

RESEARCH AND DEVELOPMENT

RICE RESEARCH

Observation on Resistance to Stem Borer (*Chilo Suppressalis*) of Newly Developed Indica Rice Lines

The characteristics of rice stem may affect the resistance to stem borer. In this study the silica content in stems and external diameter in culm of newly developed Indica rice lines which resistant to stem borer at cage and field feeding tests were analysed. The test lines had lower percentage of dead heart than that of Taichung Sen 10. Moreover, it had more number of survival pupae and lower larval survival rate of tested lines than that of Taichung Sen 10. It showed that tested lines were more resistant to stem borer than Taichung Sen 10. It were due to higher silica content at stem, larger external diameter of culm and larger length of the 3rd elongated internodes than Taichung Sen 10. All tested lines have good rice quality. The grain yield of Tai Sen 1354, 1744, 2154 and Tai Sen (waxy) 2143 were higher than that of Taichung Sen 10 and will test at provincial district yield trial from 1994 to 1995.

Rice Variety Resistance to Borers and Its Relationship to Fertilizers

Five varieties of rice, i.e., Taichung 190, Tainung 67, Hsinchu 64, Taichung

Shian 10, and Taichung Shian 1, were tested for their resistance to rice borers in the experimental field of Taichung District Agricultural Improvement Station during the 1st and 2nd crop in 1992. In terms of the extents of lateral leaf yellowing, deadheart and white-head, Taichung Shian 10 was the most susceptible variety with a damage rate between 6.9-21.0%. It was followed by Taichung Shian 1, with 3.4-13.3% damage rate. Taichung 190 was more resistant to the borers with only 0.9-7.2% damage rate. A survey of the width and thickness of the rice stem during peak tillering stage showed that Taichung Shian 1 had the widest stem averaging at 11.03 mm and Taichung Shian 1 had 9.07 mm stem width while Taichung 190 and Hsinchu 64 had only 7.28-8.15 mm stem width. Similar trend in stem thickness but with smaller difference among varieties was observed. In addition, the strength of stems of Taichung Shian 1 was the least as measured at 1208 kg; that of Taichung Shian 10 at 1323 kg. The stems of Taichung 190 and Hsinchu 64 were the strongest, with the strength measured at 1385 and 1388 kg, respectively. These results suggested that the width, thickness and strength of the stem are closely related to the insect resistance of rice varieties. Susceptible rice varieties have

wider, thicker and weaker stems. Adding slag to standard amounts of fertilizers could increase the strength of rice stem thus reducing the whitehead percentage induced by the borers. Application of high nitrogen and low potassium/phosphorus would soften the stem and caused an increase of whitehead induced by the borers.

Inheritance of Resistance to Bacterial Leaf Blight in Rice

A set of diallel crosses, parents including three resistant rice lines and two susceptible varieties, were conducted in greenhouse. F_1 of the diallel crosses and 5 parent plants were inoculated with Taiwan's isolate XF13 and XM42 of *Xanthomonas campestris* pv. *oryzae* at booting stage. The diseased lesion length of inoculated leaves were recorded at 7 and 14 days after inoculation. The diallel analysis evaluated the resistance to *X. campestris* pv. *oryzae* in five parental lines or varieties showed that significant additive effect was more important than dominant effect. The resistance to BLB of line TSWY7 was controlled by partial dominant genes and the other line TSWY1157 by partial recessive genes. Narrow-sense heritability varied from 48 to 85%.

A Model Established on the Integrated Pest Management at Regional Rice Planting Area

Due to the rice pest wasn't occurring very severe along with the shortage of agriman power in rural villages during recent years. We had adopted the wide-spectrum fungicides mixed with insecticides to control rice target pests, and to meet with the realistic integrated pest management purpose also to reduce the frequency of the chemical use as well as to set up the rice pest control model for farmers.

The result of chemical test in Taichung area indicated that single or twice pesticide application could control the pests economically and effectively. Take an example for the first rice crop, we sprayed the pesticides one time at 3-5 days before early stage of panicle initiation would increase the benefit of NT\$ 6026/ha for farmers. If sprayed twice, firstly we used 6.5% MAFA at ineffective tillering stage. Secondly, we used 75% Tricyclazole WP+25% Pencycuron WP+75% Acephate SP, could increase the average benefit by NT\$ 5,389/ha. In Changhua area, we applied 6% Cartap G 30kg/ha to control striped rice borer at the maximum tillering stage, caused only 2.8% ratio of sheath blight, but increase the average benefit of NT\$ 8,897/ha.

For the second rice crop, we applied 6.5% MAFA S 1L/ha at ineffective tillering stage, then mixed with 25%

Pencycuron WP, Stereptomycin Tetracycline WP, and Acephate SP to control the pests would increase the average benefit of NT\$ 2,373/ha.

We applied no chemical along the coastal area but for the second rice crop, only one chemical spray to control rice leaf folder and plant hopper at the booting stage when the pests reached at the economic threshold level.

Effects of Management for Soil Moisture Regime on Growth and Quality of Rice During Grain Filling Stage

The experiments were conducted in the first and second crops of 1992 to investigate the effect of soil moisture regime on the growth and quality of two rice cultivars, Taichung 189 and Taichung sen 10. Three levels of soil moisture tension were practiced by soil-drying to reach 0.00, 0.02, and 0.04 Mpa before next irrigation. The control (0.00Mpa) group was submerged continuously. Experimental results showed that the treatment plots needed 5 and 7 days without irrigation to reach 0.02 and 0.04 Mpa before next irrigation, respectively. The aim to save irrigation water was been proved. The results of yields in 0.02Mpa treatment was the highest. The milling quality, chemical properties, physical properties and eating quality of rice in 0.02 and 0.04Mpa treatments were the

same as the control. According to polynomial regression analysis, soil-drying to reach a soil moisture tension of 0.018 Mpa in the first crop and 0.027 Mpa in the second crop, respectively are recommended for management of soil moisture regime during grain filling stage.

New Japonica Rice Tai-Keng 9

A newly developed japonica rice line derived from Hokuriku 100 and Tainung sen yu 2414 was selected in the first crop season of 1985. The grain yield and pest resistance were tested from 1988 to 1991 and registered and named as Tai-Keng 9. The resistance to lodging, stripe blight, small planthopper and white-backed planthopper of TK 9 were tested in pest nursery. The performance of yield stability as good as popular variety Tainung 67 during regional yield trials over seven locations. The eating quality and stability of this elite variety are better than that of Taichung 189 which was best quality before.



Fig. 1. The rice grain of Tai-Keng 9

The International Rice Bacterial Blight Nursery in Taiwan

In order to find the rice variety resistant to bacterial blight disease (*Xanthomonas campestris* pv. *oryzae*) of which obtained from Taiwan Agricultural Research Institute, the International Rice Bacterial Blight Nursery was conducted at Taichung District Agricultural Improvement Station in Changhua. The nursery contains 366 entries which were offered by International Rice Research Institute from 1980 to 1992. The promising rice lines were selected as IR20, Cisadand, IR22082-41-2, IR54, C702015, IR35361-59-3-3-2, RP1057-187-5-3-2, and RP2151-192-1 in 1990. The testing results of 1992 showed that IR22682-41-2, IR25587-133-2-2-2, IR48787-54-1-1-1, and Ayung were resistant to this disease in greenhouse, and also in paddy field. There were 34 rice lines resistant to Taiwan's isolates of *X. camprstris* pv. *oryzae* in 1992, such as IR25587-133-2-2. In conclusion, the most resistant rice lines detected were IR22082-41-2 and IR25587-133-2-2 which might be used as resistant source to bacterial blight in rice breeding program.

