

Summary

In 2005, 71 research projects and 10 demonstration plans were conducted, 4 commissioned projects from other organizations were accepted. The results were summarized as follow:

On rice culture: HKY72 and HKY79 was submitted to attend the regional yield trail of 2006 set. The fertilizer test on breeding line HKY53、69 had shown that the highest yield was obtained on the application of nitrogen at 200 kg/ha in both lines. The panicle sprouting rate is higher in the first and second crop for Japonica type of rice. It's lower for Indica type of rice in both crops. In shattering character, most varieties are graded in middle scales for Indica and Japonica type of rice. In yield forecasting trial, the yield of TNG67 was highest and the yields were lower than the past years in every variety. In new varieties extension, the highest yield was obtained in TN11 in Hualien and Ilan area. In the research of promoting the quality of rice in the valley of Hualien, the trial of different fertilizer including organic fertilizer coupling with chemical fertilizer were tested, and the results showed that the eating quality of TK16 and KH139 were similar but TK2 and TK9 were different under different treatments. To promote organic rice production, a total of 573 and 78 hectares were grown respectively in Hualien and Ilan Counties. To enhance the production of good quality rice, a total of 920 and 2,600 hectares were guided respectively in Hualien and Ilan Counties. And two rice producing districts of good quality rice were established in Hualien.

On upland and special crops: The key works of upland and special crops including improvement of peanut, taro-like sweet potato and long-shaped yam varieties, development of green manure for landscape, development of species crops and productive estimation of energy crops are summarized as followed in this year: The two elite breeding lines of HL88-11 and HL89-02 which performed high yield potential would enter the regional trials of newly peanut lines in 2007. In the improvement for cultural practice of taro-like sweet potato, the yield performed better harvested in the 180 days after planting, high amount of fertilizer and plant spacing of 1m×0.3~0.4m performed high yield potential. The higher yield potential of the deep-plow practice in long shaped Hualien No.3 was more than the plastic-pipe practice. In the development of green manure for landscape, the niger and *Cosmos sulfureus* were introduced, and the adaptable planting period was Aug to Oct. There were 10 lines of *Ficus formosana* in antioxidant capacity was detected, and the DPPH scavenging effect of fruits was higher than stems and leaves. The yield of *Angelica* spp. in higher 800m altitude Tsukosan was higher than other areas of lower 500~600m altitude, and we have successfully develop processing products such as drinks product and the product of Dang-gui crop is good for people heath. Estimation of energy production showed that the soybean and sunflower was best adaptation in I-Lan area, but the *Brassica napus* was not adaptable. Rotation on 4 upland crops in the paddy field of Losan organic village, and the net profit of rotation on green white maize in first crop was the best.

On processing of agricultural products: The shape of the bulbils of Chinese yam (*D. oppositifolia* Thunb. cv. Hualien No. 3) is ellipsoid with average long axis 11-20 mm , short axis 10.2 mm. The average mass of particle is 1.17 g. The overall size showed that these bulbils are suitable for further processing. The results of chemical compositions analysis showed the yam bulbils enriched with nutritive materials such as zinc 0.84mg/100g, choline 19.3mg/100g, polyphenolic compounds 3130ppm, superoxide dismutase (SOD) 83.9 units/g. The bulbils are appropriate to prepare as health-promoting food for elderly people. Two type of product were developed, standing retort pouch and Sous-vide pouch. The retort pouches were sterilized with a pressurized hot water retort at step control procedure (1SP, 80 °C 0.35 kg/cm³ ; 2SP, 95 °C 0.85 kg/cm³ ; 3SP, 110 °C 1.6 kg/cm³ ; 4SP, 121 °C 1.8 kg/cm³) and sterilization conditions 121 °C 15 minute. The Sous-vide pouches were cooked with hot water at 72 °C for 120 minute and stored at -20 °C after cooking. The result of product quality investigation showed: the broken ratio of bulbils in retort pouch was slightly higher. The tenderness of meat in retort pouch was slightly tougher. The turbidity of soup in retort pouch was also slightly higher. But the overall acceptance of both products showed no significantly difference.

