜之生產費用中，以人工費佔絕大多數，占總生產費用 70.5%，其餘依序為設施費占 6.0%，肥料費占 5.7%，農藥費占 4.8%。隧道式 菜平均 1,000 m<sup>2</sup> 之粗收益 140,286 元，生產費用

90,969 元，利潤 49,317 元，家族勞動報酬 113,469 元，農家賺款 115,467 元，以全年作物制度（隧道式 菜及二期作水稻）計，平均 1,000 m<sup>2</sup> 粗收益 147,271 元，生產費用 98,545 元，利潤 48,726 元，家族勞動報酬 113,708 元，農家賺款 117,058 元。

### 臺灣水耕葉菜之生產成本及收益分析

臺灣水耕葉菜之私人農場，較具規模且經濟栽培者為苗栗縣與臺南縣各一處，本研究即以該兩個農場為對象，分別分析其水耕葉菜生產之成本與收益。結果摘述如下：兩處農場生產水耕葉菜之平均 1,000 m<sup>2</sup> 生產成本極為相近，分別為 1,143,704 元與 1,167,785 元，但成本結構則不盡相同，尤以流動物財費項下之細目差異尤大。平均每公斤第 1 次生產費用分別為 35.4 元及 39.3 元，第 2 次生產費用分別為 38.1 元及 42.7 元。No. 1 農戶固定費占生產總費用 44%，變動費占 56%，損益平衡點之銷售額為 3,601,187 元，較其實際銷售額 2,940,000 元為高；損益平衡點之銷售量為 102,857 kg，較實際銷售量 84,000 kg 多。No. 2 農戶固定費占生產費用 37%，變動費占 63%，損益平衡點銷售量為 47,724 kg，較實際 54,750 kg 為少。No. 1 農戶年虧損 260,084 元，平均每 1,000 m<sup>2</sup> 年虧損 92,953 元，即使不考慮資金利率，資本約 4.5 年方可回收，考慮利率則 5.5~6.2 年始可回收；No. 2 農戶年利潤 128,182 元，平均每 1,000 m<sup>2</sup> 利潤 64,099 元，不考慮資金利率約 4 年可回收資本，考慮資金利率，則 4.8~5.4 年可回收。

## 家政

### 臺灣省核心農民午餐習慣之研究

為瞭解農民午餐習慣，乃於 76 年 4 月~6 月將全省核心農民分北、中、南、東四區抽樣 2,012 戶，進行問卷調查，經資料統計結果分述如下：核心農民夫及妻年齡在 41 歲以上約佔 75

%，教育程度以國小，年收入在 10~20 萬元，宗教信仰以道教或佛教佔最多。家庭人口數為 6~10 人者佔 59.3%，抽樣戶之平均每戶人口數為 6.63 人。家人一起做家事以經常如此者佔 42.8% 最多，而對此項習性表滿意者佔 73.3%。又家人一向一起用餐者佔 46.7%，對一起用餐頻率表示滿意的有 62.1%。對三餐重要性認知為：早餐是三餐中最重要的一餐，午餐次之，晚餐最不重要。本調查就經濟、好吃、營養、衛生及簡便五因素來考量抽樣戶對進食午餐所考慮之因素，結果發現以營養、衛生兩因素之重要性居五項之首。製備午餐及用餐所需時間在 31~60 分鐘佔最多，而 79.4% 之取樣戶僅花 30 分鐘以內可完成其膳後處理工作。年齡在 51 歲以上之取樣戶喜歡以米飯類為午餐，而年紀愈輕，教育程度愈高，年收入愈高者對米飯類之喜好有下降趨勢。女性選擇午餐之考慮因素以『營養』居多，北區之調查戶將衛生列為進食午餐之第一優先考慮因素佔四區之首。北區核心農民午餐外食比例大於南區。年收入愈少者準備午餐時間愈長，用餐時間愈短，而膳後處理以東區所花時間短，中區時間最長。

