

AGRICULTURAL SCIENCES

ASD No. 1

GROWTH PERFORMANCE AND YIELD OF SELECTED STRAIN (GIFT) NILE TILAPIA (*OREOCHROMIS NILOTICUS* L.) IN LOWLAND IRRIGATED RICEFIELDS INTEGRATED WITH AZOLLA AND MALLARD DUCK

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Nile tilapia (*Oreochromis niloticus* L.) is commonly cultured in the Philippines and has high consumer acceptability. Different Nile tilapia strains exist in the country and the genetically improved farmed tilapia (GIFT) selected strain is widely cultured at present. The pond performance of this strain is well documented but there is a lack of information on its performance in a well-managed lowland irrigated integrated rice-fish culture. Hence, our study evaluated the growth performance and yield of the selected GIFT strain in integrated rice-fish culture with (+) and without (-) herbicide and molluscicide (HM), azolla and duck.

Five treatments: conventional rice-fish culture (RFHM), rice-fish (RF), rice-fish-azolla (RFA), rice-fish-duck (RFD) and rice-fish-azolla-duck (RFAD) were conducted in fifteen 300-m² plots with fish refuge in three cropping seasons. All treatments except RFHM were not applied with HM. GIFT strain Nile tilapia (density and weight: 10,000 fingerlings ha⁻¹ and 13-17 g, respectively) was cultured for 83 days. Mallard ducks (400 ha⁻¹) were housed over the refuge while azolla served as in situ food for Nile tilapia. Treatment effects: HM, azolla and duck and the interaction of azolla and duck on growth and yield were analyzed.

After 83 days, the specific growth rate (SGR) of Nile tilapia in the treatment -HM was 33% higher than in the treatments +HM ($P < 0.0001$) due to the strong effect of azolla and ducks based on three trials. Mean SGR from

treatments +azolla was 21% higher than -azolla whereas treatments +ducks was 83% higher than -ducks ($P < 0.0001$). Nile tilapia yield in the conventional rice-fish culture was 195 kg ha⁻¹ and increased by 33% +azolla; 1.9 times +ducks; and 2.2 times +azolla and duck ($P < 0.0001$). These findings demonstrated that growth and yield of GIFT strain Nile tilapia in the conventional rice-fish system can be significantly increased by integration with azolla and duck and without the use of herbicide and molluscicide.

Keywords: Nile tilapia, rice-cum-fish culture, azolla, mallard duck, natural resources management

ASD No. 2

**GEOGRAPHICAL DISTRIBUTION AND FREQUENCY
OF ALBUMIN, TRANSFERRIN, AND α -2 MICROGLOBULIN
ALLELES AMONG ANGLO NUBIAN, NATIVE
GOATS AND THEIR F₁ CROSSES**

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This paper reports the geographical distribution and the frequency of albumin (*Alb*), transferrin (*Tf*), and alpha 2 - microglobulin (*S2 α*) alleles among the Anglo Nubian, Native goats and their F₁ crosses in Luzon Island, Philippines. The blood serum protein polymorphisms were obtained from heparanized blood samples of 718 goats from 32 farms in 18 provinces using the using vertical polyacrylamide gel electrophoresis (PAGE).

The frequency of *Alb*-A and *Tf*-A alleles was similar in the Anglo Nubian, Native goats and F₁ crosses, ranging from 62 to 66%. The *S2 α* -A alleles however, were highest in the Anglo Nubian (72%) than the Native (67%) and F₁ crosses (62%). Native goats particularly adapted to the local subsistence level of management and environmental conditions and which have the largest number and highest density of goat populations in the country, represent a unique reservoir of genetic resources for their continuous genetic improvement. A high degree of similarity is found among Native goats in farms/

provinces along routes accessible to large and popular public auction markets such as in Padre Garcia, Batangas and Urdaneta City, Pangasinan. Our data revealed a pattern of introgression of imported Anglo Nubian alleles in local programs to upgrade the Native goats in the countryside, probably originating from Department of Agriculture Regional Field Units (DA-RFUs) and/or institutional herds of major state colleges and universities. Analysis of the geographical distribution of blood protein alleles provided a clear picture and importance of Anglo Nubian introgression in strategically located goat breeding/dispersal centers to rapidly create and expand hybrid zones in an outward direction. Marketing routes, phenotypic preferences by goat farmers, adaptation to specific habitats and to production and management conditions are the main factors explaining the current distribution of various blood protein alleles of goats in the island of Luzon.

Keywords: Albumin, alpha 2-microglobulin, Anglo Nubian, transferrin, F₁ cross, Native goats

ASD No. 3

SUBSEQUENT EFFECTS OF INTRARUMINAL SOLUBLE GLASS BOLUS ON PLASMA CALCIUM, PHOSPHORUS AND MAGNESIUM CONTENT OF GRAZING DOES UNDER BACKYARD CONDITIONS IN SELECTED AREAS IN NUEVA ECILJA, PHILIPPINES

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The effects of intra-ruminal administration of soluble glass bolus (SGB) containing selenium (Se), copper (Cu) and cobalt (Co) on the blood mineral content was determined among 60 grazing upgraded goats raised under backyard condition. The animals were fed only with available feed resources within the paddy field and mango orchard. The subsequent effects of SGB supplementation on plasma Ca, P, and Mg were determined for 12 months. Plasma mineral concentrations were determined using Inductively Coupled Plasma

Spectrophotometer (ICPS) after wet ashing with nitric acid.

