

# RESEARCH AND DEVELOPMENT

## RICE IMPROVEMENT

### Breeding for Pest Resistance in *Indica* Varieties of Rice

Rice breeding has long been one of the major works of this Station. This year the continuous efforts were made to select the desirable lines of *indica* rice having characteristics of disease and insect resistances as well as good grain quality. The selected *indica* type non-waxy lines and waxy lines showed good resistance to blast, bacterial leaf blight, sheath blight and stripe diseases. They also resistant to the major insect plant hopper and white-back hopper. In addition to these, they performed better in yielding capacity and grain quality. Therefore, the promising lines Tai-sen yu 368 and Tai-sen yu 14(waxy rice) will be proposed for registration as the new varieties in the 1st crop of 1992. On the other hand, Tai-sen yu 1577, Tai-sen yu 1775, Tai-sen yu 1155 (waxy), Tai-sen yu 1162 (waxy) selected from another series of crosses will enter into islandwide regional yield trial to evaluated their yield and quality performances at different regions in Taiwan.

### Effect of Water Stress on the Grain Filling and Grain Quality of Rice

Rice depends heavily on water dur-

ing the growing seasons. Water shortage occurred during the dry season in the second crop. This experiment was conducted to investigate how water stress will effect the grain yield and grain quality. The most popular variety Tainung 65 was grown in the experimental field in the normal way. However, during the grain filling stage, irrigation water was cut for 5 days so that to subject the rice plants to grow under the stress condition. It was observed that the number of unfilled grains were increased considerably which leads to the decrease in 1000 grain weight and seriously influenced grain yield. The milling quality of rice become poor in terms of increased thickness of rice bran, and decreased rates of milled rice, white rice and complete head rice. The physicochemical properties of rice grains in terms of amylose content decreased, crude protein content also greatly changed. From this study, it was identified that water supply at the grain filling stage of rice is very crucial in both quality and quantity of rice.

### Application of "Non-woven plastic cloth" in Rice Seedling Nursery

Nonwoven cloth is made of polymeric fiber without weaving. It is characterized by the light weight, softness, water resistance, air permeability and abil-

ity to hold temperature. The nonwoven cloth had been mainly used in medical treatment as well as civil engineering. It is now widely used in agricultural production especially in horticulture. Its suitability for rice seedling nursery has not yet been tested elsewhere before. This study was attempted to use this nonwoven cloth in rice seedling nursery during the winter time in Taiwan. The night temperature of rice nursery during the winter is very low but during the day time the temperature could rise to very high if the conventional PE film was used. The usual practice is to cover PE film at night and remove during the day time which is inconvenient and labor costing.

Two kinds of nonwoven cloth N and H, both of which have a weight of 42 g per square meter. The usefulness of these two types of nonwoven cloth was compared with the conventional PE film in rice seedling nursery. It was found that the nonwoven cloth was better in air permeability and heat preservation than the PE film under the field condition. Because of its nature of air permeability, it will not accumulate the temperature to become too high to remove it. It also will prevent from accumulating the humidity within the cover which will often lead to the epidemics of blast disease. The seedling of rice grown under the condition of covering nonwoven cloth showed a better uniformity and growth. It is

therefore considered that this type of nonwoven cloth widely used in horticulture can also be used in rice seedling nursery.



Fig. 1. The rice seedling cover with nonwoven.



Fig. 2. Comparison of seedling vigor between different cover materials. Left:PE film, Right:nonwoven.

## RICE QUALITY

### Determination of most Suitable Area for Production of High Quality Rice

Rice quality is known to be influenced by variety, environmental factors and locations. A high quality rice variety often not able to express its high quality character in certain location. Therefore

to choose a right location is very essential in producing commercial high quality rice. Present study is aimed to determine the suitable areas for commercial production of a given variety of high quality rice. The well recognized high quality rice varieties, Taichung 189, Tainung 70, Tainan 9, Kaohsiung 142 and Koshihikari together with the variety (Tainung 65) of average quality were grown on the farms of 6 elite farmers at different townships. The material were grown for 3 replications, and each replication is consisted of 100 hills. The rice plants were grown according to the ordinary field practices by the local farmers. At the maturity, rice plants were harvested and dried by the ordinary method.

The harvested samples were taken back to the laboratory for evaluation of the physicochemical properties as well as eating qualities. Based on the results of analysis of palatability and grain appearance of milled rice, it was found that the rice production area in central Taiwan could be divided into five ranks. The areas of first and second ranks always give rise to the good quality of rice, hence they are classified to be the area for high quality rice production. When the rank of production areas and grades of brown rice according to CNS (Chinese National Standard) standard were combined together, it can further be graded into six grades. The 1st, 2nd and 3rd grades are

regarded as the high quality grades, while grades 4, 5 and 6 are grades regarded as ordinary or poor grades. The system of rice grading based on the above mentioned experiment is being used by the government to determine different price of rice produced from different areas. Up to present, a total of 15,300 hectares of paddy field have been identified to be the suitable areas for high quality rice production.

### Effect of Grain Size on Volume Weight and Milling Quality of Rice

The relationship between grain size with volume weight and milling quality of rice is essential to the price determination on purchasing and marketing. Results showed that the volume weight of all the released varieties was negatively correlated with grain length: width ratio and grain length, but was positively correlated with grain width and grain width x grain thickness. The stepwise regression analysis indicated that the volume weight was mainly affected by grain width x grain thickness; milling rate was controlled by grain width. The values of grain length and grain length: grain width ratio of *indica* varieties is higher than that of *japonica*; while the grain length, grain thickness and volume weight of *japonica* varieties is slightly higher than those of *indica*. There were no significant correlation between each trait of *japonica* varieties and volume

weight and brown rice ratio. The volume weight of *indica* variety was negatively correlated with grain length, but was positively correlated with grain width and ratio of grain length and grain width. There were no significant correlation between volume weight of either *japonica* or *indica* varieties and milling rice quality.

The volume weight of *indica* varieties is mainly determined by grain length, and brown rice ratio is greatly affected by grain width. In general, The variation of grain size of *japonica* varieties is higher than that of *indica*. In determination of rice purchasing policy, it should have different criteria of volume weight for *japonica* and *indica* varieties. It is concluded that the volume weight didn't affect the milling quality of *japonica* or *indica* variety, while volume weight of *indica* varieties is affected by grain length. The brown rice ratio is mainly determined by grain width.

#### Methodology of Identification of New and Old Milled Rices

Laboratory studies were conducted to identify the new and old milled rices by single grain method with mixed rices. The ELISA plate and multi-channel adjustable micropipette methods was used. The separated single grains were injected with minute amount of chemical reagent individually, and the reaction of reagent solution or grain were observed and recorded. Two chemical solutions were

used in this studies. The first solution is prepared with Brom Thymol Blue and Phenol Red, dissolved in NaOH. Individual rice grains are rinsed in a test tube with the prepared solution, and the freshness of rice grain can be identified by reading the changing coloration of solution after its reaction with rice grains. The violet color of the solution indicated the freshness of the grain tested, while yellow color of the solution indicated the aged or old rice grain. The second solution contain Brom Thymol Blue and Methyl Red, which were dissolved in Ethyl Alcohol, new grain solution showed green color, while the old grain solution turned into yellow to orange.

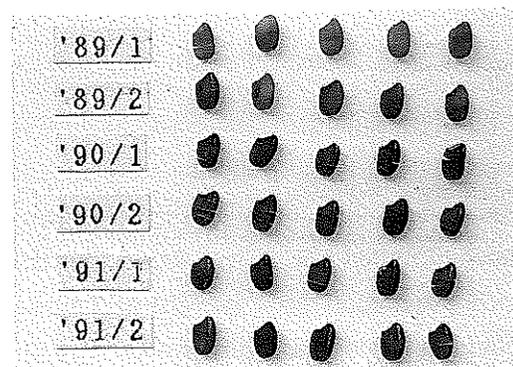


Fig.3. The color reaction of grains is used to determine the freshness condition of single milled rice.