On vegetables: The characteristics of a new wax-gourd F1 breeding line SFW03 were described, together with two controlled varieties Green Tiger and Chifong. SFW03 possesses the following characteristics: the diameter and internal length of the main stem is 8.2, and 18.1 cm respectively. The number of branch shoot is 9.0. Both young and old leaves are palmate, with shallow splits on the margin and much hair on the surface. The length of a petiole is 15.4 cm. The length and width of a mature leaf is 20.2, and 29.7 cm respectively. The plants are vigorous growing, with a common size. The first female flower appeared on 22nd node of the main stem. The day taken from seed sowing to the first female flower blooming is 71, which mean it is a middle maturation breeding line. The ovary has a long cylinder shape, with much hair outside. There were no anthracnose, blight, virus, and *Fusarium* wilt symptoms observed. The fruit has a long bolog shape, with 65.3 cm in length, and 19.0 cm in width. The average weight is 12.4 kg. The fruit skin is little green, and covered with white wax after maturation. The flesh color is white, with a little hallow in the middle, and thickness 5.3 cm. The 2005 spring crop new variety comparison test of wild bitter gourds has the results as: variety WB36 is the best of all, with small-area production above 29 kilograms and single plant fruiting number of 251. The experiment result of summer crop wild bitter gourds at three regions this year is: Average small-area production of variety WB33 is 58.9 kilograms and the estimate production per hectare is 21.8 tons, this is much better than the comparison variety F1327 with average small-area production 23.8 kilograms and its estimate production per hectare 8.8 tons. Regional trial of nest fern new lines HA178 was the best in three areas , The mean of leafs is 24.4 , The mean length of leaf is 60.3 cm. At room temperature, the

shelf life of Usawa cane shoot was 2 days when packed in PP bags, it was 10 to 12 days when stored at 0°C. Soaking the shoot in a solution containing 0.1M citric acid and 0.1M L-ascorbic acid for 1 minute before storage could extend the shelf life of Usawa cane shoot to 14 days when stored at 0°C.

Studies on breeding of green onion, results of horticultural characteristics showed the HAF10526 new line of hybrid progeny has good performance under spring season with highest weight and longest length of blanched. Preliminary trial was also made on summer crop, the 'Futsun Lanyang No.3' showed highest yield after 3 strong typhoons. The Asian Vegetable Research and Development Center (AVRDC) developed new lines of tomato for regional trial. Tomato new variety 'Hualien Asveg 17' with resistance to late blight and 'Hualien Asveg 18' with resistance to tomato leaf curl virus (*ToLCV*) were registered in January 18, 2006. Regional trial of orange-yellow cherry tomato new lines resistance to tomato leaf curl virus was made, yield of CHT1417 was better than the other new lines. Another regional trial of tomato new lines with resistance to late blight and tomato leaf curl virus was also made, the FMTT1047 showed highest yield.

On flower crops: To create new lily varieties, nine superior hybrid lines of lily were selected, which includes FLME1-22 etc. Flower characteristics were measured at the flowering time, and line FLME1-32 was the earliest flowering one. Eight lily varieties were introduced from Holland to investigate their potential for exporting. Comparison between the bare-land and boxed cultivation were conducted. It showed that boxed cultivation method got a better quality. Flowers of the variety Yelloween (O/T) had been exported to two Japanese auctions, and the price from Hiroshima central auction was higher than that of another auction. In Taiwan, the price from Taipei auction was the highest one. The best period for exporting lily to Japanese markets is between December and April. Three lavender varieties were cut at different growing stages after planted to the soil. It showed that the essential oil content was gradually increased accompany with the growing stage. However, there was a little different between varieties. The highest essential oil content was got from the variety Devantville lavender. The differences of essential oil composition among varieties were analyzed and compared by using GC-MS. The potential of year-round production of small potted plants was investigated, and three aquatic plant species was compared, which includes Giant bacopa (*Bacopa lanigera*), needle-leaf ludwigia (*Ludwigia arcuata*), and water clover (*Marsilea crenata*). The results indicated that both apical and intermediate shoots are suitable cutting types. Those cultivated in April and September recovered apparently fast. The cutting from shoot apexes to become salable needs 3 to 6 days. Ludwigia cultivated during July and September needs only one week to become salable. The survival rates of giant bacopa, needle-leaf ludwigia and water clover in every month were 100% except water clover grew in January to March-that were less than 50%. The cutting