RICE QUALITY

Study of Rice Quality in Taiwan

The rice quality is mainly determined by the four important factors: milling rice quality, milled rice appearance,

physicochemical properties and palatability of cooked rice. The major released japonica type rice varieties is belonged to short and round grain in shape, possessed high milling rate. The percentage of brown rice, milled rice and whole grain of those varieties is between 81%-83%, 70%-75% and 65-72%, respectively, and Hsinchu 56 have the highest milling rate. The transparency degree of japonica type of rice varieties mostly belong to 2nd or 3rd degree, the white center or white belly is ranged from 0 to 2 degree. The shape of indica type rice varieties is more variable than those of japonica's. Due to the effect of shape and chalkiness, it usually have low milling rate. The transparency degree and white belly degree of indica type of rice varieties is ranged from 1 to 5 degree and 0 to 4 degree, respectively. The physicochemical properties of indica type of rice variety is more complicated than that of japonica's, except waxy-rice, the amylose content is ranged from 10% to 30%, but in the case of japonica the variation is between 15% to 21%. Indica-type possessed all kind of gel-consistency, but japonica type all belong to soft gel-consistency. The average protein content of indica-type is 2% higher than that of japonica's. The analytic result of cooked rice quality measured by texturometer indicated that Tai-keng 9 have the highest balance index, which is 0.14, followed by Taichung 189,

Tainung 70 and Taichung sen 10, which all are 0.12, and Tainung 67 have the low index of 0.06.

Ultra-structure of Rice Grain and Cooked Rice

The starchy endosperm of rice grains is composed by parenchyma cell. The arrangement of parenchyma cell is elongated from the central region radially on cross-section view of rice grain. From the cross-section view of brown rice grain, there is no correlation in palatability performance with the openings degree of starch granules and amylose content. Ten of starch granules is packed by spherical starch plastid. The chalkiness of nonwaxy rice shown to be due to the loose packing of starch granules. In the transparent apperance region, the angular starch granules is tightly arranged in starch plastid. There is no relationship between size of starch granules and amylose content, but the smaller and evenly distributed starch granules seem to be have better palatability perfromance. The opaque region in waxy rice apperance is correlated to the hollowness of starch granules. The ultra-structure of cross-section of cooked rice indicated that the retrogradation rate of amylose is faster in the high amylose content rice variety, the cooked rice recover quickly and become ridially as in the case of rice grain.

UPLAND CROPS

Improvement on the Cultural Practices of Job's-tears

In order to promote the unit yield of job's-tear in Taiwan, the planting time, planting density, nitrogen rates, and application methods were studied. The preliminary results were summarized as follows:

The suitable seeding time of job's-tear is from the late March to late April and the most suitable seeding time is in early April. The suitable planting density for job's-tear is 40x10 cm or 50x15 cm. The nitrogen rate for job's-tear should be adjusted from 180 kg/ha to 220 kg/ha. The suggested application method of nitrogen for job's-tear is 50% as basal and 50% as grain fertilizer. Three times of grain fertilizer was applied at panicle development stage, booting stage, and full bloom stage. The equal amount of nitrogen fertilizer was used in each application time.

The Influence of Cropping Season on the Growth and Yield of Inbred and Hybrid Sorghum [*Sorghum bicolor* (L.) Moench]

Eight sorghum inbred lines and eight F₁ hybrids were grown at two locations in the fall cropping season of 1991 and spring cropping season of 1992. Several important agronomic characters were

investigated and the grain yield was evaluated to compare the performance of inbreds and hybrids between different cropping seasons. Experimental results indicated that for all traits, significant difference was observed between two cropping seasons but not between the two locations. The investigation of growth duration showed that the days from emergence to flowering were less in the fall than in the spring season. On the contrary, the total growth period and the actual grain-filling period were longer in the fall crop season. In general, the hybrids grew faster than their respective parental inbred lines. For the comparison of the means of agronomic traits, significant differences were observed between the two cropping seasons for both the inbred lines and the hybrids for all traits with the only exception of 1000-seed weight. The correlation between grain yield and growth duration was negative in the spring crop but positive in the fall crop.

VEGETABLE CROPS

Preliminary Studies on Artificial Hybridization in Asparagus Bean (*Vigna sesquipedalis*(L.) Fruw.)

This study was aimed to improve the technique of artificial hybridization for asparagus bean in order to raise the pod setting rate and obtain more hybrid seeds for screening.

Result of blooming observation showed that the flower opening of asparagus bean started at midnight and reached its peak at six to seven o'clock in the morning. The closure of flower began at about eight a.m. and most of flowers wilted after nine a.m.

Preliminary result of manual pollination indicated that the following methods should be taken if the greatest success is expected. Flowers that will open in one day should be selected for hybridization. Emasculation is taken place in the evening and pollination is done on the following morning. It is better to gather and apply pollen at six to seven a.m. Corolla must be kept well in the process of emasculation. Then put a wet cotton ball inside. The corolla is secured with adhesive tape after pollination to prevent desiccation. The female parent had better to be put in a growth chamber with a temperature of 21-24 °C and humidity 80-90% for about three days. A success rate of 22% was obtained in this study.

Chemical Weed Control in Cabbage Field

The weed control method of cabbage field is somewhat different from direct seeding vegetable field in term of timing of herbicide application. Pre- or post-emergence herbicides is applicable in transplanted vegetables, such as cabbage. The recommended herbicides for cabbage

field is all belong to pre-emergence application. The purpose of this trial is to evaluate the effect of Butisan, Pendimethalin, Lasso, Trifluralin and Mesoramil when apply pre- and post-emergence on the weed control of cabbage field. Preliminary result indicated that all treatment didn't cause any damage on the growth of cabbage plant. On the pre-emergence plots, Butisan and Pendimethalin have the best weed control percentage, which is 97 and 95%, respectively. On the post-emergence plots, Mesoramil have the best weed control percentage, which is 98%.

Effect of Planting Density on Podding Habits of Snap Bean

This experiment was conducted for the purpose of obtaining the podding habits of snap bean by planting at different densities. Three local varieties, Grey seed, TC#1 and Kentucky Wonder were compared at Ta-Tsun village during the autumn of 1992. The results of the experiment are shown below:

- 1.The number of nodes at first flowering of Grey seed was the lowest set among the three varieties. The total pod number and yield were also higher than the other two varieties.
- 2.Kentucky Wonder was the largest in term of length, width and thickness of pod, but had the lowest yield.
- 3.Using the same variety, planted at

different densities indicated that the first day of flowering from sowing, the number of nodes at first flowering and the length, width and thickness of the pods were not significantly different.

- 4.The ratio of available pods to useless pods wasn't significantly different in relationship to planting space.

In conclusion the optimum planting density for three local varieties, Grey seed, TC#1 and Kentucky Wonder is 8 plants per hill, 6 plants per hill, 2 plants per hill, respectively.

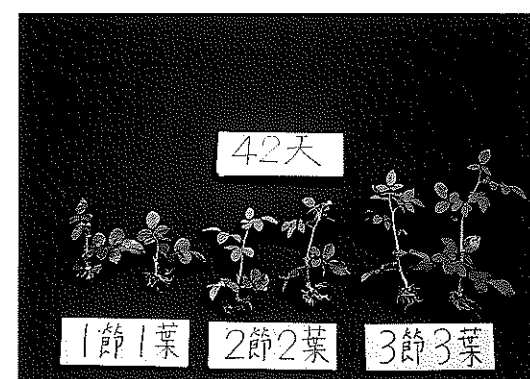


Fig. 2. The growth of common bean (*Phaseolus vulgaris* L.), Taichung No.1.

Studies on the Improvement of Tomato Varieties and Regional Yield Trial

Fusarium wilt of tomato is very serious during hot and humid condition in summer season. The introduction of heat tolerance variety is the major goal of tomato breeding program. The DAIS have been testing the tomato new lines

developed by AVRDC since 1987. The selected lines of FMTT 22 and 3 have named and registered for Taichung Asveg 4 and Hualien Asveg 5. Both are medium resistant to Fusarium wilt, high yielding and slightly cracking fruit. But the heat tolerance and Fusarium wilt tolerance properties is not yet satisfactory. We have introduced 7 Fusarium wilt resistant lines from 84 crosses of AVRDC breeding lines for regional yield trial. The check varieties is KY 301 and Taichung Asveg 4. The results indicated that the tested tomato lines have the same growth habit, heat tolerance and Fusarium wilt resistance as those of Taichung Asveg 4. Each flower cluster bearing 4-6 fruits and without fruit thinning. The fruit yield of tested lines is higher than that of KY 301, but only FMTT 277, 285 and 269 is higher than Taichung Asveg 4, the yield per 0.1 hectare is 6326kg, 6104kg and 6020kg, respectively. The increment of fruit yield is due to higher resistance to Fusarium wilt, larger fruit size, and less cracking fruit. But the fruit shoulder color of those three lines is light green to green, and have high tendency of fruit cracking, uneven distribution of fruit color that greatly affected the fruit appearance and needed to be further improved.