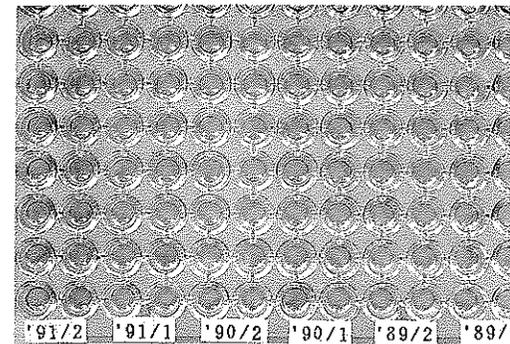


Fig.4. The ELISA plate injected with chemical reagent could distinguish the individual new rices from old rices.

## UPLAND CROPS

### Improvement of Cultural Practices for Job's-tears

In order to increase the unit yield of Job's-tear in Taiwan, seeding time, planting density, amount of nitrogen fertilizer and application time were studied. The results were summarized as follows. The Job's-tear should be seeded after late March, and the most suitable seeding time is late April. The suitable planting density for Job's-tear is 40 cm x 10 cm or 50 cm x 15 cm. The nitrogen amount for Job's-tear should be adjusted from 180 kg/ha to 220 kg/ha. The application duration of nitrogen for Job's-tear is 20% as basal, 20% applied at panicle initiation stage(55 days after seeding), and 20% at panicle developing stage(80 days after seeding), flowering stage(95 days after seeding), and full-bloom stage(110 days after seeding), respectively.

### Comparison Trial of New F<sub>1</sub> Lines of Sorghum

The purpose of this trial is to evaluate the newly developed sorghum lines for further regional yield trial. The tested lines included Taichung yu 80-01 and Taichung No.5 as the check variety. The conventional method of cultural practices was used. The design of the trial is randomly complete block design with 4 replications. Each lines planted 3 rows as the block, block length is 3 meters. The result indicated that among the new lines Taichung yu 80-01 and 80-02 have the highest yield. Taichung yu 80-08 and 80-03 have the same yielding performane as the check variety "Taichung No.5". It is concluded that the four potential lines are: Taichung yu 80-01, 80-02, 80-03 and 80-08, and will be recommended for further regional yield trial.



Fig.5. The most popular sorghum variety, Taichung No.5.

### Studies on the Combining Ability of New Inbred Lines in Sorghum

Thirsty new fertility restoring lines

(R-line) crossed with twenty-two cytoplasmic male-sterile lines (B-lines) and a total of 232 combinations were obtained. These combinations were evaluated and analyzed for their combining abilities so that select the new elite parents for development of new hybrids.

Results revealed that the 80A and 296A had the highest general combining ability (GCA) in yield, and also had a higher GCA in plant height. 632A and 2219A showed the highest GCA in leaf spot resistance than that of others. While in restoring lines, the lines of RTX435, RTX7000 and RTX2798 showed a higher GCA in yield while 2R showed a higher specific combining ability in yield.



Fig. 6. The seed production of sorghum in Taichung DAIS.

### Size Variation of Ribosomal RNA Gene is a Molecular Marker For Grain Yield in Maize

The goals of this study were to survey the variation for intergenic spacer length of the ribosomal RNA genes (rDNA) in maize populations and to

evaluate its influence on agronomic traits.

Materials surveyed for the variation of spacer length included 13 populations of maize. In order to test the correlated response of spacer length and agronomic traits, three subpopulations were established from each of the three base populations ( Nebraska Krug(NK), Nebraska B(NB), and Nebraska Stiff Stalk(NS) ) by divergent selection on the basis of spacer lengths characterized by Southern hybridization. Plants were classified based on the predominant pattern of Sac I restriction polymorphisms observed as the major fragments of 3.4, 3.6, 3.8 and 4.2 kb from the IGS regions in rDNA.

Heterogeneity of spacer length was observed within and between maize populations as well as within individuals. The frequency of longest variant(4.2 Kb) appeared to be increased in NS but not in NB population as a consequence of recurrent selection for improvement of grain yield and standability. Results also indicated that spacer variation was associated with selection. The frequency of spacer variants in subpopulations created by spacer length selection indicated that the frequency of spacer variants was shifted toward long (4.2 kb) and short (3.4 kb) directions by divergent selection.

Observations of agronomic traits indicated that Long x Long subpopulations were taller and had greater seed weight than Short x Short in all three popula-

tions. Both days-to-flower and grain yield were also likely to be affected, although no significant differences were detected. Results of this work suggest that spacer length variation in maize populations might be usefully exploited in breeding programs.

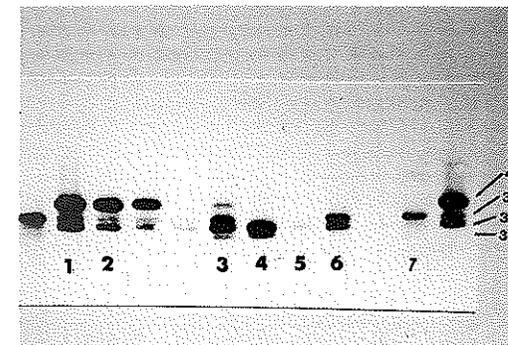


Fig. 7. Representative phenotypes of rDNA spacer length observed in maize populations.

## VEGETABLE CROPS

### Effects of Greenhouse Structure on Microclimate and Crop Growth

#### I. Performance of summer cucumber in the nethouse

This study was conducted to evaluate the effects of greenhouse structure on the microclimate and performance of summer cucumber. Two nethouses with 16 x 6.8 square meter in area and 3.6 meter in height were built in this station. The design and construction material were the same. They were covered with PVC film on the roof. The silver/black PE net which had 35% shading rate was spread 30 cm wide over the dome of

nethouse. In the control nethouse, no white plastic net(24 mesh) was used. A weather station was established near the nethouse to collect the microclimatic parameters including temperature, relative humidity, total solar radiation, photosynthetically active radiation, wind speed and wind direction by means of Campell micrologger. The results indicated that better plant characters of cucumber such as number of fruit per plant, fresh weight per fruit, and fruit weight per square meter were found in the control treatment without netting. Under netting condition, pesticide application for controlling aphid could be reduced to 2 times. However, ventilation was too poor resulted in warmer temperature and lower relative humidity in the greenhouse with netting treatment. On the basis of correlation analysis among microclimatic parameters and yield performance of summer cucumber. It was observed that lower maximum relative humidity during the day time was the limiting factor for growing summer cucumber in the nethouse.



Fig. 8. The double layers of air-inflated film plastic house.

## Effects of Greenhouse Structure on the Microclimate and the Growth of Crops

### II. Performance of summer cucumber in the air-inflated greenhouse

This study was conducted to evaluate the effects of greenhouse structure on the microclimate and the performance of summer cucumber. Two air-inflated film plastic houses having the same floor area of 16 x 6.8 square meter and a height of 3.2 meter were built in this station. The design, construction material and the control system were the same as described in the previous paragraph. It was covered with a same double layers polyethylene film. The same forced convection system operated by the pad/fan system was mounted in each greenhouse. One greenhouse was screened during the summer season. The silver/black PE net with 35% of shading rate and 30 cm in wide was spread over the dome of greenhouse. The microclimatic parameters including temperature, relative humidity, etc. were collected in the similar way as mentioned in the preceding paragraph. As compared with unscreened greenhouse, the microclimatic parameters measured in the screened greenhouse showed a 17% reduction in total radiation, 21% increase in photosynthetically active radiation, and 1.3 - 4.2°C reduction of room temperature, and 7 - 12% increase in relative humidity. Under the un-

screened greenhouse condition, crops grow much better than those under the screened greenhouse condition. The survival rate of summer cucumber was as low as 6.2%. This was due to the larger variation in microclimatic in the unscreened greenhouse. The result indicated that it is necessary to improve the ventilation condition by operating pad/fan forced system in the unscreened air inflated greenhouse.



Fig. 9. The microdata logger recording the microclimatic variation in the greenhouse.

### Screening of Summer Salad Lettuce Variety in Taiwan

In order to select desirable salad lettuce varieties to meet the need in the summer season, 13 exotic crisp lettuce varieties introduced from Leen de Mos Seed Company, Holland were grown in this station and Pu-Li Branch station, and 16 hydroponic farm scattered islandwide. The names of tested lettuce varieties were Lollo Bionda Cireo, Lollo Rossa Lotto, Notiva, Salad Bowl Pluto, Minetto, Saladin, Ultra, Bristol, Hudson,

Mir-miranda, Pascal, Salina and Valmaine Cargo. The results of two-year experiments indicated that no tip burn and bolting symptom were found in the varieties of Lollo Binda Cireo, Lollo Rossa Lotto and Hudson.