SGB administration did not affect the Ca, P, and Mg contents in the blood. Except for the marked increase in the plasma Mg level of animals in the control group during the early stage of the trial, there was no clear indication of monthly variations in plasma mineral concentrations among animals with or without the bolus supplementation. Results also revealed that plasma Ca concentrations of the animals appeared to be more stable than P and Mg. On the other hand, plasma Ca concentration showed seasonal variation. The plasma P concentrations for both groups were significantly lower during the rainy season than during the dry season.

The normal plasma Ca, P, and Mg concentration suggests that the available feed resources under a typical rice-based and mango orchard farming conditions could provide adequate amount of these essential elements to support gestation and lactation. Hence, Ca, P or Mg imbalance is unlikely to happen even without SGB supplementation.

Keywords: soluble glass bolus, plasma minerals, goals

ASD No. 4

WATER QUALITY ANALYSIS AND UTILIZATION OF SMALL FARM RESERVOIRS (SFRs) FOR AQUACULTURE IN REGION III

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This research project was conducted to improve aquaculture production in Region III through water quality analyses and utilization of small farm reservoirs (SFRs) for sustainable community development.

A total of 23 farmer-cooperators (FCs) from various municipalities of the region were involved in the study after seminar-orientation. Two different culture systems, extensive (GMT) and semi-intensive (GMT, GIFT and FAC Selected Lines) randomly assigned were tested using the genetically improved strains of *Oreochromis niloticus* (Nile tilapia). Growth monitoring is done every month and

water analysis is bi-monthly or weekly if necessary while pesticide residue and metal detection were performed prior to each culture system.

In phase I, results showed that most SFRs have water pH within the ideal range for fish culture while DO and BOD were at tolerable levels. Phosphate values are less than 200 ppm while two sites gave higher than the allowable values but corrective measures were done at once. Abucay, Bataan and Talugtug, Nueva Ecija showed positive results for Organophosphorous using Rapid Field Kit (RFK) however, Gas Chromatographic analysis confirmed the presence of the same for Talugtug, Nueva Ecija. Step-wise regression model identified percentage recovery related to phosphate and sodium as the main contributors, but phosphate as the lone predictor of average body weight (ABW) and average growth rate (AGR).

Phase II revealed that total ammonia level remained below the safe level while heavy metals, Cu and Hg were minimal and within the tolerable limit set by USFDA. No detectable residue was detected for both analyses for pesticide residue. Copper, predator, fish strain, mercury, BOD, hardness, DO and potassium ion were predictors of percentage recovery using the same regression model. Further, predator and strain as predictor of ABW while strain was the lone predictor variable of AGR.

Both type of culture systems exhibited high percentage recovery though lower fish density than the carrying capacity resulted to better growth rate and fish average body weight (ABW). Combination of rain, deep well and natural spring as sources of water is beneficial to tilapia and water exchange of at least 2-3 times every culture period yielded better harvest. Generally, SFRs water in the region is classified hard and relatively safe, an indication of its suitability for fish culture.

Keywords: water quality, SFRs, reservoirs, small farm reservoirs, aquaculture

ASD No. 5

**CONTROLLED-RELEASE FERTILIZER (CRF) FOR
LAHARAFFECTED AND COARSE-TEXTURED
AGRICULTURAL SOILS**

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Pyroclastic deposits emitted by Mt. Pinatubo in 1991 are currently being utilized as a medium for crop production, however, since lahar deposits are considered marginal due to poor physico-chemical properties, low yield, high input requirement and high nutrient losses became a consequence. Production and testing therefore of a new fertilizer material suitable to overcome nutrient losses resulting from the coarse textured characteristics of the deposits were undertaken. Specifically, it aimed to determine the physical and chemical properties of coarse textured soil and lahar deposits, determine the release pattern and percent release of fertilizer nutrients from controlled release fertilizers (CRF), measure crops response to controlled release fertilizer and evaluate/identify advantages and constraints to CRF usage in both coarse textured soil and lahar deposit.

The depth of lahar deposition ranged from 60 cm to more than 150 cm. Soil texture is mostly sandy clay loam with low water holding capacities and low available water (3.53 – 22.7%). Soil temperature can also go as high as 65 to 70°C during summer months. The deposits are strongly (pH 4.35) to slightly acidic (pH 6.7) with very low total N, adequate P and highly variable amount of exchangeable K ranging from deficient to adequate. Sulfur content is high which poses H₂S toxicity particularly to more sensitive crops such as rice and mungbean. Since lahar soil texture is mostly sandy clay loam, rapid percolation of water and leaching of nutrient particularly nitrogen and potassium are highly possible.