### 巨峰葡萄品味與品質之關聯性研究

本研究目的在於探討巨峰葡萄品質與消費者口味的關聯性。本研究係以分赴大村、東勢、卓蘭、新社、天冷、信義等地採集回來的 281 個葡萄樣本，每個樣本除隨機採取 6 粒進行品質分析，以取得品質資料外，餘則分至各地請消費者試

表一、臺中地區農會會員與推廣經費

縣市	鄉鎮農會	正會員 (人)	贊助會員 (人)	盈餘 (千元)	推廣費用 (千元)
臺中縣	21	59,418	44,835	246,081	129,537
臺中市	1	11,227	14,653	27,261	16,407
彰化縣	26	107,395	25,272	257,490	140,251
南投縣	13	61,052	19,261	173,278	99,480
合計	61	239,092	104,021	704,110	385,675

吃，並進行品味調查。以今年夏季葡萄的研究結果顯示：消費者的品味，有 58% 的人喜歡愈甜愈好，41.3% 喜歡甜中帶酸；在外觀上則大半傾向於愈大愈好。外觀品味上，以信義葡萄最為討好，其次是新社和卓蘭的葡萄。香氣品味上，則以新社、卓蘭和東勢的葡萄較討好。葡萄品質的分析結果，以信義葡萄的色澤度最高、粒徑最大、果粒最重、硬度最高、酸度最低、糖酸比最高，而糖度則以大村葡萄最高。消費者對外觀品味之不同，即葡萄的色澤、粒徑及硬度有明顯差異；滋味品味之不同，即葡萄之色澤、糖度、糖酸比亦有顯著差異；香氣品味之不同，則僅色澤和糖度有顯著差異。

### 一年來之農業推廣教育工作

#### 輔導基層農會業務發展

調節區內基層農會功能以適應農村社會的變遷，除了加強生產技能推廣業務外，對農產品運銷、農業資材供應、農村社區發展、農民福利措施等業務，積極而主動的參與及配合執行，希望能提升農民在政治、經濟、文化、福利與環保層面的地位與權益，促使農會業務能邁入整體化與現代化的新境界。區內 61 鄉鎮農會於 77 年度用於農業推廣的經費約 4 億元 (表一)，在本場的全力輔導下，對 24 萬農會會員提供最佳的服務，滿足他們的需求，進一步提升農民對農會的信心，奠定農會在現階段農業發展的功能。

### 核心農民的編組與教育

整合農業推廣基層組織與活動是年度的重要工作重點，輔導區下各農會調整農事研究班，四健作業組及家事研究班，共計重新編組為 3,621 班，37,898 人 (表二)，協助基層農會擬

表二、臺中區八萬農業大軍的編組

縣市	農漁事研究班		家事研究班		四健作業組		合計	
	班數	人數	班數	人數	班數	人數	班數	人數
臺中市	48	360	44	339	13	124	105	823
臺中縣	491	5,123	323	3,158	96	730	910	9,011
南投縣	507	5,921	419	4,220	77	738	1,003	10,879
彰化縣	795	8,802	729	7,668	79	715	1,603	17,185
合計	1,841	20,206	1,515	15,385	265	2,307	3,621	37,898

表三、臺中區各級農會辦理農業推廣教育工作成果統計

項目	農業推廣	四健推廣	家政推廣	合計
擬定計畫 (種)	7,494	4,560	6,572	18,626
訪問農民 (戶)	87,089	33,824	41,419	162,062
講習訓練 (人)	100,270	41,726	99,730	421,726
會議會報 (人)	46,141	16,388	30,401	92,930
推廣活動 (人)	143,465	64,289	123,192	330,946
推廣人員 (人)	327	80	82	489
班組數 (班、組)	4,502	1,679	669	6,850
班會員數 (人)	25,310	16,417	20,572	62,299