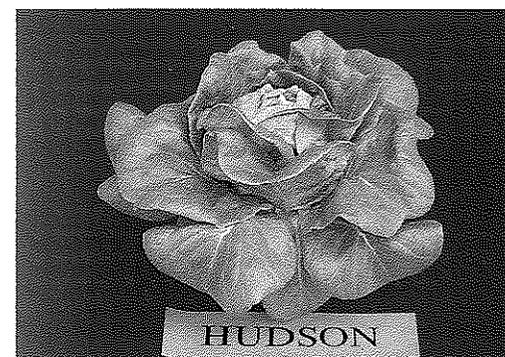


Fig.10. The semi-heading and heat tolerant lettuce variety "Hudson".

### Improvement on the Methodology of Nitrate/Nitrite Nitrogen Analyses

In order to measure the variation of nitrate/nitrite content of hydroponic vegetable, a preliminary experiment was designed to evaluate the accuracy of sample preparation and method of analysis. It was indicated that HPLC with EC detector was more sensitive than that of UV spectrometer. Owing to the nitrate content of hydroponic vegetable is about 400 - 1000 ppm, it is suggested that to dilute the sample solution by 1 to 10 and to detect nitrate and nitrite content by UV spectrophotometric method. If sample was purified by phosphate buffer solution and without discoloration process, the observed nitrate content was lower than theoretical value, but higher

nitrite content was obtained. It was also found that the higher nitrite with lower nitrate content was detected with the prolongation of storage duration, if the extracted sample solution was not prepared and stored under 5°C.

### Performance of Summer Tomato with the 3-Cluster Culture Method

The previous report indicated that under the hydroponic culture condition on the summer tomato could produce 5 tons of fruit per 1000 square meter in 100 days by using three-cluster culture method with 10 plant/m<sup>2</sup>. In order to evaluate this technology further, a two-year experiment was conducted in Pu-Li Branch Station which located in the 600 meter altitude of sloped land. The results indicated that variety Taichung - Asveg 4 was more tolerant to the high density culture than that of Known-yu 658 and San-Fu. When the planting density was increased from 10 plants/m<sup>2</sup> to 20, the fruit size, number of fruit per plant and fresh weight per fruit were reduced. However, total fruit yield per 1000/m<sup>2</sup> increased 8.3 - 206.3% which was 2 times higher than that grown in the field. Percentage of blossom end rot symptom in each cluster of Taichung - Asveg 4 was recorded to be 22.3%, 12.3% and 6.1%, respectively.



Fig.11. Three clusters tomato cultural practices in Puli Branch Station.

### Effect of Chemicals on the Enhancement of Flower Initiation and Bolting in Artichoke

Artichoke belongs to composite family grown for its flower head. Due to the shortage of chilling condition in February to March in Taiwan resulted in incomplete flower initiation, low bolting rate or uneven bolting in April. The purpose of this study is to induce flower initiation and further increase bolting rate by using the plant growth regulators. The seed of artichoke was planted in October and transplanted in November. The plant was bolted at early May to early April. The appropriate harvesting time for young flower head was found to be 18~20 days after bolting. The plant growth regulators used include IBA, Cytex and GA. The application times is at the main stem elongation period (at 12 leaves stage, early February) and before bolting (early May). The results indicated that 30 ppm of GA gave the best effects on plant

height, leaf length, leaf width, flower bud production, flower bud weight, bolting rate and flower bud yield. Compared with the control plot, the plant height increased 30 cm; bolting days was 19 days earlier, number of flower bud was 6.5; the bolting rate reached to 98%. The yield of young flower bud was 15,650 kg/ha, which is 641% higher than that of control plot (2,440 kg/ha). It is concluded that GA could compensate the effect of chilling and to enhance the flower initiation and bolting development of artichoke.



Fig.12. The GA treatment could enhance the flower initiation and bolting of artichoke.

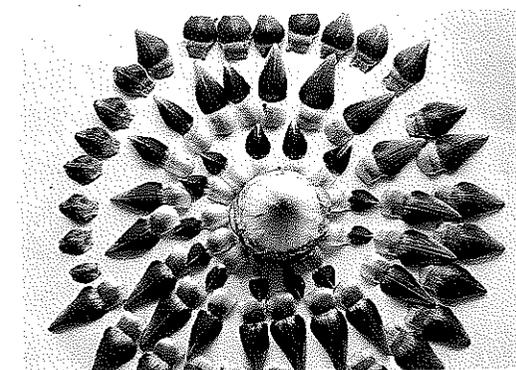


Fig.13. The edible parts of artichoke, petals and receptacle of flower buds.

### Studies on the Characteristics of Newly Bred Lines of Stringless Pea

#### (I) Influence of temperature on the expression of stringlessness of pea

An investigation was made into the temperature effect on string development of pea in winter. Eight new stringless lines together with the check varieties "Taichung 12" (stringed variety) and "Sugar Daddy" (stringless variety) were grown in the field on October 25, 1990 and an investigation was made during February of 1991. The string formation at the ventral side of pod of the newly bred lines was influenced by air temperature. Under normal temperature condition in winter, the ventral side of the pod of the newly bred lines was completely stringless, or some of the lines developed the string slightly later. While under the low temperature (i.e. cold front) condition, the ventral side was completely stringed.

The string formation at the dorsal side of pod of the newly bred lines was not influenced by air temperature. Under either normal or low temperature conditions in winter, the string was not found at the dorsal side of pod. Low temperature in winter had only affected on the string development of ventral side of pods which located between the node positions of 6 and 9 (counted from the top) and had no influence on the older or younger pods than those position. The string at the ventral side of pod of normal picking

ripeness (located at the 6th node) began to appear on the second or third day after temperature dropped and disappeared on the second or third day after temperature went up.

#### Analysis of Growth and Development Patterns in Garlic Plant

The growth and development patterns of three different bulb sizes of garlic varieties were investigated. The results of growth analysis of garlic plants indicated that there was no significant difference in growth change in plant height and leaf number between varieties. There was a great difference in growth curve for aboveground parts (fresh weight) of three varieties, but all increased rapidly at 7 weeks after planting and reaching the peak stage at 15 weeks after planting. The marked increment of fresh bulb (underground part) started at 13 weeks after planting. The growth change of dry weight of above-and underground parts are similar as those of fresh weight. Average growth rate showed that the peak stage for above-and underground parts of three types of bulb sizes were at 11 and 17 weeks after planting, respectively.

#### Effects of Planting Density on Chinese Cabbage in Summer Season

Establishing the suitable planting distance is basically required for Chinese cabbage in the summer crop. Two heat tolerant varieties, AVRDC 86181 and

Swan-sii were used. The former represented for a large plant type, the later was a small plant type. It was carried out in the summer season, 1991. A factorial experiment design with three replications was employed, the treatment consisted of five plant spacings that are 60cm × 25cm, 60 cm × 30cm, 60cm × 35cm, 60cm × 40cm, 60cm × 45cm and 60cm × 50cm. The results are summarized as follows. In all spacings and plant types, the plant height, plant width, leaf length, leaf width showed positive correlation with head weight and plant weight. The outer-leaves number of head of small plant type showed positive correlation with plant weight between different spacings. In conclusion, the plant spacings of 60 × 30 cm and 60 × 35 cm is suitable for the small plant type, and 60 × 40 cm is suitable for the large plant type. The occurrence rate of soft-rot in the small plant type and plant distance showed positive correlation, while the large plant type was not affected. There was no significant difference between plant types in terms of tip burn.