survival rate of *Salix* varieties were over 85%, only 1 variety was low. Plant height of Cat-tail Willow clones were between 130.50cm and 222.50 cm, the branches of Cat-tail Willow clones were between 2.0 branches and 7.67 branches. The results of the post harvested experiment showed that high temperature (30, 25) treatments, the quality of Cat-tail Willow, ex. injury grade and flower buds falling-off ratio, were worse than 20 and room temperature treatments, and there were no effects in flower bud-scales color and flower bud-scales falling-off ratio. 11 new varieties of flower-quinone were introduced in 2005. Among the 23 new varieties, the growth of KABATYOJU, JUNIHITOE, BENIGOROMO and MANGEKYO are more vigorous. Anthesis of which mostly concentrates between October and May to next year. KABATYOJU's anthesis is the longest, covering whole year. Got seeds of 6 varieties in which; germination percentage ranges between 18%~74%. In terms of survival rate of preliminary cutting, TANCHOBENI is the highest, 54%. The germination percentage of seeding test of *Farfugium japonicum* (L.) Kitam is the best in January. The survival rate of *Aster indicus* L. in cutting medium testing can reach 95~100% in all seasons. As to cutting medium testing of *Goodyera procera* (Ker) Hook, the highest survival rate is in October and January; sand is the best cutting medium; terminal buds are the preferred cottage.

On fruit tree: Twelve citrus cultivars/lines, including 'Nankan No. 20' and others were evaluated for their adaptation to I-Lan area. All tested plants bloomed between early to late March. The cultivar 'Kiyomi tangor' and 'Dream Navel' had the highest fruit weight with 521.2 and 452.5 grams, 'Shinjin No.3' and 'Nankan No. 20' were the two cultivars that matured earlier. 'P158-2' had highest soluble solid content of 12.7 degree Brix, and 'Murcott' had 11.6 degree Brix. These cultivars/lines are regarded to have the potential for cultivation in this area. The optimal new variety of citrus in Hualien area was 'Minneola tangelo', the highest small fruit number of 'Minneola tangelo' was grafted on stock Citrumelo, but it is not significantly different in the effect of stock on plant growth situation.

The virus-free healthy kumquat line 'HF-1-3', 'HF-1-5', 'HF-1-9', 'HF-1-10' and 'HF-1-15' were good for the characters of fruit size and product. The stock pomelo and Sunki had the largest fruit size of 16.6 grams, stock Rangpur lime had the largest product of 5.2 kilograms. The healthy kumquat line 'HF-91-2-52' and 'HF-91-2-6' was good for the highest shoot number of 5.8, kumquat line 'HF-91-2-52' had the largest fruit number with 55 fruits. 27.12% Tribasic copper sulfate SC was significantly controlled the occurrence of Phytophthora disease of kumquat ($p=0.05$) in field test of three times. 50% Dimethomorph WP, 80% Fosetyl-Al WG and 58% Mancozeb + Metalaxyl WP were effectively controlled the occurrence of Phytophthora diseases of kumquat (significance, $p=0.05$) in field test of two times.