Using soil medium, the formulation released all its N content under submerged condition at 45 DAI. Not all the N in complete fertilizer was released

in lahar deposit under submerged condition even beyond 85 DAI.

Phosphorus and potassium remaining in coated complete fertilizer though did not reach zero level, was much lower in submerged compared to upland condition at 65 DAI. A slower rate of K₂O release was observed in mineral media compared to pure water.

In the case of muriate of potash, a linear behavior of K released exist both under upland and submerged condition.

Using CRF in onion, NPK application was reduced to only half of the rate using conventional fertilizers (COF). Full substitution by CRF outyield plants applied with either full COF, partially substituted COF or those applied in combination with organic fertilizer.

Addition of organic fertilizer at the rate of 4.5 tons per hectare together with full COF did not show any positive effect on the growth and yield of onion as compared to those applied with full CRF during the first trial.

Generally, onion applied with 4.5 tons/ha + CRF had higher N and K uptake than the COF treated plants. In the same manner tomato had higher N uptake when fertilized with CRF. The rest of the fertilized plants had comparable NPK uptake.

Keywords: lahar, controlled-release fertilizer, organic fertilizer, organic fertilizer

ASD No. 6

FLY ASH FOR AMELIORATING ACID SOILS AND INCREASING CROP YIELD

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Fly ash is a residue of coal burning in thermal power stations. This waste product has been found to be useful in agriculture in modification of soil bulk density, improvement of water holding capacity of soil, optimization of soil pH, improvement in crop yield, as source of micronutrient supplement to soil and creation of conducive condition for better plant growth (Fly Ash Mission,

1998).

The potential of utilizing fly ash to ameliorate acid soils was evaluated in San Ildefonso, Bulacan. Fly ash was compared with other soil ameliorants such as rice hull ash, compost and spent absorbent. Pot and field experiments were conducted to compare the ameliorating property of the different amendments.

In pot experiment, result showed that fly ash is as effective as the other amendments as shown by increased plant survival and yield particularly at an application rate of 60 t/ha. Soil pH was increased by 2 to 2.5 pH units from 4.8 to 6 and 6.5.

In field experiments, application of fly ash at 10t/ha increased the yield of pak-choi by 245% or from 5.25 to 18.3 t/ha. The increase in yield was attributed to greater availability of nutrients brought about by an increase in pH from 4.8 to 5.8.

Lower yields of pak-choi were produced from application of rice hull ash (15.91 t/ha) and compost (11.98 t/ha).

Keywords: fly ash, soil amelioration, pak-choi

ASD No. 7a

**EFFECTS OF MULCHING MATERIALS AS A COMPONENT
OF AN INTEGRATED PEST MANAGEMENT (IPM)
STRATEGY FOR THE CONTROL OF TWO MAJOR
INSECT PESTS OF OKRA (*Abelmoschus esculentus* Linn.)**

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In growing high value vegetable crops, farmers control insect pests by using a very potent systemic insecticide sprayed in large dosages. This threatens both the farmer and his environment. Thus, this study aims to develop an economical and environmentally sound IPM strategy to control two major insect pests of okra, namely: the cotton leafhoppers (*Amrasca biguttula* Ishida) and the melon aphids (*Aphis gossypii* Glover).

Silver plastic mulch gave the lowest mean insect population, lowest mean damage ratings, tallest plants, and high yield consequently obtaining the highest gross income. However, rice straw mulch gave the highest return on investment due to its low cost. If silver plastic mulch were to be made durable enough that it may be re-used then its high investment cost would inevitably be outweighed by the benefits it offers. Another possibility of compensating its high cost would be to use silver plastic mulch where ratooning is involved. Based on the results of the study however, rice straw mulch would be the most recommended mulch.

Since a minimum dose (20 ml) of the insecticide showed no significant differences with the higher dosages used, the combination of rice straw mulch and Fipronil at 1000 a.i. per hectare is recommended.

Keywords: mulching, integrated pest management, IPM, okra

ASD No. 7b

MECHANIZING THE PROCESSES IN DEVELOPING BIOBASED FARM INPUTS

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Rice and rice-based farming system in the Philippines are becoming cost-intensive due to increasing cost off-farm and non-renewable inputs. Indigenous materials in the farm and household that are sustainable should be recovered from a biobased system of developing ecological farm inputs.

PhilRice has developed a system in converting (physical, thermal & biological) indigenous materials from farm biomass and biodegradable household wastes. Physically, a drum-type manually operated chopper/mixer-cum composter was developed for a cluster of households. Also a convertible thresher-shredder/chopper was improved by sharpening both sides of the threshing teeth and disconnecting the blower. Result showed the acceptable chopping length of 9.6, 7.0, 6.2 cm of rice straw, kangkong and ipil-ipil branches, respectively.