## FLORAL CROPS

### Effects of Corm Size and Plant Density on the Growth of Gladiolus

Result indicated that corm size over 10-12 cm have significantly enhanced the growth and qualities of winter gladiolus

in Taiwan. The days to flower-bud emergence and flowering period are uniformed. For the cultivar 'Applause' the days to harvest advanced 7-10 days while for the cultivar 'Wig's Sensation' promoted 3 weeks than those of corm size 6-8 cm. The corm which is larger than 12 cm in size performed better in plant height, stem diameter, inflorescence length, number of florets and vase life. Under the low planting density condition, the corm size of 8 - 10 cm with 20 corms/m<sup>2</sup>, 40 corms/m<sup>2</sup> showed the best growth vigor. Under the high density condition of 80 corms/m<sup>2</sup> and 100 corms/m<sup>2</sup> the worst quality of cut flower were resulted. Under the planting density of 100 corms/m<sup>2</sup> no blinding was produced. The corm sizes gave the more significant effect on the growth and quality of cut flower than planting density. There was significant difference in dry weight between different corm sizes. The dry weight of plant tends to be increased as the plant density reduced and corm size increased. Within the same corm sizes, the low density of 20 corms/m<sup>2</sup> gave the best condition for the growth of gladiolus.



Fig.14. Chloride is one of the important causing factors of leaf tip burn of gladiolus.

### Effect of Potassium Fertilizers on Quality and Tip Burn of Gladiolus

Gladiolus is one of the important cutflower that has high economical value in Taiwan. However, the growing of this flower is often encountered with the problem of serious tip burn of the leaves that is very harmful to its ornamental quality. This experiment was conducted to study the effect of the two potassium fertilizers, potassium chloride and potassium sulfate, on the leaf tip burn, plant growth, and the quality of cutflower. The results of the experiment showed that application of potassium fertilizers promoted the unit weight of the peduncle that reached to the maximum of 5.9g/80 cm. Potassium chloride could made a more concentrated flowering of the floret; potassium sulfate have lengthened the

floret life for 1.5 days. The affected rate of leaf tip burn is significantly higher in potassium chloride treatment than in potassium sulfate treatment. Their differences were 8.2% in growth stage, and 6.7% in harvesting stage. The length of tip burn in potassium chloride treatment was also longer than those in the check, and even the bract of floret also showed the increased symptom by the potassium chloride treatment. It seems that chlorine is one of the important causing factors of the leaf tip burn of gladiolus.

## FRUIT TREE CROPS

### The Observation of Growth Habits of High Chilling Asian Pears

This study was aimed to observe the factors related to the CO<sub>2</sub> exchange rate (CER) of high chilling Asian pears (*Pyrus serotina* Rehd.). The dropping of leaves and the rate of abnormal bud break of various cultivars and different growth status during summer season were also studied.

The results of CER measurement indicated that the net photosynthesis occurred in the leaves at 3-days stage. The highest CER ( 16.7 μ mol CO<sub>2</sub> m<sup>2</sup> s<sup>-1</sup> ) continued for 21-days in the old leaves. The photosynthetic photon flux density (PPFD) for light saturation of photosynthesis of adult leaves were about 1180 μ E m<sup>2</sup>s<sup>-1</sup>. The diurnal study indicated that

the CER reached around its maximum 9:00 a.m., then decreased thereafter. The diurnal variation of stomatal conductance followed the diurnal pattern of CER. The optimum leaf temperature for CER was about 26°C. CER declined dramatically if leaf temperature was over 30°C.

Between July to September, the increment in plant height and the number of leaves dropped, Shinko pear was more adaptable to the lowland climate than the other cultivars. During hot season, Shinko pear tended to slow down the terminal growth and result in less dropped leaves, and break lateral buds. On the contrary, cease or recovery of terminal growth could lead to more dropped leaves and broken buds.

### Study on the Development of Flower Cluster and Fruit Setting of Grape in Different Production Seasons

Comparative observation was made on the development of flower cluster in grape between different production systems, i.e. normal production season, summer-fall crop and greenhouse production. The effect of plant growth regulators on the development of flower clusters was also studied. Results indicated that in the normal production season, the longest flower clusters of over 0.8 cm were produced. The application of cell mitosis stimulants in early developmental stage of new shoots could elongate the flower clusters. Application of 500x Cytex

and Cytex mixed with amino acid before blooming have the best effect on fruit setting. There was no significant effect on fruit setting by application of KT 30 and GA. Repeated applications of Cytex before blooming and at young fruit stage could increase the berry weight, but berry color and quality was lower than that of control.

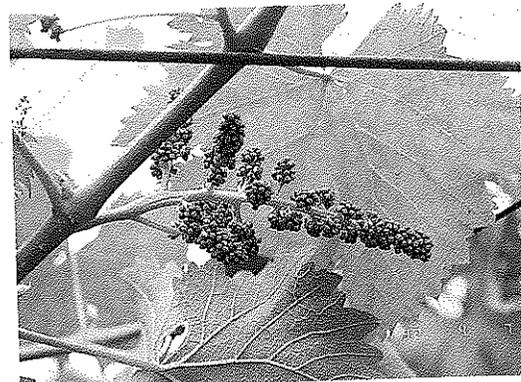


Fig.15. The normal fruit cluster of grape in summer season.

### Study of Growing Temperate Pears on Lowland Areas in Taiwan

Due to the rather short time of cold period in winter in Taiwan, the lowland areas is not suitable for growing temperate pears. They are some alternative methods available for the production of temperate pears in Taiwan: 1) grow in highland areas, 2) develop low chilling requirement variety, 3) artificial defoliation to escape dormancy, 4) top-grafted the cold treated flower buds on lowland pears, 5) chemical to enhance bud emergence in lowland areas.

The shoot of "Shinko" temperate pear that grown at this station, treated with 1-4% cyanamide, 20% ethylenechlorohydrin, 10% and 20% of calcium cyanamide from Feb. to March. Results showed that 2% cyanamide treatment have the best effect on rate of budbreaking, which is reaching 85%. The single fruit weight is ranged from 190 g to 460 g, while average fruit weight is 263 g. Sugar content is 11.8° Brix. Application of 0.5% cyanamide on plant during mid-August to force defoliation and bud emergence, could reduce the dieback of flower buds, thus the buds could complete the flower initiation in February.



Fig.16. Top-grafted the cold-treated flower buds of temperate pear on lowland pear.

### Effect of Different Frame Types and Pruning Methods on the Yield and Quality of Grape

Comparison of production of grape by different frame types and pruning

methods was made in this Station. The frame types are: single trunk, double trunks with trellis, V-shape training with double trunks, T-shape training with horizontal frame, double trunks training with horizontal frame, X-shape training and four trunks with horizontal frame and one trunk without frame. Results indicated that under high temperature and humid conditions in Taiwan, grapevine that training upward tend to be outgrown, resulted in the fruit-bearing shoots have low rate of budbreaking and the number of flower clusters in new shoots is reduced in the next year. The length of flower cluster in single trunk and V-shape training with double trunk type is slightly longer than those of others. The shoot length and ratio of ligninization in double trunks with trellis, horizontal frame type have reached the developmental standard. Single trunk type have the lower fruit setting and berry quality than other frame types.



Fig.17. The most popular horizontal training frame type for grape production in Taiwan.

## AGRICULTURAL ENVIRONMENT

### Experiment on the Resistance of Green Belt Plants to the Waste Gas Emitted from Brickfactories

This experiment was conducted in a slightly acid and loamy slate old alluvial paddy soil. The experiment plot was adjacent to the southern part of a collected area of about 45 brickfactories. Therefore air pollution on the experiment area was more serious in the winter season than in the summer season. The main air pollutants in this area are fluorides, sulfur oxides (SO<sub>x</sub>), fly ashes, and possibly nitrogen oxides (NO<sub>x</sub>).

Fluorides is the main air pollutant that is harmful to the crops in this area. The most harmful stage of the fluorides was from January to March, during which 3~6 ppb of hydrogen fluoride (HF) was appearing stably in the air. However, some sensitive plants also showed the symptoms of fluoride injuries during April to October when the concentration of hydrogen fluoride (HF) was 1~2 ppb in the air. This suggested that under the long sustaining period of pollution, even 1~2 ppb of hydrogen fluoride is harmful to some crops. As fluorides are accumulative in the plant leaves, generally the lower leaves of the plant have much higher fluoride than upper leaves do and their symptoms are also more severe.