Effects of Shading Nets on the Growth and Development of Vegetable III. Variation of nitrate/nitrite content in the vegetable

The experiments were designed to evaluate the effects of shading nets on the growth and development of Chinese leafy vegetables. Six kinds of commercial PE shading nets such as 2SB35(silver/black, 35% shaded), R2650(black, 50% shaded), A1810(silver, 60% shaded), LS(black, 50% shaded), GB1010(green, 60% shaded) and B1010(Black, 40% shaded) were respectively hung on the hydroponic greenhouses and three kinds of Chinese leafy vegetables such as Pai-stai, leafy lettuce, and edible amaranth were grown in the hydroponic culture. The results indicated that the nitrate nitrogen content of the vegetable was reduced with the enhancement of photosynthetic activity among the shading treatments in the summer season, but on significantly responded on the nitrite nitrogen content. These significant reduction efforts were also found in treatments in LS50 on Pai-stai and edible amaranth and B1010 on Chinese leafy lettuce. Based the correlation analysis, the consumption amount of nitrate nitrogen in the nutrient was positively correlated with the increment of the yield and chlorophyll and nitrate content in the vegetable leaf. There were no significantly differences of nitrite content in tested vegetable among six

shading treatments. The nitrite content of tested vegetable was remained in 1 to 2 ppm.

Change of the Composition of the Nutrient Solution as Affected by Zeolite through the Recycling Process of Hydroponic Culture — Preliminary Report

A series experiments were designed to evaluate the filtration effects of Zeolite on the composition variation of the nutrient solution through the recycling process of hydroponic culture. Based on this preliminary studies, 99.1% of $\text{NH}_4\text{-H}$ ion was absorbed by zeolite powder under 0.1% treatment. Four kind of ion such as $\text{NH}_4\text{-H}$, K, Mg, and Mn were more significantly absorbed by the zeolite granular with 0.5 cm D than 1.0 cm D in a ratio of 200gm : 1000ml. Moreover, this positive effort was enhanced with the increase of zeolite granular added up to 500gm. It also indicated that these ion absorption and releasing effects of zeolite were started in a ratio of 50gm : 1000ml and the efforts were improved with the increase of the reaction duration. Besides, seven kinds of ion found to be absorbed by zeolite were $\text{NO}_3\text{-H}$, $\text{PO}_4\text{-P}$, $\text{MH}_4\text{-N}$, K, Mg, Mn and Na and $\text{SO}_4\text{-S}$, Cl, and Ca were released from zeolite. However, no response with the ions of Fe, B, Cu, and Zn were detected in the experiments.

FLORAL CROPS

Effect of Light Shading on Summer Cut Chrysanthemum in Taiwan

Chrysanthemum (cv. Cheng-Hong, Shin-Chung-Huang, and Ah-Lai-Feng) were cultivated in 35, 45, and 55% light shading condition from May to July. Control treatment was in open field. Horticultural characteristics were investigated.

1. Plant height: Height of three shading treatments were longer than control. Cheng-Hong variety in shading was 7-8 cm longer than control, Shin-Chung-Huang, 10-12 cm, Ah-Lai-Feng, 15-20 cm, respectively.
2. Nodes: Control of Cheng-Hong had more 3 nodes than shading treatment. The other two varieties had no difference in four treatments.
3. Flower neck of control of var. Cheng-Hong was shorter and thicker than shading flower. And the stems of control were also thicker.
4. Leaf area: There had no difference in four treatments of Cheng-Hong. Shading of Shin-Chung-Huang had more 20-30 % leaf area than control. Ah-Lai-Feng in shading had more 30-35% leaf area.
5. Water absorption and transpiration of cut flowers harvested from shading condition were higher than control. Leaves chlorosis of cut flowers of control were investigated in 5~7 days.

Shading flowers had longer vase-life.
6. Chlorophyll content of leaves from shading had more 30 % than control.

Effect of Node Position and Number on the Cutting Propagation of Rose

Rose (Var. Samantha) cutting were harvested from one-year old plants, after immersed in fungicide, treated with powder rooting reagent, and then rooted in the mist system. The results indicated that the growth of adventitious roots and sprout shoots had no difference within cuttings from different node position. In experiment of cuttings with different number of nodes, triple-node cuttings grew faster than double-node, followed by single-node cutting. Harvest time of triple-node cuttings were 4 ~ 7 days earlier than double-node. Double-node cuttings could be harvested 16 days earlier than single-node cuttings. Ratio of rooted cutting was all above 85% in three treatments which had different numbers of node.

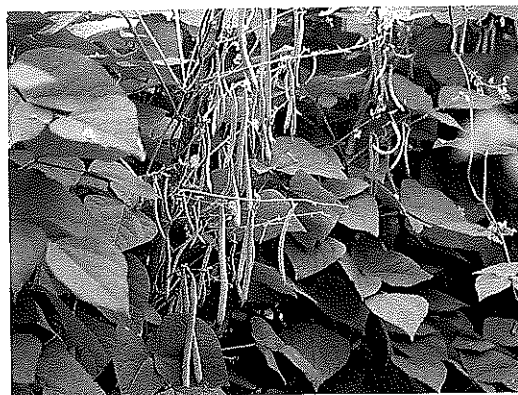


Fig. 3. Growth of rose cutting of 42-days old for the different No. of nodes.

FRUIT TREES

Effects of Apical Dominance on the Growth Habits of Temperate Pears

This experiment was aimed at evaluating the effects of apical dominance on the growth of pears and its application to the improvement of the management technique of pears. Cultivar Hsinseiki and Kosui (*Pyrus serotina* Rehd.) were the two varieties adopted as the experimental materials. Significant difference in the number of dropped leaves and partial opened buds were found among the 3 kinds of apical growth status of 1-year old Hsinseiki. The dropped leaves and partial opened buds were 5.7 and 1.9 in growing plants respectively; 7.8 and 3.3 in resumed growth plants; and 8.8 and 3.9 in ceased growth plants. Based on this results, three grafting treatments were designed for 2-years old Kosui pears: A, Kosui grafted on Niauxli (stock); B, top-grafted Niauxli on Kosui at the trunk of 180 cm high (Niauxli was also the stock); C, Kosui grafted on 8 lateral twigs of Niauxli. The ceasing of the apical growth of A was on August 30, 1993, and B and C was on September 13. In the period from July 31 to October 4, the net increment of trunk cross section of A, B, and C were 268 mm², 272 mm², and 482 mm²; and the percents of the dropped leaves were 73.3%, 76.8%, and 79.9%, respectively. By application of cyanamide on October 6, the rate of

budbreaking of A, B, and C were 58.1%, 50.8%, and 72.4%; and the percents of flower buds were 3.5%, 3.2%, and 4.2%, respectively. These results showed that C treatment possessed the advantages of higher growth rate, longer apical growth, and was helpful to the budbreaking of the 2nd crop of pear in the autumn.

Study and Investigation of Damage by Natural Disaster in Vineyard

The purpose of this study is to understand the effect of natural disaster, such as heavy rainfall, flooding and typhoon on the yield and quality of grape. The three typhoons occurred during October, 1991 to September 1992 have caused severe damage on growth and development of grape. The major damage is as follow: vineyard flooding, broken branches, fruit dropping, rotting and cracking of fruits. The flooding experiment of vineyard indicated that the degree of damage is depended on the location and different growth stages of grape tree. Flooding is affected the photosynthesis, leaf growth and fruit growth of grape tree.