Thermally, rice hull is carbonized by simple open-type carbonizer using a perforated oil drum with chimney, producing a black colored substance with uniform particle size. Ten bags of rice hull make 6-7 bags carbonized rice hull (CRH) in four hours.

Biologically, a biogas digester was designed to produce methane or alcohogas. The system uses a 150-L plastic container and commercial gas control mechanism. The process anaerobically ferments a mixture of farm biomass and kitchen garbage to produce gas for cooking.

Keywords: indigenous materials, physical, biological and thermal conversions

ASD No. 8

**EFFECT OF WEEDING LEVELS ON THE INCIDENCE
OF *Amrasca biguttula* (ISHIDA) ON EGGPLANT**

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This study was conducted to determine the effect of three weeding levels on the incidence of the eggplant leafhopper, *Amrasca biguttula* (Ishida) on resistant and susceptible eggplant varieties. Insect and natural enemy populations were counted and weeds were sampled randomly per plot from 30-90 days after transplanting (DAT).

The numbers of insects and natural enemies (leafhoppers, ants, aphids, spiders, flea beetles, whiteflies) were counted and the number of individuals per weed species were also counted, ranked and classified as broad or slender.

Results showed that fewer insect pests and more natural enemies occurred in the regulated and unweeded treatments. Although it was in the unweeded treatments where fewest insects occurred, weed species diversity was higher in the regulated weeding treatments.

The available data support:

- a) that regulated weeding is compatible with the use of resistant varieties for eggplant pest management.
- b) that the presence of weeds affords diversity in the eggplant farm and renders conditions favorable for natural enemies but not for pests like leafhoppers; and
- c) that regulated weeding maybe more economical as a practice than total weeding, realizing the costs farmers incur for weeding in clean culture.

Keywords: eggplant, *Solanum melongena* L., leafhopper, *Amrasca biguttula* (Ishida), resource concentration, natural enemy hypothesis

ASD No. 9

**EVALUATION OF THE PROCESSING QUALITIES OF
SQUASH (*Cucurbita moschata* Duch. ex Lamk)**

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Recent researches on breeding works should not only consider improved agronomic, horticultural qualities and resistance to insect pests and diseases but also its ultimate utilization, otherwise, increasing yield without corresponding increase in utilization will just result to wastage. At present, squash products are prepared from just any available varieties from the market resulting to inconsistent sensory characteristics and end products. Development of squash products will thus require a comprehensive study of the most suitable varieties to ensure that uniform end products will result from its use.

Local collections from major squash-growing areas in the country and commercial varieties were subjected to sensory evaluation, physico-chemical and nutritional analyses and tested for their suitability in the development of squash products, namely, frozen squash slices, puree, and flour at the IFST Sensory Evaluation Laboratory. For squash slices, color, texture and cohesiveness of mass are important parameters for consideration. Among the samples evaluated, San Marcelino-1, Ormoc-3, Tinuning-1, and Asingan-1 were the promising materials that can be used in the study of frozen slices. Consistency is very important in preparation of puree. San Marcelino-1 was the most consistent and the process of pureeing was relatively easy possessing homogenous appearance. Botolan-1, San Marcelino-1 and Ormoc-1,2 had the highest starch content of 21.17, 20.66 and 20.16%, respectively. San Marcelino-1 had the highest amylose content while highest total sugar content was obtained from Tinuning-1 and Botolan-1. The moisture content of samples ranged from 75.19-96.31% wet basis while the total soluble solids ranged from 3.90-14.05°Brix. Flours were prepared from samples and San Marcelino-1 gave the highest drying yield. The samples differed in particle sizes. Those particles that passed thru sieve mesh no. 80 were considered acceptable as composite flour for noodle making. Preliminary evaluation of Tinuning-1 flour (>80) in combination with wheat flour showed promising results for noodle making.

Keywords: *Cucurbita moschata* (Duch. ex Lamk), sensory evaluation, physicochemical analyses, processing

ASD No. 10

***Bacillus Cereus*: A NEW BIOLOGICAL N₂-FIXING
ORGANISM AND ITS UTILITY AS BIOFERTILIZER
IN COTTON PRODUCTION¹**

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The bacterial isolate, *Bacillus cereus*, from the rhizosphere of the grass weed *Cenchrus echinatus*, is a non-symbiotic N₂ fixer. This is the first time that this species is reported of its capability to fix atmospheric nitrogen. Used as cottonseed inoculant, it significantly affected the germination percentage, seedling vigor index and fresh seedling weights of the cotton variety, UPLC-2.

Both screenhouse and field conditions showed that ½ RR combined with N-BOF by *B. cereus* gave comparable agronomic performance and seedcotton yield of UPLC-2 with the recommended rate (RR) treatment. Cotton plants of the said treatments grew luxuriantly, and distinctly developed the minor fruit-bearing branches, i.e. the Ax Sy and Se Ms Sy, in addition to the mainstem sympodia.

The quantity of inorganic fertilizer recommended for cotton that can be substituted by the nitrogen bio-enriched organic fertilizer (N-BOF) by *B. cereus* was within the range of 37.5 to 65 kg N/ha.