The second important air pollutant is sulfur dioxide (SO<sub>2</sub>). The highest concentration of sulfur dioxide with an average of about 100 ppb appeared in the period of January to April. Although no visible symptom had been found in all experiment plants, however the chemical properties in the leaves had already showed substantial changes, because the soluble SO<sub>4</sub><sup>2-</sup> in the leaves of all plants increased rapidly to more than 2%, and the total anions increased rapidly to more than 60% of the total basic elements. This suggested that appearance of over 100 ppb SO<sub>2</sub> in the air, greater than 2% of soluble SO<sub>4</sub><sup>2-</sup> in the leaves, and total anions exceeding 60% of total basic elements in the leaves is a signal of significant pollution of sulfur oxides in the air in this area.

The resistance of plants to fluorides differed greatly with plant. *Acer trifidum* and *Liquidambar formosana* (maple) may be classified as the most weak plants to fluorides; *Casuarina equisetifolia*, *Tamarix*, *Eucalyptus*, *Ficus religiosa*, and *Cinnamomum camphora* as the medium resistant plants; *Ficus microcapa*, *Ficus elastica*, *Nerium oleander*, *Broussonetia papyrifera* and *Ricinus communis* (castor-bean plant) as the resistant plants.

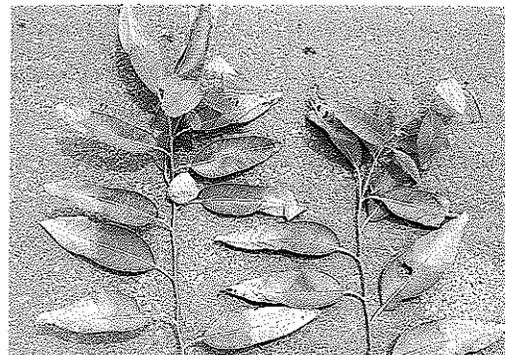


Fig.18. The symptom of fluoride injury on the leaves of *Eucalyptus*.

### A Study on the Relations of the Soil Cadmium Contents of an Old Slate Alluvial Soil to the Growth and Cadmium Contents of Maize

In order to evaluate the critical soil Cd levels which may affect the growth of maize and the Cd contents of its edible parts, a study on the relationship between the soil Cd contents of an old slate alluvial soil and Cd accumulation in different parts of maize were conducted.

Results showed that the Cd contents in different parts of maize was in the following order: leaf > root > stalk > husk > ear in those divisions with 2.0 to 4.9 ppm Cd in the top soil. However, in 5.0 - 5.9 ppm division, the Cd contents in the different parts of maize was in the following order: root > leaf > stalk > husk > ear. Judging for the two distinct difference in the order, it seems that 5.0-5.9 ppm soil Cd contents may be an important critical boundary for indicating either leaf or root was the highest Cd content. The Cd contents in maize ears in all divisions of

the plots exceeded 0.1 ppm of the Germany grains Cd pollution limitation. However, the growth and yield of maize were not affected by the soil Cd contents within the 4 ppm. When the soil Cd contents exceeded 4ppm, the growth of maize was significantly retarded and the yield reduced. When it exceeded 5 ppm, some toxic effect on maize growth was found and the yield of maize decreased 60%.

## SOILS AND FERTILIZER

### Effect of Chicken Manure and Nitrogen Fertilizer on Yield of Cabbage

The experiment was conducted at highland area in Taichung county to study the effect of fermented and non-fermented chicken manure, different amount of nitrogen fertilizers on yield of cabbage and soil fertility. Results showed that the application of fermented chicken manure could increase soil organic matter, exchangeable potassium, calcium and magnesium in Fusoshan Farm, while increase soil organic matter, total nitrogen, available phosphorus, exchangeable magnesium in Wuling Farm. There was no significant difference of soil fertility in cabbage experimental plots between treatment of fermented and non-fermented chicken manure. The plots applied 12 ton/ha of fermented chicken manure have the highest yield of cabbage than those of other treatments. The amount of nitrogen fertilizer at 350 kg

and 250 kg/ha have the best yield increment effect on cabbage in Fusoshan and Wuling Farms, respectively. The amount of fermented chicken manure at 3 and 9 ton/ha in each crop season could increase the yield of cabbage in Fusoshan and Wuling Farms, respectively.

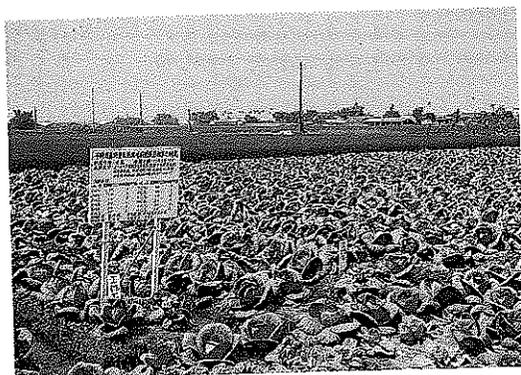


Fig.19. The experimental field of chicken manure and nitrogen fertilizers applied on cabbage.

### Effects of Application Rate and Application Time of Hog Waste on Cabbage

The effect of application rates and times of different hog wastes on soil fertility and the yield of cabbage was studied on alkaline slate- alluvial soil at Pitou and acidic red-earth at Waipu. The results showed that the application of both dry hog waste and lime hog waste could increase the contents of soil organic matter, available P, exchangeable K, water and also reduce soil hardness. However, as concerned the effect on soil fertility and the yield of cabbage, treatment of dry hog waste was the best than that of lime hog waste and the application rate of 20 t

/ha was better than 10 t/ha. When applied 20 t/ha of hog waste, the contents of soil heavy metals might increase from lower to medium range. There was significant effect of application time of hog waste on the survival rate of cabbage after transplanting. Result showed that the application time of hog waste which applied 14 days before transplanting had the highest survival rate and yield of cabbage after transplanting.

### Effects of Organic Manures on the Yield and Quality of Grapes

The present experiment was aimed to compare the effect of organic manures on the yield and quality of Kyoho grape. Nine treatments including chicken manure (5 t/ha), hog manure (12 t/ha), rice bran (6 t/ha), peanut cake (4.5 t/ha), soybean cake (4.5 t/ha), rice straw (15 t/ha), bark compost (15 t/ha), humid acid (35 l/ha) and chemical fertilizer (N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O : 100-100-200 kg/ha) as a control were laid out in a randomized complete block design with three replications. The experiment was carried out at the farm of Taichung District Agricultural Improvement Station from 1988 to 1991.

The result of the studies indicated that the application of rice straw compost and bark compost have higher yield and sugar content of fruits than those plots applied with only chemical fertilizer. The rice bran applied plot showed the second high values in fruit yield and sugar con-

tent exceeding the chemical fertilizer applied plot. Further, it was observed that the sugar content of grapes grown under the application of chicken and hog manures, soybean cake and humid acid was higher than grown under the chemical fertilization.

## PLANT PROTECTION

### Purification, Characterization and Serological Analysis of Rice Wilted Stunt Virus

Rice wilted stunt was first discovered in central Taiwan in 1978. This disease causal agent is transmitted by brown planthopper, *Nilapareata lugens* (Stal) in a persistent manner. The virus was purified from infected leaves of *Oryza sativa* L. by one cycle of differential centrifugation, followed by sucrose gradient centrifugation, or subjected to another cycle of isopycnic centrifugation in cesium sulfate gradient. An yield of about 14.8 ug per gram of leaf tissue of purified virus was obtained. The A<sub>260</sub>/A<sub>280</sub> ratio of purified nucleoprotein obtained from Cs<sub>2</sub>SO<sub>4</sub> gradient was 1.33. Purified RWSV preparation first fixed with 2% glutaraldehyde and followed by uranyl acetate staining indicate that their consistently appeared as helical structure about 6-8 um wide with various lengths. The longest circular filament was measured about 80 um. Two capsid protein with molecular weight es-

timated at 36.2K and 38.9K was obtained in the purified RWSV using SDS-PAGE procedure. Immunological analysis of double diffusion and ELISA showed that the antisera of rice grassy stunt virus were specific in the antigen of RWSV. In symptoms, host range, electron microscopic comparative study, insect transmission and serological relationship, the RWSV of Taiwan is considered to be a strain of rice grassy stunt virus of the Philippines.