Cultivation of Temperate Pear at Lowland Area

The major constrain of growing temperate pear at low elevation area in Taiwan is uneven bud emergence and dieback of flower bud. Experiment results

indicated that 1 ~ 2% of Hydrogen Cyanamide have the best effect on the enhancement of budbreaking. Apply this chemical during Jan. to Feb. on pear tree, the bud emergence rate could reaching 70%. Application of 0.5% Hydrogen Cyanamide on tree could enhance the leaf dropping, budbreaking, and the bud emergence rate is above 90%. The flower bud will complete the initiation stage at January on the following year. Treated the flower bud between January to February with Hydrogen Cyanamide to enhance the fruit setting, and the fruit is ready to harvest at July ~ August. This method will replace the topgrafted practice in pear production.



Fig. 4. Kosui pears in Taichung DAIS.

Effect of Bagging on the Fruit Growth of Kyoho Grape

The production of table grape "Kyoho" is mainly on winter season, partly due to the unacceptance of fruit bagging practice at summer season by the farmers. The fact of high temperature and high berry rotting rate of summer

fruit resulted from bagging are well-recognized by farmers. The purpose of this study is to observe the effect of bagging on the growth and ambient temperature of berry cluster. The primary bagging result indicated that at July of summer season, the internal temperature of bag is 6°C higher than that of unbagging treatment. The effect of bagging on the fruit growth and development as well as berry quality will be studied in the future.

SOIL AND FERTILIZER

Effect of Organic Manures on the Growth and Yield of Sweet Pepper

This experiment was conducted in a slate alluvial sandy loam soil in the farm of Taichung District Agricultural Improvement Station at Tatsuen, Changhua. The whole experiment consisted of the following six treatments arranged under randomized complete block design with four replications: (A) chemical fertilizers only (control); (B) hog manure compost added with microorganism; (C) chicken manure compost added with microorganism; (D) microbialized oil refuse; (E) microbialized oil refuse with rice hull; (F) microbialized oil refuse with rice straw. In treatment A, chemical fertilizers at the rates of 150-120-150kg/ha of N-P₂O₅-K₂O was applied as the common recommended way, and a pesticide, Benlate, was sprayed for three times during the whole growing

period. In the other 5 organic treatments, the amounts of manures were applied based on the same rate of 150kg/ha of nitrogen calculated in accordance with the nitrogen contents of individual manures, and three sprays of sugar-vinegar solution were applied instead of chemical pesticides.

The results showed that the plant height, fruit size, fruit number, and fruit yield in all organic treatments were all very significantly higher than that of the chemical treatment; among them the yield of the plot of chicken manure compost with microorganism increased for 77% was the highest. Apparently this very significant increases in plant growth and yield was the combined effect of organic manures and the added microorganism.

Significantly lower iron content, and very significantly lower manganese content in the fruit of organic treatments suggested that it had the tendency to lose the nutrient of iron and manganese, however as the unfavorable metallic elements, sodium and nickel were both very significantly lower and fruit size were bigger in all organic treatments, it may say the organic sweet pepper is better in quality from the view point of their nutrient safety and outside appearance.

As to the diseases, the affected plants by phytophthora blight was significantly

lower in organic treatments than in chemical treatment. The affected rate of soft rot also tended to be lower, and the virus chlorosis tended to be higher in organic treatments than in chemical treatment, but both of them were not statistically significant.

The Influence of Applying Phosphate Fertilizer on the Yield and Quality of Citrus

The study was to find out the effect of applying phosphate fertilizer on the yield and quality of citrus on Latsol. The field experiment was conducted in 1991 to 1993 at Shinsho in Taichung County. The 12 treatments of four levels of phosphate content (<200, 200-400, 400-600, >600 ppm) in original soil and three application rates (0, 300, and 600 g/plant) on P₂O₅ base were used. The randomized complete block design with three replications was adopted in the experiment.

From three-year experiment, the results indicated that the yield of citrus fruit was 75.61 kg/plant and its juice had 10.4% Brix sugar content in the combination plot of applying 600 gram phosphate fertilizer per plant when the P content level was 200-400 ppm or less than that in the original soil. If P content in soil was lower than 200 ppm and together with no applying P fertilizer, the yield was 50.3 kg/plant. However, the P content in soil was 400-600 ppm or higher

than 600 ppm, the citrus yield was 63.5 and 75.1 kg/ha, respectively. In addition, no significant difference of sugar content was found. Therefore, high yield and good quality could be expected if P content in original soil was 400-600 ppm or higher and phosphate fertilizer is not necessary to apply.

Evaluation of Chemical Indices of Potentially Available Nutrient for Compost

The mineralization potential of an organic fertilizer is referred to as its potentially available nutrient (PAN). The most efficient use of composts was to match their PAN values with the amounts of nutrients needed for the aim crops. Two corn pot experiments with different levels of composts (rice straw, chicken-sawdust, and dairy composts) were conducted to evaluate four chemical extracts (0.1 M NaOH, 1 M NaCO₃, 1M (NH₄)₂CO₃, 1 M Urea) in measuring the PAN value of composts.

Results showed that the high correlation between the amounts of N and P uptaken by corn shoot and extractable N and P was the ammonium carbonate extract. The relationship between the amounts of organic N and P extracted by ammonium carbonate and their amounts uptaken by corn shoot can be significantly described by Langmuir equation, $r^2=0.831^{**}$ for N, and 0.746^{**} for P,

respectively. Their regression equations can be employed to estimate the quantity of compost which is required for production of a crop. Therefore, ammonium carbonate extracting method can be used to evaluate the PAN value of composts.

A Study on Preparation of Composts from Used Mushroom Culture Medium

A study on the characteristics of composting processes and products was conducted by piling used mushroom culture medium with soybean oil extract waste and bone meal (A treatment), chicken dropping (B treatment), hog feces (C treatment), urea and perphosphate (D treatment), under the condition of initial carbon/nitrogen (C/N) was 30, moisture content was around 60%, piling volume was slightly more than 1 m³ (1 l x 1 w x 1 h) and turning frequency was every 10 days. The result showed that treatment A, B, C, D required 80, 20, 50, >110 days, respectively, to become matured composts with C/N ratio lower than 15. However, evaluating matured compost on the base of almost no temperature raising after turning those piles for several days, treatment A, B, C, D need around 72, 51, 58, 77 days, respectively. The maturity days of each treatment was different while judging them on different criteria, but the order of maturing speed were still the same as treatment B > C > A > D. The

result of biological test indicated that the germination percentage of cabbage seed in 1:5 (w/v) water extract solution didn't increasing with piling days and showing the unstable tendency. Then, it is difficult to be as a criterion for the treatments in assessing maturity degree. However, cabbage seed could germinated more than 70% in same water extract solution from each treatment with 70 days' piling.

The treatments could become matured composts after piling for 110 days and the products' properties are as followings: (1) pH is in the range of 7.5~8.5. (2) electrical conductivity (EC) is more than 4 ms/cm for A and B product and less than 4 ms/cm for C and D product. (3) carbon content is between 30 and 36%. (4) total nitrogen content is in the range of 2.0~2.5% and product A is the highest while product D is the lowest. (5) product B has the highest phosphorus, potassium, calcium and magnesium contents among the four products.

The result of primary test showed that the initial effect of the products on cabbage growth didn't have a positive relationship with the total nutrient content. In other words, effect of different compost treatments on the early stage of the growth of cabbage was not coincided with the order of the total nutrient content.

Study on the Improvement of Salt-Accumulated Soil

The experiment is to evaluate the improvement method for salt accumulation slate alluvial soil under protected cultivation (PE film tunnel system). Based on the salt-tolerance concept of Maas and Hoffman, the threshold salinities for non-heading Chinese cabbage (*Brassica Chinensis* L.) and leaf lettuce (*Lactuca sativa* L.), which were grown on the slate alluvial soil under protected cultivation, were 9.77 and 3.30 m⁻¹, respectively. The relative efficiency of the reclamation by five techniques used for both non-heading Chinese cabbage and leaf lettuce grown on the slate alluvial soil under protected cultivation was quite regular with their ECE in the order: 1. Removed salt accumulated soil (5 cm) and applied with 3 Mg ha⁻¹ dairy manure; 2. Deeply plowed to 50 cm below soil surface and applied with 3 Mg ha⁻¹ dairy manure; 3. Applied with 3 Mg ha⁻¹ dairy manure; 4. Covered with 5 cm paddy soil and applied with 3 Mg ha⁻¹ dairy manure; 5. Applied with 20 Mg ha⁻¹ dairy manure. The relationship of EC value of soil under protected cultivation in central Taiwan with concentration of water soluble ion is as follow: $I = 1.895 EC^{(1/5)}$ cmol L⁻¹, the unit of EC is dS m⁻¹, the correlation coefficient is $r = 0.997$.