### 農業訓練中心業務成果

本場附設的農業訓練中心成立於民國 74 年，除了辦理區內農業人員與核心農民培訓業務外，並接受有關機構之委託，辦理農企業以及友邦國家的農業專業訓練。77 年度辦理各類專業訓練班 21 班，訓練區內基層農會的農業從業人員 310 人，核心農民幹部 173 人，縣市級農業人員 268 人，合計 751 人。編輯訓練教材四冊，除供受訓學員講習之用，並免費贈送國內大專院校及區內農業機構收存參考。

### 農業電視

本場農業電視製作小組，經常將本場及各有關農業試驗研究機構的研究成果、鄉鎮農情、推廣活動與成果及成功農民的經驗談等題材，攝製成教學錄影帶，除提供農業電視節目播放外，亦可提供基層農會辦理農民教育訓練之用。本年度本場已彙集 14 卷教學錄影帶，並攝製 17 項主題的五分鐘電視節目帶，提供臺視「農情報導」及中視「農業專欄」等節目播出。

定及執行推廣教育計劃 (表三)，宣導重要農訊及政令，解答與反映農民問題 578 件，提供定期班會或推廣活動的資料與教材 198,210 冊，接待來場參觀訪問農民 17,537 人，外賓 1,025 人，提供優良種苗 142 件，辦理土壤分析 176 件，或由本場直接派員擔任講師 723 人次。

## 農業廣播

廣播媒體也是一項重要的大眾傳播媒體，它的影響力是無遠弗屆的。鑑於目前農業廣播節目的農友聽眾仍不在少數，實有必要加強。因此，本場的農業廣播工作除與中國廣播公司有關電臺連繫製作廣播節目外，並與該公司聯合製作「農業世界」區域性廣播節目，每週日中午 1:00~2:00，透過中廣第二調幅廣播網 1242 千赫週率播出。

## 農業新聞

農村變遷的策略必須是由政府或有關機構或農民本身「蓄意」來策劃農村的改變或成長。因此，近年來本場皆採取主動，加強與各種傳播媒體聯線作業「蓄意」使本場發佈的農業訊息，儘可能地在農民的周遭環境曝光，達到教育農民的效果。本年度發佈新聞稿在報紙刊登 114 件，電視播出 48 件，電臺節目播出 78 件，農業雜誌刊登 44 件。

目前臺灣現有農業期刊相當之多，但以本場研究人員經常發表推廣性文章的農業雜誌有「豐年」半月刊，「興農」雜誌及「農藥世界」雜誌；過去一年發表在「豐年」有 16 篇，「興農」11 篇，「農藥世界」13 篇，其中以發表在「豐年」雜誌最多。

## 農業推廣刊物

透過農業雜誌的傳播管道，將農業有關訊息及技術傳遞給農民，是行之有年的農業傳播教育工作。目前本場按實際需要發行各種推廣刊物，計有以下四種：

1. 研究彙報：屬季刊，以刊載本場試驗研究報告為主，目前已發行至第 21 期。
2. 特刊：不定期出刊，為專題性的學術研討會刊物，目前已出刊至第 14 期。
3. 農推專訊：屬月刊，係專題介紹的推廣刊物，目前已發行至第 85 期。
4. 推廣簡訊：屬季刊，為農業推廣消息及政令宣導的刊物，目前已發行至第十卷第四期。

## 農業錄影帶圖書室

一般錄影帶教材是為達到特定學習目的而設計製成。如果該錄影帶係透過電視臺播出，即成了大眾傳播媒體；但同樣的錄影帶是在團體教學的環境中使用，則是一種視聽教材。由於目前先進國家的發展經驗是比較強調「小眾播傳」，因此，本場乃借用市面上錄影帶視聽中心的傳播理念，率先於民國 75 年 12 月成立「農業錄影帶圖書室」，並編印錄影帶目錄，除方便有關機關參考借用，並提供免費代拷自製錄影帶服務。迄今本場已蒐集 589 卷各種錄影帶，截至 78 年 6 月止，出借卷次達 1,015 次，代拷 401 卷次。本場「農業錄影帶圖書室」成立以來，深受外界好評。