### Influence of Dilution Concentration and Water Amount of 6.5% MAFA on the Control of Sheath Blight and Yield of Rice

Results of application of 6.5% MAFA on rice to control sheath blight are as follows. One spraying of 300x and 500x dilution of MAFA and two sprayings of 1000x and 2000x dilution of MAFA, both added with 1200 liters of water per hectare, have the low stem infection rate (0.4%) and damage rate (0.04~0.39%) in sheath blight inoculation plots. One spraying of 300x MAFA dilute with 1200 liters of water per hectare have the lowest fertility rate (84.5%) than other plots. One spraying of 300x MAFA dilute with either 1200 liter/ha or 600 liter/ha of water, and two sprayings of 500x and 1000x of MAFA dilute with 600 liter/ha of water have the lowest 1000-grain weight than other plots. In conclusion, increase the concentration of 6.5% MAFA or reduce the wa-

ter amount per hectare have no effect on the control of sheath blight and rice yield.

### Study on Succession Cropping, Occurrence and Control of Soft Rot of Ginger

Soft rot (*Pythium myriotylum*) is one of the most important diseases of ginger in high temperature and humid regions. Low pH and succession cropping caused severe soft rot occurrence due to the survival of pathogen from previous crop. The pathogen of soft rot could carry by ginger root. The following chemicals and soaking time for ginger root is very effective in reduce the occurrence of soft rot: soaking the roots in 58% WP Ridomil MZ dilute to 400x for 20 minutes, or 5 minutes in 25% EC Terrazole 1500x. Spraying 25% Terrazole 1500x on soil from planting to germination stage at one month interval for 2-3 times could reduce the occurrence rate of soft rot, which is 23.5% and 15% for long and short rhizome type of ginger, respectively.

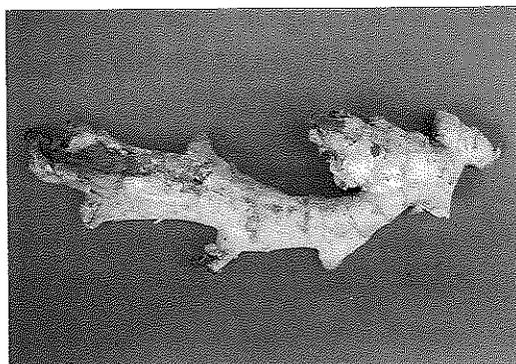


Fig.20. Soft rot (*Pythium myriotylum*) mainly occurred on rhizome region of ginger.

### Study on the Ecology of *Fusarium averceum* in *Eustoma russellianum*

*Fusarium averceum*, the pathogen infects *Eustoma russellianum* by entering leaf sheath tissue, forming water-soaking lesion, lesions are usually sunken and coalesce together, causing plant wilted and death. Red spore masses often appear on lesion at humid conditions. The pathogen mainly infects gramineous crops, this is the first report of occurrence on the non-gramineous crops. Infection and disease development can occur over a wide temperature range from 8 to 32°C, with an optimum of 16-20°C, fungus growth stops at temperature greater than 32°C. The growth of macroconidia is enhanced when cultured at 2% agar medium with addition of 2 g starch. The addition of water soluble lactose, maltose and fructose could inhibit the production of macroconidia. The macroconidia sporulate only when grown on a medium containing 0-0.4 M potassium chloride, while higher concentration have inhibitory effect.

### Watermelon Mosaic Virus-1 Transmitted by Aphids

The objectives of this experiment was to determine the aphid species and their efficiency to transmit watermelon mosaic virus-1 (WMV-1) on cucurbita crops. Thirteen aphid species occurred in the field were collected and reared on

their original host plants under control conditions ( $24 \pm 1^\circ\text{C}$ ), respectively, for several generations and the apterous adults were used as experimental insect source. The tested aphids were pre-starved 2 hrs and then allowed to feed on the infected zucchini plants for 30 minutes. After acquisition, aphids were confined singly or in a certain number with clip-on cages on the 3rd or 4th leafy stage of health zucchini plant for 24 hrs and then eliminated. Each aphid species applied to transmission test were 1, 5 and 10 individuals and with 5 plants feeding by non-acquisition aphids served as control. The results indicated 11 of 13 species of the test aphids could transmit WMV-1. They are *Aphis gossypii* Glove, *Myzus persicae* Sulzer, *Hysteroneura setariae* Thomas, *Uroleucon solidaginis* Fabricius, *Rhopalosiphum maidis* Fitch, *Semiaphis heraclei* Takaha, *Cavariella salicicola* Matsumura, *A. rumicis* Linnaeus, *Toxoptera aurantii* Boyer de Fonscolombe, *A. craccivora* Koch and *A. citricola* van der Goot. Whereas *Lipaphis erysimi* Kaltentbach and *R. padi* Linnaeus fail to transmit WMV-1. All control had no symptom expressed. When *M. persicae* and *A. gossypii* were used singly to inoculate the test plants, inoculation treatment including four different acquisition feeding periods (5, 10, 30 seconds and 1 minutes), the rate of infection were 80, 80, 40, 70 and 30, 50, 30, 60%, respectively. In

squash field, ELISA was used to detect the rate of zucchini yellow mosaic virus (ZYMV) and WMV-1 infected in the field and found that the infection rate from March to October was higher than November to February.

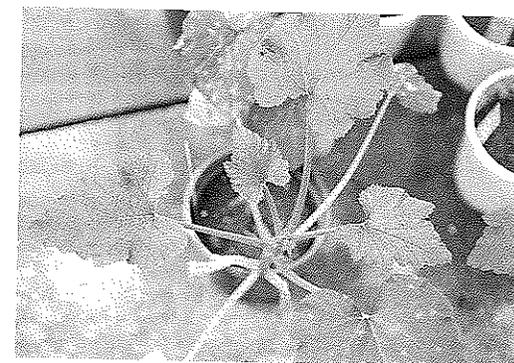


Fig.21. The symptom of watermelon mosaic virus-1.

### Occurrence of Cercospora Leafspot of Statice and Chemical Control

*Cercospora* leafspot of statice could cause a discolor round spot on leaves at early growth stage of statice, and then enlarge gradually. Later, the spot might become brown in the middle and surrounded by red-brown or orange margins. Some spots could coalesce each other to result in dryness of leaves, and the whole leaves wither when they become serious. This pathogen could produce stromata under or upon the leaf and many conidiophore and conidia would appear in it. The conidiophore always grows with 3-20 in clump. The conidia was colorless with 2-16 septa. The causal organism was affirmed *Cercospora insulana* Sacc. by ways of separation and reinoculation.

Isolation from infected leaves of statice of different regions revealed that the optimal temperature of mycelial growth was 24°C. Whereas, the maximum germination temperature was at 20°C. The occurrence of leafspot of statice could be affected by temperature. It often occurred at 16°C. Differences in susceptibility to *C. insulana* were noted on different color variants of statice. The yellow variant was the most susceptible among them. Field trials showed that 75% Daconil W. P. was the most effective chemical, followed by 25% Tilt E. C.

### Study on the Occurrence Factors of *Chilo suppressalis* of Rice in Heavily Infested Areas in Central Taiwan

Surveys revealed that ca. 4000 hectare of rice paddy in central and west Changhua prefecture had been heavily infested by rice stem borers (*Chilo suppressalis*) in the past few years, while the infestation of rice fields in other areas had been less serious. Populations of this insect pest between these two situations could vary up to 10-fold. Several environmental factors and cultural practices are responsible for this difference. In heavily infested areas, wheat and green pea had been the intercrops in the winter, and this allowed 11.8-fold rice stem borers to overwinter. The residual stalks left in the field facilitated the emergence and egg-laying of adult stem borers to attack the first rice crop. More than 85% of the

rice fields which were heavily infested had been planted with the susceptible cultivar Taichung 10 and glutinous rice. On the contrary, 80% of the lightly infested fields had been planted with the more resistant cultivars, i.e. Tainung 67, Tainung 70, Taichung 189, etc. In addition, some farmers in the heavily infested areas still reared their own rice seedlings for transplanting, resulting in the borers laying eggs in these scattered seedling beds. Farmers in lightly infested areas all received their seedlings from the supplying centers which took control measures more effectively. From the above observations, we suggested that in heavily infested areas, 1) residual rice stalks should be removed immediately and the soil should be submerged in water, 2) borer resistant cultivars should be planted, 3) only seedlings from the supply centers should be used. These measures should reduce the occurrence of the rice stem borer to the extent that less insecticide is needed for its control.