Buds of four cultivars/lines of wax apple were collected and top-grafted onto 4-year old stocks. Among them, the 'Feng-Shan No. 73-1' had the largest fruit size of 209.2 grams. With respect to

fruit sugar content, the 'A-Tu Large' had the highest of 10.7 and 13.1 degree Brix in the upper and lower half of its fruit and is highly recommended for cultivation. The growth situation of abiu in Hualien area depended on the characters of different variety of abiu. The shelf life of pitaya that stored at room temperature was 10 days, the deterioration was wild and decay. Utilizing PP plastic bag and 5 °C stored temperature could extend the shelf life to 28 days. Effect of different PP plastic bag thickness on the shelf life of red dragon ball stored at 5 °C was not significantly.

On biotechnology: To develop the detected technique of the seeds and seedlings of genetically modified (GM) papaya, the Seed Improvement and Propagation Station designed and supplied five steps blind samples tests. The primers, CPMO, 35S829, PAPA215, GUS861 and so on, were designed according to the gene sequence in the NCBI database. The results revealed that GM and non-GM papaya could be distinguished by the PCR assays. The 1% GM powder samples also were detected by the 35829 primer and the fragments of CaMV 35S promoter were amplified in the PCR assays. The LA2 and LG41 lilies callus lines were transferred gene into lilies' callus by particle bombardment method. The brown proportions transferred with DFR1AGUS plasmid were highest than other constructions. The brown proportions transferred with CHIAGFP plasmid were lowest than other constructions. The transient callus were continue to induce plantlets on the selection medium. Some regenerated plantlets expressed the GUS gene. When the capsules ages of *Spathoglottis plicata* were 25-30 days and the capsules age of ribbon grass was 20 days, the embryo germination percentages were better than other capsules ages. If the 1/2MSPMP or OWRS medium were used as germination medium, the embryo germination percentages were also better than other medium. It could reduce the subculture frequency when the OWRS medium was used as subculture medium. It could obtain more adventitious shoot when the *Spathoglottis plicata* explants cultured on the OWRS medium with high concentration of BA and low concentration of NAA. Runners of Boston fern are good tissue cultural materials. The fittest salt strength of tissue culture medium is between 1/2MS and 1/4MS. In these conditions, the shoot forming, shoot height, and leaves number of explants were expressed well, and there were no vitrification. Low concentration of BA would induce shoot formation. Between 0.5 and 1 ppm of BA concentrations were the best for proliferation of Boston fern explants.

On plant protection: The organic cultivation in crops, non-chemicals controlling and biological pesticides preparation, agricultural extension and safety using of chemicals in crops were conducted in this year. Besides, we also set up the detection, and monitoring system of plant epidemic to enhance pest control efficacy and produce quality, so as to guaranty the health of the consumer and protect the agricultural environments. The citrus canker and black spot of pomelo was not found in field. The adults of *Bemisia argentifolii* were highly sensitive to Abamatic and Imidacropid. The culturing tunnel made of transparent plastic film or ultra-violet light absorbent plastic film was

effective on delaying or reducing the incidences of grey mold on strawberry. *Bacillus amyloliquefaciens* B190 mixed with adjuvants effectively controlled powder mildew of muskmelon and gray leaf spot of tomato in bioassay trials. The highest effect for controlling the Pythophthora disease of tomato and sweet pepper were found in the treatment which mixed with castor cake (60:1) or tobacco cake (70:1), and the isolates of PBCAB and C2-6-60 were proved to be the best. There was no adverse effect on scion of pear when dipped with 1000 ppm of pyriproxyfen. The detection of *Cacopsylla chinensis* on topgrafting pear at Yilan area showed that Yilan is still free of *Cacopsylla chinensis*. The damping off on spinach seedlings was effectively controlled by seed coating with 75% Mepromil WP (2g/kg seed). The nursing soil amended with castor cake (1%,w/w) showed the effect on reducing the incidences of damping off and root-knot nematode on cucumber. The insecticide 19.7% Tebufenozide (500ppm) controlled beet armyworm effectively. Alternate spraying of 10.3% *Bacillus thuringiensis* (1000ppm) and 19.7% Tubufenozide effectively controlled beet armyworm in the field. The leaf blight on leek was predicted well and controlled by application of Azoxystrobin and phosphorous acid. There was no significant control effect on rice water weevil by weekly spray 3×10^7 spores/ml of *Beauveria bassiana* on rice in the field. On the contrary, the control rate of wentan pomelo weevil was 86.7% and 100% by spraying 3×10^7 spores/ml of weevil strain and leaf beetle strain of *Beauveria bassiana*, respectively.