Keywords: *Bacillus cereus*, Biological Nitrogen Fixers (BNF), *Cenchrus echinatus*, biofertilizer, UPLC-2, sympodial branches, seedcotton, plant maps

ASD No. 11

**BIOLOGICAL AND CULTURAL MANAGEMENT OF SOME
MAJOR INSECT PESTS OF EGGPLANT**

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The effectiveness of several component control tactics such as the use of biological control agents (*Trichogramma chilonis*, *Orius tantillus* and microbial isolates: *Metarhizium anisopliae* and *Beauveria bassiana*), cultural control (mechanical removal of infested shoots and fruits and planting of culinary herbs) were evaluated against major insect pests of eggplant at the Central Experiment Station, UPLB. Integration of component control approaches including the application of selective insecticide (thiamethoxan) was also evaluated and compared with farmers' practice in Asingan, Pangasinan and in Balete, Batangas.

An isolate of *Beauveria bassiana* (Bb-1) gave 87% leafhopper mortality in 6 days while *Metarhizium anisopliae* (Fmll) gave 45% mortality in 9 days.

Okra was found to be a preferred host of leafhopper than eggplant. Therefore, okra was used as trap crop where application of thiamethoxan was directed (drenched at the rate of 100 ml per hill) at one week after sowing instead of spraying eggplant to control leafhoppers. This control method was found equally effective as the farmer's practice in controlling leafhoppers. Likewise, the three weekly field releases of *Orius* at the rate of one nymph (immature predator about to become adult) starting at three weeks after transplanting (WAT) was comparable with farmers practice (weekly calendar spraying of recommended insecticide, deltamethrin) against *Thrips palmi*.

Basil intercropped with eggplant (approximately 20% of the total plant populations) appeared to have potential in reducing the infestation of aphids and leafhoppers shown by the lower density of the pests and higher yield.

The results of the integration of selective insecticide, thiamethoxan (drenched 1 WAT at 100 ml per hill), weekly releases of *Trichogramma chilonis* (40,000 parasitoids/ha/release starting 45 DAT) and sanitation (mechanical removal of damaged shoots and fruits) suggest that the approach can be an alternative management tactic against leafhoppers and fruit and shoot borers.

Keywords: *Trichogramma*, biological control agents, leafhopper, shoot of corn borer, culinary

ASD No. 12

**COST-EFFECTIVE MECHANIZATION FOR
CROP DIVERSIFICATION**

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Crop diversification improves productivity and profitability. Mechanizing this will help increase land and labor productivity. Since machines are cost-intensive investment, they should be used effectively and efficiently, combining several functions to reduce their fixed and variable costs. In this regard, mechanization inputs that can handle several crops simultaneously will help farmers in uplifting their living conditions.

A multi-purpose power unit and attachments that will perform subsequent farm operations such as precision seeding, weeding, and harvesting were developed and evaluated. First, the power unit consists of a handle-frame, transmission, and cage wheel-skid assemblies. The transmission system of the machine was a direct-coupled shaft mechanism from the prime mover (1:2.5 ratio of chain & sprocket, and 50:1 worm reduction gears) to reduce the engine speed of 1600 rpm to 15~34 rpm required for its respective attachments. Second, the 6-row precision seeder attachment has a 19-kg seeding rate fabricated from local and recycled materials that substantially reduced its initial cost. Third, the brush cutter-type rice harvester attachment acceptably laid the rice stalks in windrows. It had an effective swath (cutting width) of 1.8 meters (7 hills/row) with a field capacity of 400 m²/hr, and cutting height of 3.5 cm. Labor productivity was doubled. Fourth, the power weeder attachment consists of rotor blades adapted from a rototiller design. Test revealed its potential weeding performance. Further improvement and adaptation trials are being done.

Keywords: cost-effective mechanization, crop diversification, multi-purpose power unit, precision seeding, weeding, harvesting.

ASD No. 13

**THE EFFECT OF INTERCROPPING SWEET POTATO
AND POLE SITAO ON INSECT PEST AND
NATURAL ENEMY POPULATION**

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Pole sitao is an important legume in the Philippines. However, pole sitao is attacked by a number of insect pests causing damage from seedling to maturity resulting to tremendous reduction of yield. Weeds also cause yield loss by directly competing with crops or intensify the problems of diseases, insect and other pest by serving as host. On the otherhand, crop fields with dense weed cover and high diversity usually have more beneficial insects than do weed free field.

This study was conducted at the Central Experiment Station of the UP Los Baños from December 2001 to April 2002 to determine the effect of sweet potato intercrop on the pole sitao insect pest complex and the natural enemies.

There were four treatments namely: 1) control plot; 2) 2 sitao and 1 camote; 3) 3 sitao and 1 camote and 4) 4 sitao and 1 camote. A randomized complete block design was used. Each plot measures 5 x 6 square meters and these were replicated four times per treatment.