### Chemical Damage Evaluation on Application of 10% Techlofthalam Mixed with Selected Fungicides and Insecticides

Chemical damages of spraying mixture of 10% Techlofthalam with selected insecticides and fungicides at pre-booting stage in first rice crop of 1991 have been investigated. Results indicated that 10% Techlofthalam mixture with 75% Tricy-

clazole and 75% Orthene, 25% Pencycuron and 75% Orthene, 75% Tricyclazole and 55% Monocrotophos have caused leaves damage with wilting and browning symptoms on rice plants at 5 days after spraying. The rice plants treated with mixture of 45% EPN all showed yellowing in tip of the leaves. Those affected fertility rate are mixture of 10% Techlofthalam with 6.5% MAFA and 25% Pencycuron, which is 76.3 and 79.6%, respectively. While mixture of 10% Techlofthalam with 50% Padan have less effect on fertility rate. The mixture of 10% Techlofthalam with 6.5% MAFA have the greatest effect on rice yield, which is 6,030 kg/ha, while yield in check plot is 7,043 kg/ha. The mixture of 10% Techlofthalam with 25% Buprofezin have the less effect on rice yield.

In general, among the 18 treatments, the following five treatments that mixed with 10% Techlofthalam have great effects on fertility rate, 1000-grain weight and yield: 6.5% MAFA; 25% Pencycuron; 75% Tricyclazole; 22.5% Dursban; 25% Pencycuron and 75% Orthene, while 50% Fthamide, 50% Padan and 25% Buprofezin have less effects.

### Life Cycle and Control of *Appanostigma jakusuiense*

*Appanostigma jakusuiense* mainly infected top-grafting pears in lowland areas. The warm winter in 1990 favored the occurrence and spreading of *A. jaku-*

*suiense* causing great losses to Asian pears production in Li-san area. The skin of infected fruits turn into coarse structure and rusty color, eventually become rotten. The population density of larva and egg masses is quite high around fruit stalk and near the receptacle area. The aphids usually hiding inside the bark of tree trunk for overwintering after harvesting. When temperature is rising from Feb. to March, the aphids climbing up toward the scions and young fruits for multiplication. The incubation of aphids sampled from young shoot of pears indicated that the optimum temperature for larva growth is at 24-28°C. The developmental duration for larva is 7-14 days, while the adult have 21-30 days of life duration. A female lays about 46-107 eggs. The oviposition period lasts 9-15 days. The scions from highland areas often carried with the eggs and larva. Dips the scions into 400x of 80% sulfur solution before grafting could reduce the occurrence of aphids. Applies vaselin oil and grease on basal portion of stock after top-grafting could prevent the aphid moving upwards from the ground.

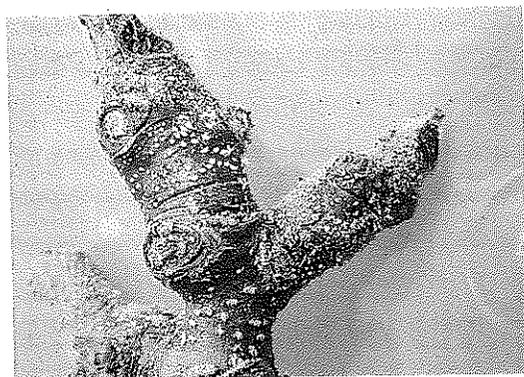


Fig.22. *Appanostigma jakusience* mainly infected top-grafting pears in lowland areas.

### The Fluctuation of Insect Pests in Snap Bean and Asparagus Bean

The Asian corn borer is the most important insect pest that infected leguminous crops, other minor insects are aphid, thrip, mite, leaf miner, cabbage worm, pod borer, green leafhopper, leaf roller and cutworm. Asian corn borer mainly affects asparagus bean, the population reaching peak stage at 90-110 days after sowing during spring-summer crop. Aphids and thrips also mainly occurred on asparagus bean, the peak period are at March~May and September~November, respectively. Leaf mite mostly found on snap bean, the peak period is at Sept.~Nov. Root and stem miners occurred on early growth stage of leguminous crops, while leaf miner occurred on later growth stage. The population of *Liriomyza trifolii* increased gradually at July, and reaching peak stage at September to November. Green leafhopper mainly attacked asparagus bean, and reaching

peak stage at September to November.

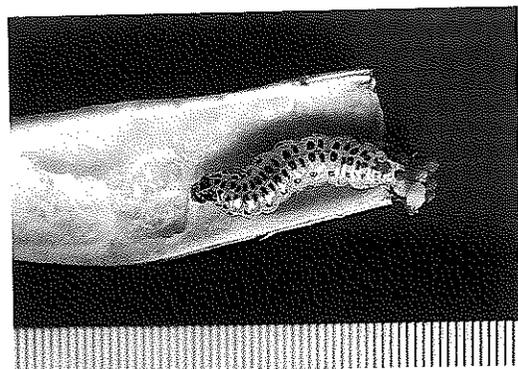


Fig.23. Pod borer is one of the important insect pest of snap bean.

### Study on Trapping Methods on *Frankliniella intonsa* of Pea

There was no significant differences between trapping number of *Frankliniella intonsa* by different colors of sticky trapping cards placing at different directions. The average trapping number of adult thrips per card of white, blue and yellow color is 8.2, 6.6 and 6.4 per week. The white and blue sticky cards attracted more larva than other colors, of which is 9.8 and 9.0. The blue water pan attracted more female and male adult thrips than those of other colors, of which is 11.0 and 13.2 per week. The trapping number of larva for white and yellow water pans is 12.6 and 12.5, respectively. The relationship of placing height and trapping number showed that both sticky cards and water pans placing on the ground surface attracted more thrips than the other positions. The yellow water pans added with detergent attracted 26.8 thrips per week, while the white water pans added

with detergent and salt attracted 47.7 thrips per week. In conclusion, the yellow, white and blue water pans added with detergent solution placing on ground surface have the best trapping ability on *F. intonsa*.

### Toxicity of some Insecticides against Larvae, Pupae and Adults of Diamondback Moth

Diamondback moth (DBM), *Plutella xylostella* L., with its high reproductive potential, short generation time and characteristics adaptive to adverse conditions, has become the most serious insect pest of cruciferous plant. There is no information available on the toxicity of currently recommended insecticides against DBM pupae and adults. Therefore, 19 commonly used insecticides were tested for their toxicity against DBM larvae, pupae and adults. Among those tested, Cartap 50% W.P. (1000-fold dilution), Phenthoate 50% E.C. (1000x), Dichlorvos 50% E.C. (1000x), Phosalone 35% E.C. (1000x), and Thiocyclam hydrogenoxalate 50% W. P. (1500x) were rather effective toward DBM adults and mortality reached 90.7% to 100% three days after treatment. Thiocyclam hydrogenoxalate 50% W. P. (1500x) was the only insecticide showing satisfactory killing effect toward DBM larvae and 94.6% mortality was obtained three days after treatment. None of the insecticides had significant effect toward pupae and the highest

mortality recorded was 57.1% for Thiocyclam hydrogenoxalate 50% W. P. (1500x). This was probably due to the cocoon which prevented the pupae from contacting the chemicals. To cope with the threat of DBM which develops resistance to insecticides rapidly, alternate use of 3 or 4 insecticides which give satisfactory control efficacy with microbial insecticide *Bacillus thuringiensis* may be a feasible strategy.



Fig.24. Adult of diamondback moth, the most serious insect pest of cruciferous crops.