## 推行創新模式的委託經營

第二階段農地改革方案是現階段之重要農業施政措施，其內容包括：(1)提供擴大農場經營規模之購地貸款；(2)推行共同委託及合作經營；(3)加速辦理農地重劃；(4)加強推行農業機械化；及(5)其他配合措施。其中以推行共同委託及合作經營為本方案之核心。委託經營為各界公認擴大農場經營之最有效的途徑，由於受限於種種因素，推行以來，成效不彰。本場研創之「委託經營模式」，頗具消除委、受雙方心理障礙的作用，經農政當局支持採納命名為「農會居間仲介式委託經營」，在全省各地全面推行辦理，77 年度臺中區推廣辦理面積達 1,347 公頃，佔全省推行總面積的 53%。

## 加速農村發展與建設

協助區內農會及考慮農民需求與農村發展趨勢，共有 83 位家政督導員及 1,520 位農村婦女接受多種訓練課程。另外，針對數種季節性蔬菜製作 35 本蔬菜食譜。為加強文化設施，保留優良社會傳統，培養守望相助精神，促進社會和諧，推行「吾愛吾村」運動，本年度共有 132 個村里實行，計有 29,118 個農村家庭受惠。

## 二、七十七年度來賓訪問及參觀本場統計表

1. 元月廿三日 日本琉球宜野座農林農業考察團一行 10 人來場參觀
2. 元月廿六日 菲律賓國際稻米研究所 Dr. Sharima 一行 3 人來場討論水稻育種問題
3. 元月份 農試所學員、大村國中師生及苑裡農會農友等 150 人來場參觀及訪問
4. 二月二日 泰國農業推廣官員及農民一行 22 人來場討論水稻原原種及採種田試驗現況
5. 二月二日 亞洲農業新聞從業人員 Mr. Derinder 及 Sharma 來場參觀
6. 二月八日 日本伊和富農協一行 10 人來場參觀
7. 二月十二日 美國愛荷華州立大學遺傳系教授暨美國農業部研究員 Dr. Reid G. Palmer 來場訪問並專題演講
8. 二月份 臺中市東峰國中、省立高農、鳳山市公所及全省模範農民等 633 人來場參觀水耕
9. 三月八日 菲律賓土地改革部等政府官員 18 人來場參觀
10. 三月八日 日本佐賀大學和佐野喜及久生教授等 6 人來場參觀
11. 三月十一日 日本甘木朝倉地區農業協同組合會長等 6 人來場參觀
12. 三月十五日 日本鹿兒島縣經濟農業協同組合連合會職員一行 8 人來場參觀
13. 三月廿一日 日本東京大學齊尾乾三郎等 3 人來場參觀
14. 三月廿四日 鳳山園藝分所率領養液栽培講習會會員 40 人來場參觀
15. 三月份 七股、雲林縣、竹崎、霧峰等鄉鎮農會 355 人來場參觀設施園藝及水耕栽培
16. 四月十一日 亞蔬研究中心國外來華受訓學員 37 人來場參觀
17. 四月十二日 挪威種子檢查室主任 Mr. Arne Wold 來場參觀採種及試驗
18. 四月十二日 日本設施園藝協會代理會長龍野得三博士等 3 人來場參觀養液栽培試驗
19. 四月廿五日 南非農水部蔬菜及觀賞植物研究所副所長柏格博士等 3 人來場參觀
20. 四月份 左鎮、西螺、麻豆、東山、蘆洲、員山、高樹等鄉鎮農會及嘉義農專等 760 人來場參觀設施園藝及水耕栽培
21. 五月三日 中央長官監察、財政、經濟、交通委員全體委（職）員一行 50 人來場考察業務
22. 五月三日 日本鹿兒島縣名瀨市農林課技師東秀幸等來場參觀
23. 五月四日 美國 Rutgers 大學農業和生物工程學系教授兼主任 Bill Roberts 來場訪問
24. 五月九日 亞蔬代訓國外來華學員 21 人來場參觀
25. 五月十一日 日本國立農業總研究所開發市場經濟組伊藤順一先生來場參觀
26. 五月十九日 亞太地區及我國農業主管一行 35 人來場參觀
27. 五月廿日 土地改革訓練所學員等 33 人來場參觀
28. 五月廿日 農試所代訓友邦學員 8 人來場參觀
29. 五月份 草屯、義竹、泰山、清水、橋頭、嘉義市、新社、龍井、頭份、羅東、後壁、田中等鄉鎮農會及嘉義農專、金門縣政府等 846 人來場參觀設施園藝及水耕栽培
30. 六月一日 臺灣省歷屆十大傑出專業農民等 200 人來場參觀
31. 六月一日 南非農水部蔬菜及觀賞植物研究所副所長柏格博士來場參觀
32. 六月二日 美國普渡大學生化遺傳教授蔡家寅博士來場參觀並做專題演講
33. 六月八日 韓國青年農漁民訪問團來場參觀水耕栽培
34. 六月十三日 菲律賓生產力中心農業計劃主管謝可先生來場參觀