Insect pest and natural enemies were monitored on a weekly basis through the use of sweep net and actual count. Leafminers, leafhoppers, flea beetles, snout beetles and cutworms were the pest observed using sweep net. The order of decreasing density of pest are: control (30.6) > 2 sitao + 1 sweet potato (23.6) > 3 sitao + 1 camote (13.7) > 4 sitao + 1 camote (10.3).

The natural enemies observed were: ladybird beetles, Ichneuomonid wasp, spiders, praying manthis and myrid bug. The order of decreasing density of natural enemies were: 2 pole sitao + 1 camote (1.3) = 4 sitao + 1 camote (1.3) > Control (.90) > 3 sitao + 1 camote (.70).

The actual count of pest was done on aphids, leafhoppers, flea beetles and katydids. The order of decreasing density of pest were: control (465) > 3 sitao + 1 camote (367.5) > 4 sitao + 1 camote (269.8) > 2 sitao + 1 camote (254.3). The ladybird beetle and spiders count were: 3 sitao + 1 camote (3.0) > 4 sitao + 1 camote (2.75) > 2 sitao + 1 camote (1.0) > control (.25).

The results showed that pole sitao alone had high pest population count and low natural population count while those that have camote intercrop showed the reverse. The findings suggest that camote provides diversity and refugia for natural enemies which in turn reduce the pest population through predation and parasitism.

Keywords: pole sitao, sweet potato, intercrop, natural enemy, pest population, parasitism, predation

ASD No. 14

**OCCURRENCE OF *Spodoptera litura* (FABRICIUS) AND
Helicoverpa armigera (HUBNER) ON EGGPLANT AND
COMPARATIVE STUDY OF DAMAGE WITH THE
SHOOTFRUIT BORER, *Leucinodes orbonalis* GUENEE**

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The insect pests of eggplant (*Solanum melongena* Linn.) in the Philippines were first compiled from previous publications by Gabriel in 1969 and later updated it in 1997. He treated the pests of eggplant together with those of sweet pepper (*Capsicum frutescens* L.), pungent pepper (*Capsicum annuum* L.) and tomato (*Lycopersicon lycopersicum* (L.) Karsten) under the lumped heading "Nightshade Family (Solanaceae). However, this compilation as far as eggplant and other solanaceous crops are concerned is incomplete.

In Gabriel's compendium, the common cutworm, *Spodoptera litura* (Fabricius) and the corn earworm or tomato fruitworm, *Helicoverpa armigera* (Hubner), are two of the lepidopterous pests listed under solanaceous crops. *S. litura* was listed as among those chewing on young branches and leaves while

H. armigera was listed as among those chewing insect on fruits, i.e. as the tomato fruitworm. On eggplant, the only insect listed on fruits is the shootfruit borer, *Leucinodes orbonalis* Guenee.

However, during our screening trials to evaluate the resistance of eggplant to *L. orbonalis* and leafhoppers for our DA-BAR and IPM-CRSP PhilRice projects, the common cutworm and the corn earworm were observed for the first time feeding on whorls (curled, immature leaves that form loose heads) and flower buds of eggplant. They were heavily feeding on these parts of the test plants. The field trials were conducted in Aliaga, Nueva Ecija and Asingan, Pangasinan. As far as known, there have been no reports on the occurrence of these two pests at several stages of eggplant growth and development. The occurrence of the two pests, although not surprising as they are polyphagous, are, therefore, new records for eggplant.

The nature of damage of *S. litura* and *H. armigera* was also compared with the most serious and the number one insect pest of eggplant, *L. orbonalis*. The damage caused by the former unfortunately was even more serious compared to that caused by the shootfruit borer.

Keywords: eggplant, *Solanum melongena* L., *Solanaceae*, common cutworm, *Spodoptera litura* (Fabricius), corn earworm, tomato fruitworm, *Helicoverpa armigera* (Hubner), shootfruit borer, *Leucinodes orbonalis* Guenee, pest resistance

ASD No. 15

EFFICIENT INDUCTION OF SOMATIC EMBRYOGENESIS AND MULTIPLE SHOOTS IN AVOCADO (*Persea americana* MILL.) AND EFFECTS OF GAMMA RAYS ON AVOCADO CULTURES

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Avocado is a popular and promising fruit crop but lacks formal breeding in the Philippines. The objective of the study is to improve plant regeneration systems (somatic embryogenesis and shoot organogenesis) in avocado to allow efficient generation of somaclonal variants and induction of mutants by gamma