## AGRICULTURAL MACHINERY

### Studies and Manufacture of a Multi-purpose Tractor and Attachment for Short-stalk Crops

This project was to set up a research group composed of researchers from four organizations : Taichung DAIS, T.A.M., National Jiayih Institute of Agriculture and Sunon Company. Then to set the objective of the tractor for the short-stalk

crops and start to develop and manufacture the tractor and attachments. During the three-year period, through the procedure of manufacturing, testing, re-manufacturing and testing again, the tractor's form changed three times. Right now, two types of the newest tractors, A type and B type, are made for different purpose. Both the A and B types machine have almost the same specifications but different engines. The A type is designed to use on experiments of testing attachments and the B type is designed to use for mounting and testing harvester machines. The A type uses a 33 HP engine and the B type uses a 28 HP engine. The other one difference between two machines is the turning system. The A type has a hydraulic four-wheel turning system, the B type also has a hydraulic four-wheel turning system but can be switched to front-wheel turning system. Other specifications are the same. The driving speed on road is 3.6 to 36 km/hr and 0.9 to 8.7 km/hr in field, both can be shifted to 6 speeds forward and 2 speeds backward. The lowest ground clearance is 25 cm, wheel distance 180 cm and wheel base 180 cm. All the front and rear wheels use 7.00-15 AG agricultural tires. The brake system is driven by hydraulic oil and there is a mechanical hand brakes system too. Only A type tractor has the front and rear three-point hitch linkage system which are driven by hydraulic

cylinders. The capacity of the front and rear hitch system are 1000 and 1200 kgs for each. There is a accessory container which can be used as a chemical tank by putting a plastic chemical bag in, this make the change of chemical very convenient.

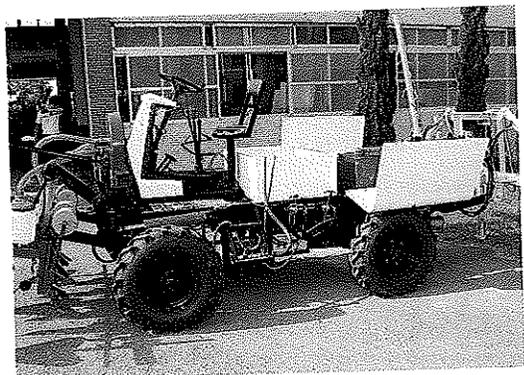


Fig. 25. The multipurpose tractor for short-stalk crops.

#### Tests for Performance and Comparisons of Compost Spreaders

A lots of unproper processed waste from agricultural production, imported grain and livestock farming cause pollution and environmental problems in Taiwan every year. Also most of the farm soil in Taiwan have pollution problems by over usage of chemical fertilizer. To utilize those agricultural waste as compost is one of the solutions of these problems. But the labor spreading compost is uneven and waste of time since the recommended quantity of compost is so large, from 2 to 20 tons per hectare. So the compost spreader is urgently needed in Taiwan under these situation.

Taichung DAIS introduced and tested a SASAKI GT-1110K compost spreader from Japan, and later the spreader was demonstrated to farmers. This spreader is towed and driven by 20-45 HP tractor. A special two parts three-point-hitch system is adopted for the spreader to minimize the turning radius to 4 in. The capacity of the spreader is 1.1 tons, spread width is 1.3 to 12 m by adjusting the PTO speed. This spreader is suitable for small farm cultivation. Some other informations of different brands of spreaders used in Taiwan were compared, those machines were STAR TMS30B from Japan and New Holland 327, GEHL MS-175, MS-309 from U.S.A.. The investigation included field operation and performance conditions of those machines. The results were analyzed and compared. The former three are rearward spreading type and the MS-309 is side spreading type. Only New Holland 327 uses vertical spreading axle, others adopt horizontal spreading axles. All of them are towed by tractor and driven by P.T.O.. The investment of the machine seems unnecessary since the spreaders got only 1-2 weeks utilization period in whole year. So, the compost spreader is much more suitable in entrusted farming system and should be strongly recommended for farm usage.



Fig.26. The Sasaki GT-1110K compost spreader.

#### Development of Multipurpose Auto-fogspraying Equipment for Protected Horticulture in Taiwan

The multipurpose auto-fogspraying equipment has a ropeway which is composed of 2 parallel cables. They are set on a level surface by 4 concret columns, dimension 14 x 14 x 350 cm, at the ends of the steel pipe facility. The surface height is 2.3 m. There are 7 steel pipe frames hang on the roof inside the facility to support the cables. The facility's span is 55 m. A 4-wheel spraying carrier, weight 15 kgs, can be driven back and forth on the ropeways by a wire. This driving wire is loop on a 13 cm diameter winch which is driving by a 110 V DC motor. The facility field, area 330m<sup>2</sup>, can be sprayed single-way in 73 seconds. The spraying volume could be adjusted by the speed of the spraying carrier and the spraying time is changed as well. The electric device has a flexible mini-programmable logic controller and several input/output elements. The functions of timing-sequence chart

and demands of input signals control the output elements and make this equipment work exactly.



Fig.27. The multipurpose auto-fog-spraying equipment is designed to use under protected facility.

## AGRICULTURAL MANAGEMENT

### Analysis on the Fertilization Habit of Rice Farmers in Taichung Area

The purpose of this study is to understand the fertilization habit of rice farmers. The data obtained from 150 randomly sampled farmers in Taichung area. It was found that most of the farmers applied N fertilizer four times while applied P or K fertilizers twice in different rice growth periods. Also, more than 50% of those farmers applied fertilizers in quantity higher than the recommended amount. In addition, most of the rice farmers obtained fertilization knowledge from experience, some others from local Farmers' Association or the agricultural improvement station. As for the main

communication channel of such knowledge was personal communication or the related professional training course.

## AGRICULTURAL EXTENSION

### Analysis of Agricultural News on Newspaper

This study was aimed to analyze the agricultural news appeared on the local newspaper in 1985-1990. During this period, the prominent change were noticed with regard to agriculture production system, structure of farmers and rural life in Taiwan since World War II. Agriculture development has been slow down, rural cultures and farmers personality has been changed greatly. The agricultural new technologies and extension activities were popularized greatly by the mass communication media. Agricultural policy was also frequently introduced in the mass media, however, less news about agricultural resources and the activities of farmers' organization was reported. The reports are mostly general news and very few less content the results of deep analysis of the concerned event. The impact of economic internationalization and liberalization to the local agricultural production and farmer's income is the hot topic of newspapers in recent days.

## RURAL LIFE

### Analysis of the Results of Demonstrative Education for Maintaining Ideal Body Weight

Thirty over-weight members of the home economic class in Taichung City and Chin-shui Township were selected to maintain ideal body weight by practicing the controlled diet and exercise. Meanwhile, blood test and interviewed were made according to a set of questionnaire. The following results were obtained. 1) In general, the body was over weighted by 26-41% and 42-57% in comparison with the ideal body weight in Taichung and Chin-shui, respectively. The urban-type women were found to be more over-weighted than the rural-type women. 2) The women with 26-41% over weight showed the most significant reduction in body weight in comparison with those with 42-57% over weight 3 months after diet control in this program. Respectively, 3.5 Kg and 3.1 Kg of the body weight were reduced 6 months after practicing the diet control in this program for the women in Taichung and Chin-shui. 3) The glucose content of the interviewer decreased after the diet control program, especially significant for those over 58% of ideal body weight. No significant differences in uric acid, total cholesterol and triglycerids contents in the bodies were observed before and after joining the diet

control program. 4) The majority of over-weight was fulltime housewives due to little amount of activity and lack of exercise. 81% of them like deep fat frying food, 24% of them like pastrier and dessert, and another 24% like noodles as their snacks. The highest eating amount was dinner which account for 48% in one day diet. The main factor of failure to reduce weight was found to be due to the lack of consistence and determination.

### A Case Survey on the Annual Home Expenditure Status of the Farm Families in Yuanlin Area

A total of 4 farm families in Yuanlin area were chosen and surveyed to find a structure of the farm family expenditure. The results indicated that one of the farm family worked for fruits production with fulltime spend more farming income(47.8%) than the other three families (17.0%, 7.0% and 18.8%). In the majority of cases, the farming income was not enough for farm family expenditures. The expenditure on diet, house repairing and installation, furniture and household equipment, medical and health care, as well as social activities, marriage and funeral were found to be rather high, while spending for entertainment and recreation were relatively low. Most farmers express their satisfaction over housing, family relationships and living conditions. However, most farmers dissatisfied with the low farming income and the increasingly polluted living environment.