35. 六月份 民雄、大雅、社頭、橋頭、龜山、湖口、燕巢等鄉鎮農會及草屯鎮公所等 582 人來場參觀水耕及設施園藝
36. 七月十八日 泰國農民一行 30 人來場參觀
37. 七月廿日 美國密西根州立大學梅德思教授等來場參觀推廣課業務
38. 七月廿九日 日本山口大學鈴木義則教授及早川誠而助教授來場參觀及演講「農業氣象」
39. 八月三十日 南非農水部香蕉運銷委員會湯瑪士博士及柑桔亞熱帶果樹研究所研究員費契特女士來場參觀
40. 八月卅一日 菲律賓土地改革部等 17 單位官員來場參觀
41. 八月份 魚池、左營、臺北市等農會合計 289 人來場參觀水耕栽培
42. 九月六日 全國大專院校教授一行 50 人來場參觀
43. 九月七日 日本愛知縣農業考察團來場參觀
44. 九月七日 日本沖繩縣農業考察團來場參觀
45. 九月十三日 國際農村青年亞太地區第一屆會議與會人員來場參觀
46. 九月份 竹東、西港、泰山、枋山、福興及五結等鄉鎮農會共 479 人來場參觀水耕栽培
47. 十月四日 行政院科技顧問畢迪曼博士來場參觀
48. 十月六月 僑務委員會中華函授學校菲律賓學生 30 人來場參觀
49. 十月廿六日 日本土壤協會一行 4 人來場參觀
50. 十月廿六日 日本鹿兒島縣農業考察團來場參觀果樹
51. 十月廿八日 南非農水部農業發展處包威爾先生等 5 人來場參觀
52. 十月份 臺南市、竹崎及平鎮鄉農會等 223 人來場參觀水耕栽培
53. 十一月八日 日本長野縣東信地區上小農協部會來場參觀果樹
54. 十一月廿四日 韓國農協人員一行 23 人來場參觀
55. 十一月份 新竹市、梧棲、北斗、鹿草、彰化市、荊桐、三峽、田寮、龍崎、壯圍等鄉鎮農會以及員林國中、宜蘭農工等合計 1,023 人來場參觀水耕栽培
56. 十二月五日 韓國四健會工作考察團一行 25 人來場參觀
57. 十二月十六日 亞非農村復興組織 (AARRO) 會員國農業官員等來場參觀
58. 十二月十八日 中央研究院植物研究所帶領「國際植物化學生態學研討會」國內外專家一行 45 人來場參觀
59. 十二月廿五日 第一批來臺訪問之大陸留美學生五人來場參觀
60. 十二月份 伸港鄉、臺南市、宜蘭縣、名間、集集、二崙、臺西、苑裡等鄉鎮農會及嘉義農專等合計 665 人來場參觀水耕栽培