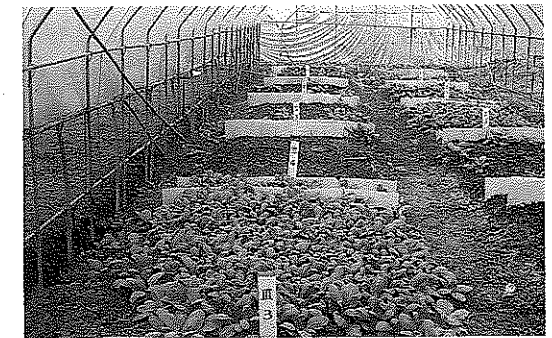


Fig. 5. Normal crop growth after improvement of soil salt accumulation under structural facility.

The Effect of Dairy Compost on Crop Production and Soil Characteristics

Field trials including rose, bitter gourd, gladiolus, and grape were conducted to study the effect of dairy compost on crop production and soil characteristics at Changhua (Teichung) and Taichung (Houlee, Waipu) counties.

The result showed that the use of dairy compost had positive effects on the improvement of soil characteristics such as the decrease of soil bulk density, soil hardness, and the increase of soil water content, pH, OM, and available phosphorus, but no difference for the exchangeable potassium and inorganic nitrogen content in soil. However, the effect of using dairy compost on soil characteristics showed only between 0~30 cm from soil profile during one cropping season. The application of dairy compost also significantly increased both yields and qualities of crops. For example,

the yield of rose, bitter gourd and gladiolus increased by 7.3%, 29.5%, and 9.6%, respectively. Therefore, it is recommended that dairy compost can be as a resource for organic fertilizer.



Fig. 6. The composting of dairy waste.

Effect of Application Rate of Hog Manure on the Growth and Yield of Spinach and Leaf Lettuce

Effects of hog manure on the growth and yield of spinach and leaf lettuce when grown on red soil and slate older alluvial soil were studied. Result of pot experiment indicated that the amount of hog manure is correlated with the growth and yield of spinach and leaf lettuce, the treatment of hog manure at 20 t/ha have the greatest increment effect. The percentage of yield increase for spinach is 113.0% and 44.9% and for leaf lettuce is 80.2% and 59.4%, while grown on red soil and slate older alluvial soil, respectively. It is recommended that hog manure is a very good organic fertilizer for field crop.

Effects of Soil Amendments on the Growth of Loquat and the Amelioration of Strong Acid Soil

Result of soil amendments experiment on strong acid soil in loquat orchard at Shinshe and Taiping, Taichung county, indicated that application of humic acid plus ammonium laureth sulfate (ALS) and gypsum have the best effect on growth, yield and fruit sugar content of loquat. Among treatments, application of humic acid 40 ml, ALS 3 ml and gypsum 5.0 kg for each plant per year have the best performance. Fruit yield increment in Shinshe and Taiping is 7.7% (2.9 kg/2 plants) and 10.8% (2.5 kg/3 plants), respectively. Application of humic acid, ammonium laureth sulfate and gypsum could improve the soil bulk density, soil hardness, soil infiltration rate, and decrease the content of iron, manganese and aluminum in the soil.

PLANT PROTECTION

Identification of Tomato Spotted Wilt-like Virus on Peanut in Taiwan

Some ring-spotted plants of peanut were collected during the fall growing season of 1992 and 1993 from central Taiwan. The disease was characterized by one or more fan-shaped light green to yellow discolored areas along the main vein, each enclosing one ring spot. The plants showed tip necrosis and dieback

symptoms in a later stage. When the diseased leaf samples were assayed on test plants by mechanical inoculation, local chlorotic lesions or ring spots were produced on *Datura stramonium*, *Phaseolus vulgaris* L. (cultivar Victor) and *Chenopodium quinoa* and necrotic spots only produced on *Nicotiana benthamiana*. Symptoms on mechanically inoculated peanut seedlings were similar to those as observed in the field. Attempts to transmit the virus, tentatively designated as TSWV-P, by methods other than mechanical means were unsuccessful. In the crude saps of infected peanut leaves negatively stained with uranyl acetate, spherical particles 75-100 nm in diameter were observed. Particles with an elliptical outline, about 60-65 nm in width and 85-120 nm in length, were also observed frequently. In ultrathin sections of infected peanut leaf, virus particles were either spherical, enveloped, 80-100 nm in diameter, or elliptical, olive-like, about 60-90 nm in width and 90-140 nm in length. Most of the particles were arranged in line or clusters with a surrounding membranous structure and were found in the cytoplasm adjacent to cell wall. In western blotting, polyclonal antisera raised against TSWV-W, TSWV-NY, TSWV-I and the peanut yellow spot virus reported from India failed to recognize TSWV-P. The results strongly suggest that TSWV-P occurring

in Taiwan has no serological relationship with TSWV-W, TSWV-NY, TSWV-I and the peanut yellow spot virus.



Fig. 7. Symptoms of tospovirus on peanut.

Investigation of Orchids Diseases

Orchidaceae is an extremely diverse group consisting of over 800 genera with at least 25000 known species. The Orchidaceae is the largest assemblage of flowering plants known to man. Cattleya, Dendrobium, Phalaenopsis, and Oncidium are major cutting flowers. Disease became dormant in the hot, moisture summers and with the advent of fall rains and splash water. The major diseases included black rot, anthracnose, southern blight, Fusarium wilt, petal blight, brown spot and soft rot. *Fusarium solani* caused by orchid is a new disease. Typical diseased symptoms on the leaves is a brown discoloration which is round or irregular in shape, more or less sunken and rather clearly defined.



Fig. 8. Soft rot of orchid.

Control of Gray Spot on Loquat

The loquat gray spot disease caused by *Pestalotia eriobryicola* in Taiwan. The pathogens could isolated from diseased leaves, bud, stem, flower and fruit. The optimum temperature for pathogen germination and hyphal growth was found to be 20-28°C. The occurrence of gray spot in loquat was found to be most serious during the period of June to October in Taiwan. This disease could be controlled by spraying chlorothalonil and carbendazim-mepconil. There are totaled of 32 hectare demonstration plot for control of gray spot at Shin-she, Kaoshin, Taipen and Taichang in 1990. The number of application of fungicide is 9 times. The period of application is concentrated on July to August. Field experiments indicated that gray spot incidence of non-treated and treated plots were 38% and 8.3%, respectively. In 1992, field experiments with non-treatment and treatment incidence of 51% and 1.5%, respectively. Increase per yield 717797

NT\$ per hectare.

Survey of the Diseases of Vegetables Under Structure in Central Taiwan

Different vegetable species, seasons, the sort of structures and managements, occurrence of different diseases and their seriousness under structure were surveyed during July 1991 to May 1992. The diseases found were *Rhizoctonia* blight, *Pythium* rot, soft rot, root knot, wilting, downy mildew, black rot, anthracnose, white rust and black spot (leaf spot). The continuous cultivation under structure favored the development of soil-borne diseases, such as *Rhizoctonia solani* and *Pythium* spp. For air-borne disease, the most serious one is downy mildew. Among 10 vegetable species surveyed, black mustard have the highest disease ratio which always results in devastating damage.