ray irradiation. Immature zygotic embryos of five locally grown avocado genotypes were aseptically cultured in 'M14' medium (MS basal medium + 5.0 mg/L 2,4-D and 0.5 mg/L BA) and 'B₃P' medium (B5 major salts, MS minor salts and 0.1 mg/L picloram). Percentage callus formation was higher with the use of 'B₃P' medium (48.3 to 61.9 %) as compared with M14 medium (10.0 to 40.5 %). After the first subculture (SC1), embryogenic cultures were selected in genotypes 'Semil' and 'Mainit', and transferred every 3 to 4 weeks on three media namely, 1) 'B₃P'; 2) 'RA₃' (MS + 0.1 TDZ and 0.5 GA₃); 3) 'BA₂' (MS + 2.0 BA + 1.0 IBA) for induction of somatic embryogenesis. The radiosensitivities of embryogenic cultures of 'Mainit' and 'Semil' were determined by exposing embryogenic masses to increasing doses of gamma rays (0, 10, 20 and 30 Gy). Proliferation rates were enhanced at a dose of 10 Gy but exposures to 20 and 30 Gy resulted in approximately 50 and 30 % reduction in proliferation rates of 'Mainit' and 68 and 15 % reduction in proliferation rates of 'Semil', respectively, as compared with the control. Somatic embryos at cotyledonary stage from 8-month-old cultures (irradiated and non-irradiated control) are now placed on the maturation medium as part of continuing experimentation on the requirements for germination and plant regeneration. On the other hand, germinating seedlings from aseptically cultured zygotic embryos from mature fruits of 'San Felix' were exposed to gamma rays (0 to 50 Gy). The resulting shoot cultures are now being propagated in vitro by culturing nodal cuttings on B5 basal medium with 1.0 mg/L BA until M₁V₄ generation.

Keywords: irradiation, mutation, plant regeneration, somaclonal variation, tissue culture

ASD No. 16

**IN VITRO STUDY ON CALLUS INDUCTION AND
PLANT REGENERATION OF GRAMMATOPHYL
SCRIPTUM (ORCHIDACEAE)**

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Rizal Technological University's Conservation of Philippine Native Orchids Project involves the optimization of the most suitable medium for

mass propagation of Philippine orchid species, somatic embryogenesis and plant regeneration with the use of plant growth regulators. Somatic embryogenesis and further plant regeneration were observed using young leaves and node of *in vitro* cultured plantlets of *Grammatophyllum scriptum*, a native Philippine orchid. The explants were cultured in modified Vacin & Went (MVW) medium supplemented with different levels of auxin. The range of 2,4 - dichlorophenoxyacetic acid concentration is from 0 to 10 μ M. Callus formation was observed to occur in all auxin concentrations except in MVW with no auxin supplementation. Instead, root formation with the presence of root hairs was observed to occur. Calli formed in the different set-ups were all subcultured after three months in MVW without plant growth regulators. The most favorable results were observed. The callus most suitable for plant regeneration was obtained from MVW supplementation with 4 μ M 2,4-dichlorophenoxyacetic acid. In this set-up, most profuse and highest percentage of callus formation (67%) was observed. In addition, calli obtained were also suitable for plant regeneration.

Keywords: *Grammatophyllum scriptum*, *in vitro* culture, callus, somatic embryogenesis

ASD No. 17

**INDUCED CALLUS FORMATION OF HYBRID
Dendrobium cv. 'Clomen White' ANOTHERS BY
COLD PRETREATMENT AND 2,4-D SUPPLEMENTATION**

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The application of anther culture (AC) techniques in orchids has a great potential for revolutionizing orchid breeding technology and propagation. Anther culture of *Dendrobium* 'Clomen White' was investigated to identify its potentials in orchid breeding programs.

Anthers derived from three different bud size ranges namely: (01) 0.90 x 0.40 cm to 1.40 x 0.70 cm; (2) 1.50 x 0.75 cm to 1.85 x 1.00 cm; and (3) 2.0 x 1.10 to 2.40 x 1.30 cm, were subjected to cold shock pretreatment at 4°C in 5,

10, and 15 days duration. Calli were obtained in all treatments but highest (24.17%), over-all performance was observed at bud size ranges of 2.0 x 1.1 to 2.4 x 1.3 cm when cultured in B5 (Gamborg et al, 1968) with 1 mg L⁻¹ 2,4-dichlorophenoxol acetic acid (2,4-D) for 30 days in the dark. Further optimization of the culture condition was conducted using anthers from bud size ranges of 2.0 x 1.1 to 2.4 x 1.3 cm. Anthers were subjected to cold shock pretreatment at 4°C in different durations (5, 10 and 15 days) and cultured in B5 medium with different levels of 2,4-D (1,2 and 3 mg L⁻¹ medium). Callus induction was observed after 5 days of inoculation and was significantly higher on cultures with the following treatments: (a) on B5 + 2-3 mg L⁻¹ 2,4-D without flower bud cold pretreatment (21% & 17.5%); B5 without 2,4-D and buds subjected to 15 days cold shock pretreatment (26.7%). The results of this study showed, cultural requirements of *Dendrobium* for anther culture, and opened up an opportunity for further researches in breeding orchids.