### 三、出版刊物

#### A. 發表文章 (臺中場研究彙報第 18 至 21 期)

1. 郭俊毅 抗白粉病豌豆臺中 12 號之育成 18:1~2
2. 曾勝雄、宋勳、侯福分 稻田轉作高粱耕作技術之改良 18:3~12
3. 蔡宜峰、黃勝忠 施肥對高粱葉片組成分及產量之影響研究 18:13~22
4. 何榮祥、高德鏗、林國照、梁純玲 高粱臺中五號種子採收技術機械化研究 18:23~30
5. 許愛娜、宋勳 稻米物理化學性質與食味間關係之探討 (第一報) 18:31~40
6. 盧訓、宋勳、吳淑靜 栽培環境及品種對稻米碾米品質與物化性質影響之研究 18:41~50
7. 黃賢喜、張素貞 早熟硬稻品種臺中 190 號之育成 18:51~64
8. 章加寶 葡萄咖啡木蠹蛾之空間分布 18:65~71
9. 陳慶忠 稗草皺縮矮化病之病徵、寄主範圍、傳播及病原性質 19:1~2
10. 古錦文 菜豆抗銹病新品系在不同地區適應性之探討 19:3~10
11. 鍾維榮 菜豆的遺傳與有種行為之研究 II. 控制豆莢形狀之最少因子數及其因子作用 19:11~20
12. 陶家駒 臺灣與大陸各省蚜蟲相之比較 19:21~26
13. 楊瓊儒 改進甘蔗嵌紋病毒之純化 19:27~34
14. 方敏男、章加寶、黃祥 臺中三號高粱黍蚜之防治適期 19:35~44
15. 楊涌祚、王玉沙、鄭墨珠 葡萄葉斑病之發生與防治 19:45~54
16. 侯福分、洪梅珠、宋勳 土壤質地對稻米品質之影響 19:55~63
17. 古錦文 新育成抗銹病菜豆品種——臺中 1 號 20:1~2
18. 王錦堂、徐國男 薏苡三要素肥料適量及其效應研究 20:3~12
19. 郭孚耀、林天枝、莊杉行 夏季蔬菜防雨栽培研究 20:13~22
20. 黃祥慶、蔡宜峰 極柑園施用石灰之研究 20:23~32
21. 林再發 水稻穀粒外部性狀與白墨質相關之研究 20:33~40
22. 謝慶芳 不同肥料和不同施肥法及鋅對中部微鹼性粘板岩沖積土菠菜生長之影響 20:41~48
23. 章加寶 扁蝸牛之發生及防治 21:1~2
24. 林再發 臺中 1 號之育成 21:3~14
25. 張素貞、許誌裕 臺灣中部一年一作水稻生產潛力之研究 21:15~22
26. 趙佳鴻、陳慶忠、江華璋、王玉沙 臺灣玉米條紋毒素病之發生研究 21:23~32
27. 劉達修 溫室粉蝨的形態、為害與防治研究 21:33~42

#### B. 研討會專集

1. 植物生長調節劑在園藝作物之應用 林信山、張林仁、林嘉興主編 臺中改良場特刊第 12 號 339 頁
2. 稻米品質 宋勳、洪梅珠主編 臺中改良場特刊第 14 號 379 頁
3. 葡萄生產技術 林嘉興、張林仁主編 臺中改良場特刊第 13 號 259 頁

### C. 臺中區農推專訊 (月刊)

1. 第 74 期 動態浮根式葉菜水耕栽培技術
2. 第 75 期 茼蒿食譜
3. 第 76 期 臺灣發展設施園藝之綜觀
4. 第 77 期 蔬菜設施栽培技術諮詢座談會專輯
5. 第 78 期 毛豬技術諮詢座談會專輯
6. 第 79 期 蔬菜技術諮詢座談會專輯
7. 第 80 期 茭白筍栽培與管理
8. 第 81 期 苦瓜食譜
9. 第 82 期 深層鬆土施肥 (藥) 機多角化利用及田間試驗
10. 第 83 期 農村親職教育問題諮詢座談會
11. 第 84 期 農產運銷專輯
12. 第 85 期 臺灣農業傳播未來之走向