Studies on the Physical Control Methods of the Striped Flea Beetle

Sticky boards of six colors were placed in radish field to test the color preference of the striped flea beetle, *Phyllotreta striolata* (Fab.). The order of color preference of *P. striolata* was yellow > green > blue > white > red > black. Sticky card placed at a height of 25 cm from the ground trapped the largest number of adults of striped flea beetle. Radish plants were grown under green-

house conditions in pots containing soils of different textures that were innoculated with adult beetles. Significantly fewer larvae and pupae were subsequently observed in sandy soil than in silt loam and clay loam. Pot experiments showed that soaking the soil with water for 48 hr resulted in complete death of the larvae and pupae inside the soil. The occurrence of this beetle was nil during the entire growing period (25-35 days) of Pok-choi in two experiments carried out under established house conditions when the soil was soaked in water for 48 hr before sowing. A survey made in harvest time gave 0.5 to 2 adult beetles per square meter for water-soaked soil as compared with 10 to 18 adult beetles per square meter for non-soaked soil. The occurrence of other insect pests, including tomato leaf miner, *Liriomyza bryoniae* and diamond-back moth, *Plutella xylostella*, was either very low or delayed when the soil was water-soaked. To ensure continuous cultivation of vegetables under established house conditions, after removing the debris and preparing the soil and before sowing, yellow sticky board was placed in the house to attract and kill large numbers of adults of striped flea beetle, tomato leaf miner and diamond back moth to reduce the sources of insect pests. The present work has demonstrated that soaking the soil for 48 hr before sowing could effectively control

the striped flea beetles, and the production of good-quality vegetables is ensured without spraying any insecticides.

Integrated Control of *Frankliniella intonsa* and *Liriomyza bryoniae* in Pea Plant

Frankliniella intonsa and *Liriomyza bryoniae* affected pea plants at 20 days after sowing to harvesting stage. The recommended control chemicals for *F. intonsa* is 25.3% Mevinphose E.C. 500 X, 2.8% Bifenthrin and Cyhalothrin E.C. 1000 X; for *L. bryoniae* is 75% Cyromazin W.P. 6000 X. Although placing yellow sticky card and water pan at ground level could attract *F. intonsa* and *L. bryoniae*. If combine Bifenthrin and Cyromazin with yellow sticky card, sugar-vinegar solution and detergent solution will increase the control effect. The pod yield of pea plant at plots of 2.8% Bifenthrin E.C. 1000 X, 2.8% Bifenthrin E.C. 1000 X plus 75% Cyromazin W.P. 6000 X and 2.8% Bifenthrin E.C. 1000 X plus two yellow sticky cards are 1.44, 1.35 and 1.33 kg/15m², respectively. The difference is significant compare with other treatments. Application of 75% Cyromazin W.P. 6000 X plus 2.8% Bifenthrin E.C. 1000 X plus 10.9% Penconazole E.C. 4000 X at 10, 15 and 20 days intervals showed that the 10 and 15 days applicaton intervals have the best control effect. The

difference also reaching the significant level.

From the above result, we recommended that during the occurrence period of *F. intonsa* and *L. bryoniae*, application of 2.8% Bifenthrin E.C. 1000 X plus 75% Cyromazin W.P. 6000 X at 10 - 15 days interval could reach the aim of integrated control.

The Damage of Bulb Mite on Gladiolus and Lily Plants

Bulb mites can damage many corm or bulb-flower plants and other crops on roots and shoots by reducing their growth vigor. Gladiolus corm and lily bulb are the major hosts of the bulb mites. A survey of selected spots in the field showed that bulb mites invaded the bulbs or corms immediately after they were planted and by the time of harvest, the infection rate was over 90%. Treating the bulbs or corms with pesticides before planting could reduce the damage slightly, yet the infection was still common, suggesting the existence of significant numbers of bulb mites and their eggs in soils. The damage was the most serious for both gladiolus and lily plants at harvest time. Those slightly damaged showing browning of the bulb or corm near the roots. Seriously damaged plants showing rotting at the roots and the base of the scales. The occurrence of bulb mites together with diseases hastens the

rotting and the yellowing of leaves; eventually the plants dry up and die. Examination of yellowing and abnormal plants in the field revealed that 46.6% of the gladiolus and 29.3% of the lily plants had bulb mites together with disease infection. The average damage rate by bulb mites of gladiolus plants in Taichung area was 12.6%. Among the areas surveyed, the damage rate of gladiolus was the highest (17.7-21.5%) for Bei-dou and Tian-uei areas in Chang-hua and the lowest (4.5%) for Pu-li area. The average damage rate of lily plants was 6.8%. Lily plants in Bei-dou area had the highest damage rate (20.4%) and those in Pu-li area had the lowest rate (0.5%).

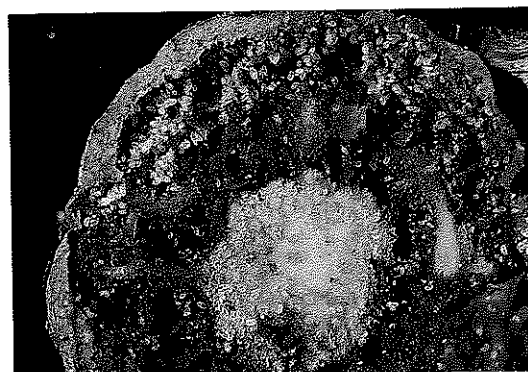


Fig. 9. Mites covering the entire damaged part.

Investigation on the Population Fluctuation and Life Cycle of the Mealy Bugs Damaging the Leguminous Vegetables

Nezara viridula, *Riptortus clenaris* and *Scotinophara lurida* are the three important mealy bug pests damaging

leguminous vegetables in central Taiwan. Among them, *N. viridula*, *R. clenaris* and *S. lurida* mainly attack asparagus bean, snap bean and vegetable soybean, respectively. Usually, their population reached its peak after podding stage and damage the bean pod by sucking the juice that always results in unfilled pod fruit. Field survey showed the population of these mealy bug increasing from mid May (flowering and podding stages) and reached its peak during June to August, then the population declined since September. When *N. viridula* was fed on asparagus bean under laboratory conditions (26-30°C), duration of the egg, larval and adult longevity were approximately 5.4, 24.9 and 21.3 days, respectively, and it took 36.5 days in average to complete one generation. The predepositing stage was about 8.2 days. A female adult deposited 67.6 eggs in average each time and their consecutively deposited 1 to 6 times with a 3 to 8 days intervals. The highest total deposited egg number for one female was observed up to 425 eggs. The duration of the egg, larval and adult longevity for *R. clenaris* were approximately 4.7, 18.7 and 34.8 days, respectively and it averaged about 58.2 days to complete one generation. Under laboratory conditions, there were 12 overlapped generations in one year.

Toxicity of Mixtures of Several Miticides with Fungicide Triforine against Kanzawa Spider Mite

While the Kanzawa spider mite, *Tetranychus kanzawai* Kishida, is a major pest, powdery mildew and black spot are the major diseases on roses. Therefore, to save labor, rose growers often tank-mix miticides with fungicides for their control. This experiment first tested in the laboratory for the effectiveness of mixtures of fungicide 18.6% Triforine E.C. (1000-fold dilution) with seven miticides and two plant nutrient supplements that were proved to be effective against the spider mites. Four mixtures with better effect were subsequently tested in the field. In terms of toxicity against Kanzawa spider mites, mixing 18.6% Triforine E.C. with the 8 pesticides did not produce any adverse effect. In the field test, mixing 18.6% Triforine E.C. (1000-fold) with 2% Abamectin E.C.(2000-fold), 25% Bromopropylate E.C. and 2.8% Bifenthrin E.C. gave excellent control rate (92% to 100%) of eggs, larvae, nymphs and adults of Kanzawa spider mites. In contrast with laboratory results, a mixture of Triforine with 20% Amitraz E.C.(800-fold) was quite ineffective against this spider mite. Thus, growers should avoid mixing these two pesticides.

Survey on the Occurrence of Insect Pests on Vegetables under Pipehouse

In terms of cultivated areas, *Ipomoea reptans* L., *Brassica chinensis* L. (Pak-choi), *B. nigra* Koch, *B. campestris* L., *Lactuca sativa* L., *B. chinensis* L. (Ching-geeng), *B. juncea* Cosson., *Amaranthus mangostanus* L., *Chrysanthemum coronarium* L., *Spinacia oleracea* L. and *Apium graveolens* L. are the most important vegetables (in that order) grown under pipehouse throughout the year in central Taiwan. Insects occurring on vegetables under pipehouse vary with species of cultivated vegetable, seasons and management inside the facilities. The major pests on individual vegetable are tobacco cutworm (*S. litura*), Kanzawa spider mite (*T. kanzawai*) in *I. reptans*, striped flea beetle (*P. striolata*), diamond-back moth (*P. xylostella*), tobacco cutworm and *Liriomyza bryoniae* in *B. campestris*; diamond-back moth and tobacco cutworm in *B. nigra*; striped flea beetle and diamond-back moth in *B. campestris* and diamond-back moth, striped flea beetle and tobacco cutworm in *B. juncea*. Pests occurring in other cultivated vegetables are fewer and their damage is always limited. Striped flea-beetle, diamond-back moth and tobacco cutworm are three major pests under facility cultivation. These pests occur throughout the year, however, the striped flea beetle reaches its

peak from October to December and from March to April during dry seasons. Diamond-back moth reaches its peak from November to the next May and tobacco cutworm always causes serious damage during October to December.