The density of oriental fruit fly and damage ratio was lowered by whole area controlling scheme this year in Yilan area. As a result, the density of beet armyworm of green onion was also reduced by 50%. The population of Brumese mouse and wild mouse were surveyed before and after baiting, the controlling rate reached 66.7%. In order to control rice pest at suitable time and monitor plant epidemic, the plant pest forecasts were issued 12 times, and the pest warning report and meteorological information were issued 12 and 36 times, respectively. The survey points for quarantine harmful insect have been set, results indicated that there was no quarantine pest in Hualien area. More than 10 samples of suspected red imported fire ant were identified and control guidance was recommended. 319 cases of diagnosis and prescription were conducted among 50 kinds of crops. 103 groups using of GAP mark in Hualien and Yilan were assisted.

Soil and fertilizer: In the study of applying bio-fertilizer on organic farming of vegetables, the results indicated that it got the highest yield 52,563 kg per hectare of cucumber when treated with powder of soybean cake (N : P₂O₅ : K₂O=3.4 : 1.5 : 1.3%)17,650 kg/ha, the highest yield 11,256 kg/ha of sweet pepper when treated with bio-fertilizer 15,800 kg/ha of rice hull compost (N : P₂O₅ : K₂O = 1.9 : 4.0 : 2.4 %). In the study of pseudo-composted rice hull medium and hydroponics technique, the preliminary results showed that: 1. Both the yield and quality of tomato will be promoted by increasing the potassium concentration and its effect of spring cropping is better than autumn crop 2. The pseudo-composted rice hull is merit extension to the protected

culture, because the two year pseudo-composted rice hull is same as the other culture medium on water supply ability to crop. In the research on the medium and compost for horticultural crops, the fractionation of water-soluble and exchangeable potassium, calcium and magnesium in the rice hull compost showed the highest level at four month age. The compost application rate could be reduced by band application. In the study of developing technique of vegetable growing under strong wind and heavy rain, the results indicated that soil redox-potential of the treatment adding 20 tons/ha rice hull and having 40 cm furrow deep could recover to 300 mV in eight hours after drainage, that is, could avoid the flooding injury. In 2005, there were 2,219 samples of soil and plant tissues were analyzed, including 908 samples of plant tissue, 1,048 samples of soil, and 263 samples of organic materials. Those data were used to make recommendation of soil fertility and plant nutrition for farmers.

On agricultural machine: Agricultural machine development and improvement: There are three potions with agricultural machine development in HDAIS agricultural office. In the farmland machine, the scallion transplanting and holing machine has been developed. This machine was used the wheel part of the cultivator. And its depth can be adjusted to match the different ridge. The holing machine combines the limit switch, a head of liquid, solenoid valve and liquid hose. It was designed application from 800mm ridge width, 150mm holing depth and 25mm diameter. It can hole four holes one circle. In the process machine of wentan pomelo fruit, it improves the peeling process. And the air compressor is used to the automatic entry the wentan pomelo fruit. It used the wentan pomelo fruit that has been planted 18 years. In the mold development of vegetable seeding machine, it includes seed case, seed case cover, seed channel, seed box, seed box cover, wheel, fixed frame, chain cover, free adjusted keep, and three kinds seed discs. The seed disc includes Water Convolvulus, Spinach, and Radish seed disc. The vegetable seeding machine can be used very convenience and popularization with different machines carrying.