### D. 臺中區農業推廣簡訊 (季刊)

1. 第 10 卷第 1 期 設施園藝專輯
2. 第 10 卷第 2 期 家政專輯
3. 第 10 卷第 3 期 夏季蔬菜專輯
4. 第 10 卷第 4 期 農產運銷專輯

### 四、專 題 演 講

1. 郭俊毅 抗白粉病豌豆臺中莢系 15 號之育成
2. 楊涌祚 甘藍黑腳病的發生與防治
3. 邱建中 殺草劑的作用機制
4. 許志聖 裸粒水稻裸粒基因之連鎖分析
5. 古錦文 紅花菜豆引種觀察
6. 方敏男 十字花科蔬菜主要鱗翅目害蟲之生態及防治
7. 陳慶忠 番茄萎凋斑點病毒
8. 張盛添 本省水田具危害潛力之多年生新雜草——雲林莞草
9. 章加寶 昆蟲生長調節劑
10. 王錦堂 葡萄園施肥與土壤肥力對產量及品質之效應
11. 林再發 秈稻品種臺秈 1 號之育成
12. 鄭健雄 臺灣偏遠地區農會組織效能之研究
13. 許愛娜 臺灣主要水稻推廣品種之理化及入口品質特性
14. 許志聖 水稻同功駢研究
15. 何榮祥 高粱宿根處理與深層施肥機研製
16. 許謙信 園藝盆栽介質之物理特性
17. 許猛超 國外引進甜瓜品種特性調查
18. 張林仁 數種果樹花芽分化觀察
19. 劉達修 褐飛蝨長距離遷移
20. 黃祥慶 液體肥料對作物之效果
21. 林嘉興 修剪及抑制劑處理對枇杷果實品質改進之研究
22. 林國照 深層鬆土施肥機多角化利用
23. 鍾維榮 矮性菜豆開花結莢習性之研究

## 五、七十七年度出國人員統計表

姓名	出國期限	前往國家	出國目的及任務
林薰生	七十七年二月廿六日至三月廿六日	巴拉圭	研究調查高粱生產條件與技術協助。
林天枝	七十七年三月十一日至三月廿四日	日本	研習農村小型食品加工之經營管理。
高德錚	七十七年五月八日至五月廿一日	日本	研習設施園藝科技。
邱建中	七十七年六月廿五日至七月八日	荷蘭 德國 瑞士 法國	研習考察農業產銷及推廣業務。
曾勝雄	七十七年六月卅日至九月廿七日	日本	研習稻田轉作雜糧作物。
林信山	七十七年七月廿三日至八月一日	加拿大	出席第六屆國際植物生產調節劑與果樹生產研討會。
謝順景	七十七年八月十日 至八月廿九日	加拿大 美國	赴加拿大參加第十六屆國際遺傳學會議及順道赴美加州大學有關機構作稻米研究考察訪問並作專題研究。
陳慶忠	七十七年八月廿日至八月廿七日	日本	參加第五屆國際植物病理學大會。
謝順景	七十七年九月十七日至九月廿八日	美國	應美國農部邀請前往參加持久性的農業體系會議。
洪梅珠	七十七年十一月十四日至十二月十三日	日本	研習稻米品質分級檢驗。