AGRICULTURAL MACHINERY

The Design and Development of a Furrow Digger and a Two-speed Belt Transmission

There are about 500 hectares of soft ginger produced in the Baogua mountain area in central part of Taiwan. These ginger farmers dig a lot of 40 cm depth and 15 cm width furrows first and then plant ginger rhizomes in the furrow. This part of digging work is all by hand and very hard thus the labor problem is very serious. To solve this problem, Taichung DAIS developed a cultivatormounted type furrow digger. This digger uses mechanism of rotary chain with digging knives and can dig about 35~40cm depth. But the machine's original ground speed is too fast, so the 8.5 hp engine power is not enough. According to power calculation result, the machine's ground speed should be lowered down 2.5~4 times. But if only change the original transmission or pulleys to lower down the whole machine's speed, it will be too slow to move on road. A new design of two-speed belt transmission set has been developed to solve the ground speed problem and to

help the machine matching its ground speed needs. This transmission set has 21 teeth solar gear, 17 teeth planet gear and 54 teeth ring gear inside to reduce speed by principle of self and around revolution. It is fully sealed and with lubrication oil fullfilled, can reduce speed about 3.6 times and is very easy to install. Take out the original pulley and replace by the transmission can make the cultivator driving on road for 1:1 speed and working in field for 1:3.6 speed. This transmission set can also use on similar field machinery.

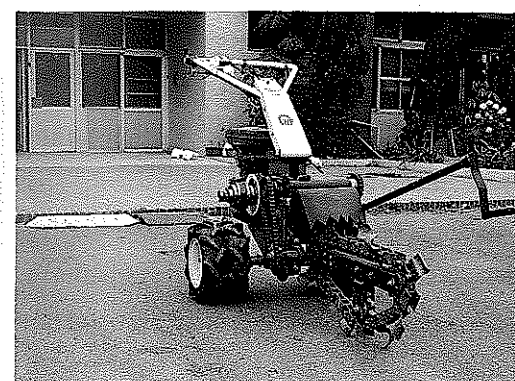


Fig. 10. Overview of the furrow digger and a two-speed belt transmission.

Storage Quality and Bud Force Relaxation Quality of Chrysanthemum Cut Flower

For the purpose of improvement the quality of chrysanthemum, this research is to explore the quality change of chrysanthemum cut flower under various amount of compression deformation and period of transportation as well as its relaxation and creeping behavior. The

information about compression effects, we can control the bud transformation and find the best packing size in practice.

The results showed that the longer chrysanthemum cut flower was in the post-harvest process, the more broken leaves it had, the shorter its flowers and leaves lasted, and smaller its blossoms were. It was also showed that the amount of broken leaves increased and the size of blossoms decreased when chrysanthemum cut flower was packed in the lower layers of packages.

The force relaxation of chrysanthemum cut flower was predicted by a Generalized Maxwell model which consisted of three parallel Maxwell elements. According to an equation of chrysanthemum cut flower force relaxation, it was predicted that in the condition of 10mm deformation, the relaxation force of chrysanthemum cut flower buds would become "0" after 15 hours.

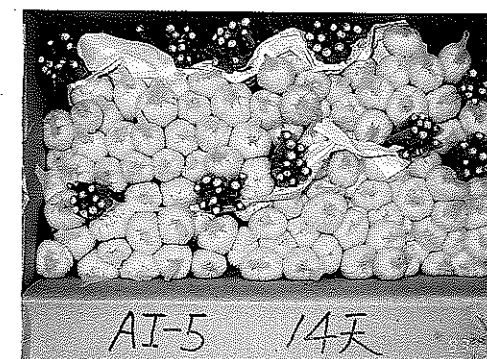


Fig. 11. Deformation of the chrysanthemum cut flower after 14 days of cold storage.

The Harvesting and Transporting Process of Grain Tank Rice Combine Harvester

The graintank rice combine harvester was imported from Japan in 1993. It was tested in the central area of Taiwan by Taichung DAIS. The harvesting grain are loaded into a 1000 liter bag or a truck and then transport to the rice drying center directly. This machine is better using in consolidated rice field to reach 0.3 ha/hr capacity, this is better than normal bagging combine. The volume of graintank is about 950 liter, it could be filled up after about 25 minutes harvesting, and then the grain could be moved from graintank to a transporting vehicle by a auger automatically in about 2.5 minutes. This harvester need two or more grain transporting vehicles when carrying distance is longer than 1 km, because the grain have to be unloaded in a carrier immediately, or the harvester will stop until the tank is empty.

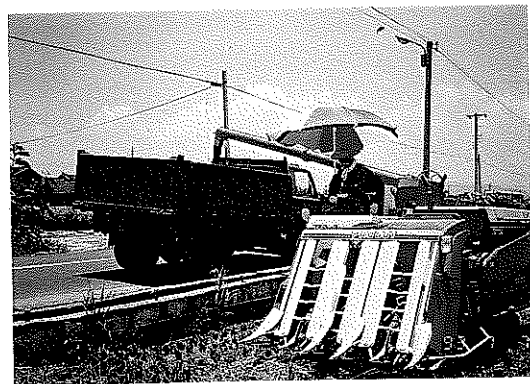


Fig. 12. Graintank rice combine harvester loading paddy rice to the truck.

Studies and Improvement of Manure Spreader on Agricultural Carrier

A Japan-made SASAKI GT-1110K manure spreader was imported by Taichung DAIS in 1991 for testing and comparing its performance with other kinds of spreaders. It was found that the mechanism of cutter blades with triangular spreading turnplates get better effects. According to this results, the research of fabricating a manure spreader in cutter/turnplate form from a 13 Hp diesel engine agricultural carrier was set up. The original carrier's cargo deck was taken out and replaced by a spreading head with manure bin. The scraper at the bottom of manure bin was intermittently driven to scrape manure backward. The spreading head contains turning cutter blades and triangular turnplates to smash and spread the manure. This experimental machine has been assembled in this year. The spreading head can be easily removed when not in use, and then replaced by a piece of backboard to change the machine into a general agricultural carrier. The carrying capacity of this spreader is about 0.8 ton(1.4 m^3), and spreading width is 6-8 m. It spends 1.6-2.6 minutes to spread for each loading. If the recommended quantity of manure application is 5 ton/ha and the spreader is in high manure output speed with 9 km/hr ground speed, the machine spends only

about 16.7 minutes to spread those manure except the time of reloading and transporting in road. This spreader works well when testing in field. But, a few defects of the spreader still need to be improved such as the slipping problem of scraping chain and the heaviness problem of the structure, etc.



Fig. 13. Overview of manure spreader on agricultural carrier.

AGRICULTURAL MANAGEMENT

Analysis on the Production Cost and Farming Income of Citrus Cultivation by Liu's Family

This study was suggested by the Agricultural Management Team of "Reducing Citrus Production Cost Project" to observe the citrus production cost and farming incomes of Liu's family in order to obtain useful information for further improvement. The owner of the studied farm, Mr. Liu, was at the age of 30. He graduated from high school and willing to work on citrus production for his future career. The farm located at the suburb of

Taichung City with total land area of 1.85 ha. The results of the study indicated that the amount of total production, gross revenue, production cost, farming profit, return to family labor and farming earn were 32,865kg, NT\$ 908,039, NT\$ 771,385, NT\$ 136,654, NT\$ 438,764 and NT\$ 493461, respectively. The analysis on the structure of production cost showed that labor cost, fertilizers and marketing cost were NT\$ 302,110, NT\$ 127,508 and NT\$ 94,620, of which they occupied about 67.96% of total production cost, the rest were around 32.04%. A study on the break-even point were found that the total production cost were NT\$ 771,385. Among them, the variable expense and fixed expense were NT\$ 318,090 and NT\$ 453,295. The sale amount of break-even point were NT\$ 697,699 and 25,253kg. The total sale of Liu's farm were higher than this break-even point to which the citrus production of Liu's farm had benefits.