## 六、主要職員

## MAIN PERSONNEL

S. C. Hsieh (謝順景) Director	W. J. Liaw (廖萬正) Assistant Pomologist
S. S. Lin (林薰生) Senior Research Fellow	L. R. Chang (張林仁) Assistant Pomologist
L. S. Yang (楊麗賢) Secretary	J. Y. Kuo (郭俊毅) Associate Horticulturist
H. C. Kao (高和增) Head of Comptroller's Office	W. J. Chung (鍾維榮) Assistant Horticulturist
K. T. Wang (王坤同) Head of General Affairs Office	J. W. Guu (古錦文) Assistant Horticulturist
C. H. Liao (廖肇輝) Head of Personnel Office (1)	C. S. Sheu (許謙信) Assistant
Y. Y. Lee (李雨玉) Head of Personnel Office (2)	C. C. Lai (賴建旗) Assistant
	Protected Horticulture Staff
	T. C. Kao (高德錚) Associate Agronomist
	F. Y. Kuo (郭孚耀) Assistant Horticulturist
	S. T. Chang (張盛添) Assistant
Crop Improvement Division	
S. Song (宋勳) Head	Crop Environment Division
	C. C. Chen (陳慶忠) Head
	L. I. Chiu (邱玲瑛) Assistant
Rice Staff	
S. J. Chang (張素貞) Assistant Rice Breeder	Plant Protection Staff
T. F. Lin (林再發) Assistant Rice Breeder	Y. C. Yang (楊涌祥) Associate Pathologist
A. N. Hsu (許愛娜) Assistant Agronomist	M. N. Feng (方敏男) Associate Entomologist
M. C. Hong (洪梅珠) Assistant Agronomist	T. S. Liu (劉達修) Assistant Entomologist
C. S. Sheu (許志聖) Assistant	C. P. Chang (章加寶) Assistant Entomologist
C. P. Lee (李健鋒) Assistant	C. S. Lin (林金樹) Assistant Entomologist
	S. H. Huang (黃秀華) Assistant Pathologist
Upland Crop Staff	T. C. Chang (張德前) Assistant
S. H. Tseng (曾勝雄) Associate Agronomist	W. Y. Chen (陳武揚) Assistant
L. Z. Chang (張隆仁) Assistant Agronomist	K. C. Huang (黃金助) Assistant
C. C. Yang (楊景期) Assistant Agronomist	K. N. Sheu (徐國男) Assistant
S. C. Huang (黃勝忠) Assistant Agronomist	C. S. Lin (林正賢) Assistant
S. Shen (沈勳) Assistant Agronomist	T. T. Liu (劉添丁) Assistant
C. L. Yang (楊嘉凌) Assistant	C. F. Chen (陳聰富) Assistant
	C. C. Chen (陳啓吉) Assistant
Horticultural Crop Staff	C. T. Ko (柯宗德) Assistant
H. S. Lin (林信山) Associate Pomologist	C. H. Chao (趙佳鴻) Assistant
J. H. Lin (林嘉興) Assistant Pomologist	

## Soil and Fertilizer Staff

C. F. Hsieh (謝慶芳) Associate Soil Scientist  
 C. T. Wang (王錦堂) Assistant Soil Scientist  
 H. C. Huang (黃祥慶) Assistant Soil Scientist  
 Y. F. Tsai (蔡宜峰) Assistant  
 S. H. Tsai (蔡素蕙) Assistant  
 H. T. Chen (陳鴻堂) Assistant

## Agricultural Machinery Staff

J. H. Ho (何榮祥) Assistant Agricultural  
 Machinist  
 G. W. Long (龍國維) Assistant Agricul-  
 tural Machinist  
 K. C. Lin (林國照) Assistant

## Agricultural Extension Division

C. C. Chiu (邱建中) Head

## Agricultural Economics Staff

Y. J. Lin (林月金) Agricultural Economist

W. C. Hong (洪武澄) Assistant Agricultural  
 Economist

C. W. Chen (陳清文) Assistant Agricultural  
 Economist

## Agricultural Extension Education Staff

T. F. Chen (陳廷煥) Assistant Extension  
 Specialist

T. J. Chiu (邱存金) Assistant Extension  
 Specialist

H. Y. Lee (李惠元) Assistant Extension  
 Specialist

Y. J. Huang (黃穎捷) Assistant

J. S. Cheng (鄭健雄) Assistant

H. C. Chang (張惠貞) Assistant

## Puli Branch Station

T. C. Lin (林天枝) Head

S. T. Hong (洪滄堂) Assistant

S. H. Chuang (莊杉行) Assistant