An Investigation of Production-marketing Groups of Flowers and Vegetables in Taichung Area

Seven kinds of production-marketing groups, including teams of flowers and vegetables were organized by COA (Council of Agriculture) since 1993 to reduce the impact of attending GATT in future. In order to carry out the government's program of assisting farmers and

enhance the function of production-marketing groups of flowers and vegetables, a project of collecting basic data from the groups was conducted by staff of extension center of Taichung DAIS.

The result showed that 109 teams of flowers and 227 groups of vegetables in Taichung district were registered at Taichung DAIS in 1993. And among those registered groups, 81% was assisted by Farmer's Association while the other 19% was assisted by cooperative farm. However, there were overlapping of group within them.

In the aspects of the cultivated plants, farmers of flower group preferred Chinese cymbidium, lily, rose, gladiolus and baby's breath than others flower crops, while farmers of vegetables team preferred cauliflowers, co-ba, vegetable sponge, bamboo shoot, tomato, eggplant, kidney bean, watermelon, balsam pear, and cucumber than other vegetables.

As to the property of production-marketing group, only meeting place, tables and chairs are more popular than other facilities, members of a group gathered 6 times yearly at group leader's house, activity center or the meeting room of Farmers Association and they sale most of their product to consumer market.

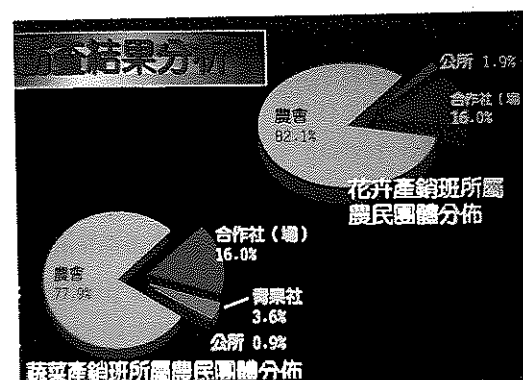


Fig. 14. Survey of flower and vegetable production-marketing groups in Taichung district.

A Case Study on Farm Management for a Joint Farming Group

The joint farming group engaged in the cut-flower production is an excellent type of enterprise organization. The purposes of this study were to analyze the characteristics of farm management and financial status in order to use as reference for guiding the agricultural production and marketing groups.

The results obtained showed that the annual management income was NT2,853,664, the ratio of management income to business receipt was 15.7%. Both the net farm income and the return to operator's capital were all equal to NT3,286,814. The rate of return on operator's capital was 60.7% and that on total capital was 35.3%. The ratios of operator's capital and of long-term capital were 46.4% and 93.8%, respectively. The rate of security on equipment investment was 29.1%, current capital ratio was 1150.3%, the

ratios of net worth to liability and of fixed assets to net worth were 86.7% and 58.7%. Turnover rates for total capital, fixed assets and operator's capital were 1.8, 8.5 and 3.4, respectively. The productivity per hectare cultivated land was NT7,381,091, the productivity of one person equivalent was NT5,712,825 and that of capital was NT1.78.

In general, the revenue for this joint farming group was high, but non-cash receipt was also high. It was excellent solvency for short-term debt although it may be just all-right for long-term debt. The liquidity position and security of finance were favorable. The recovery periods of fixed assets and operator's capital were very short although the total capital may be longer. The productivity for this business was very high.

In conclusion, several suggestions could be made as following: (1) Strengthening the collection of market information and establishing the marketing concept conducted by consumers. (2) Strengthening the management of seeds. (3) Repaying some long-term loan in order to reduce long-term liability, or adding operator's capital. (4) Farm record-keeping should be in detail so that the production cost and revenue of individual cut-flower can be analyzed and data obtained may be used for planning of the future production. (5) Training the members in the joint farming group to

analyze record-keeping data and utilize data for improvement of farm management. (6) Strengthening the program for research and development.

AGRICULTURAL EXTENSION

Survey on the Recognition Trend of the Farmers' Subsidiary Jobs' Training in Taichung District

Due to the comparative low income of the farm families and the rural-urban migration, the amount of full time farmers remaining in the village become fewer. A pioneer project namely programme of the subsidiary jobs' training for farmers and fishermen were started conducting from 1990. A total number of 1000 trainees has attended these subsidiary jobs' training courses since then. A survey was designed to make a better understanding of the recognition trend of farmers in Taichung district on these kinds of the subsidiary jobs' training. A random sampling of 30 members from each of 61 Farmers' Associations (FA's) was questioned respectively. The results were summarized as follows:

- (1) The information resources of training was obtained from the expansion of the extension agents of FA's, magazine and this questionnaire issue.
- (2) There were 45.1% of them thought to attend trainings which were organized by the public training institute and the venue closed to their village was better.

They were also preferring to obtain a training from district agricultural improvement station or FAs'(62.7%).

- (3) The training held in the off-season or leisure time was better (51.7%).
- (4) There were 62.7% of them thought to become part time farmers even if they were shifted to enjoy their secondary jobs.
- (5) The training duration arranged in 1 - 3 month was better(54.4%).
- (6) They were 54 % of them opted to get financial support from government due to they were shortage of income during the training duration.
- (7) Four training courses i.e. car repairing, home watering and electric repairing, resturant service and home decoration were popular.
- (8) The constraints of attending training of these secondary jobs were thought to be a) shortage of income, b) not acceptable in training period, c) not allowed by present job, d) far from the village.

Survey on the Living Quality and the Educational Needs for Rural Women in Taichung Area

The objective of this survey was to evaluate the responses of farm women to the home economic training courses conducted by the Farmers' Association

and as well as to their living styles and characters. The sampled farm women were interviewed by questionnaire method. Based on the Maslow's theory, five levels of living demand of human being could be catalogued as physiological needs, safety needs, belongingness & love needs, social needs, esteem needs and needs for self-actualization. The results indicated that the majority of farm women were satisfactory in the mid-level of "belongingness and love needs", and they were urgent for the "safety needs". There were no significant differences between members of home economic group and those from non-home economic group in other four levels of living demand of human being. However, those from non-home economic group were more careful on the expression of "needs for self-actulization". The locations of villages made a significant influences in the living demand. Less satisfactory responses were shown on those from rural villages. Home economic training was practically useful for the improvemnet of the demand of health and the recognition of living demand. The individual farm woman showed more interesting in attending the activities of home economic group. Those from different locations of villages showed no differences in the demand of home economic training courses.

Studies on the Adoption of New Agricultural Technology by the Trainees of Rural Youth

In order to survey the adoption of new agricultural technology by the trainees of rural youth, a total of 270 trainees receiving an one-week specialized training course in 1989-1992 were evaluated by trainee followups according to the methods such as telephone interviews and questionnaires. These training courses included eight protected horticulture classes with 209 trainees, two organic agriculture classes with 40 trainees and one floriculture class with 21 trainees. The results indicated that 13.4 % trainees (28 person) of protected horticulture class grew greenhouse vegetables in which 16 of them by hydroponic technique and the others by simple vegetable farms. It was also found that the main factor of non-adopting protected horticulture techni-

ques was the high cost of facilities. Consideration of the motivation of adopting hydroponic techniques was of industrial prospect. For the trainees worked at the protected structural vegetable farms, a marketing channel was identified as the main reason. 27.5 % trainees of organic agriculture class adopted new techniques because it is easy and practical. No space and material to making compost was considered to be the main factor by the non-adopted trainees. It is clearly indicated that 90.5 % trainees of floriculture class devoted themselves to the flower production in which only two of them adopted new floriculture techniques and the others was the Chinese orchid growers. For the motivation of growing flower, more than 50% trainees considered the industrial development in progress as the main priority reason, and then followed by the economic profits and personal interesting.