Keywords: *Dendrobium*, anther culture, cold shock pretreatment, 2-4, D, breeding

ASD No. 18

**GENETIC TRANSFORMATION OF BANANA FOR
BUNCHY TOP VIRUS RESISTANCE**

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Banana bunchy top disease is the most devastating viral disease of bananas in the Philippines. Development of BBTV resistant banana by conventional breeding is difficult since most commercially important cultivars are sterile and triploid. Thus, genetic transformation of banana with viral genes, to develop resistant plants, was applied to banana-BBTV system. The coat protein gene (CP) was amplified from local BBTV isolates using specific primers. PCR amplification of total nucleic acid extracts generated a 589 bp product. The development of gene constructs was carried out by cloning the coat protein gene of BBTV into a plant transformation vector pBI 121. Compact and embryogenic calli and somatic embryos were initiated from immature male inflorescence explants of Lakatan. Small male inflorescence explants (~1-2mm)

initiated earlier and higher percentage of embryogenic calli formation than the 3-5mm inflorescence. Plantlet regeneration was observed on both compact and friable calli. The conditions for transient transformation (using particle inflow gun) of calli, somatic embryos and shoot tips were optimized. The effect of distance and helium gas pressure on transient transformation was studied. Compact embryogenic calli bombarded at the 15 cm and pressures of 900- 1000 kpa gave the highest percentage of transient transformation with more than 50% of cultures showing Gus expression. Shoot tips bombarded using the same conditions showed no Gus expression. Since banana cultures are not so sensitive to antibiotic kanamycin, the sensitivity of the banana cultures to antibiotic geneticin, another antibiotic in place of kanamycin, was evaluated. Embryogenic calli and plantlets were sensitive to geneticin in the range of 50-100mg/L. All explants died at 150mg/L geneticin after 20 days of culture. Transformation of embryogenic calli with the BBTV CP gene and using the optimized bombardment parameters are currently being undertaken. Bombarded calli are now in selection and regeneration medium.

Keywords: Banana bunchy top virus, transformation, somatic embryo, coat protein, particle bombardment

ASD No. 19

CONTAINED FIELD TESTING OF TRANSGENIC RICE WITH XA21 GENE FOR RESISTANCE TO BACTERIAL BLIGHT

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Preliminary field testing of transgenic IR72 lines with Xa21 gene for bacterial blight resistance was conducted during the 2002 WS to determine gene expression for resistance to bacterial blight under field conditions, compare the agronomic performance of transgenic and non-transgenic rice, and assess further the horizontal gene flow to non-targeted rice plants. Seeds of transgenic rice TT103 (IRRI transgenic line), IR72-82-3-13-2-2 and IR72-82-3-42-4-6 (PhilRice transgenic lines), untransformed IR72; IRBB21, a conventionally bred line with Xa21 gene; and IR24, a susceptible control were evaluated. Bacterial blight susceptible purple rice was planted in between varieties (3 rows) and around

the periphery of the field (10 rows) that served as buffer and indicators for horizontal transfer of Xa21 gene. Species of Sesbania trees were planted outside the 1.2 m fence surrounding the field as pollen barrier. Inoculation was done at maximum tillering stage following the clipping method using PXO79 race 3 (Maligaya isolate) and rated for percentage diseased leaf area (%DLA) 14 and 21 days after. The agronomic traits: days to flowering and maturity, plant height at maturity, percentage productive tillers, panicle length, weight of 1000 grains and the harvest index were obtained to determine possible phenotypic change between transgenic and non-transgenic IR72. IR24 showed the highest mean %DLA as expected. The untransformed IR72, which contain some genes for resistance to Xoo, showed an intermediate response, IRBB21 showed a moderately resistant response, and the transgenic lines were resistant to moderately resistant. Yield component data in the wet season of 2002 revealed that the transgenic lines were comparable to the untransformed IR72 in days to flowering and maturity, percent productive tillers, plant height, 1000 grain weight and harvest index. At present, the second season of field testing is being conducted this 2003 DS.

Keywords: transgenic rice, field testing, bacterial blight, IR72, genetic engineering

ASD No. 20

**AGROBACTERIUM-MEDIATED TRANSFORMATION
OF DAVAO 'SOLO' PAPAYA FOR PRSV (PAPAYA
RINGSPOT VIRUS) RESISTANCE**

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Transformation of plants with viral genes has been utilized to produce resistance in agriculturally important crops. Development of transgenic papaya resistant to PRSV in Hawaii has been successful, however, resistance did not hold for Asian isolates of PRSV. *Agrobacterium*-mediated transformation of papaya is currently being undertaken to produce papaya resistant to the local strain of PRSV. Studies have shown that resistance is highly specific and depends on the relatedness of the transgene and the challenging virus. Hence, primer pairs based on PRSV Philippine isolate were made to amplify the coat protein (CP) and replicase (NIb) genes of PRSV by RT-PCR. The amplified CP and NIb genes were cloned into pMON plant expression vector and then transformed

into *Agrobacterium tumefaciens* strain ABI by electroporation. Somatic embryos obtained from Davao 'Solo' papaya were co-cultivated with the transformed and activated *Agrobacterium* for three days. After 3 months on selection medium containing kanamycin, embryos were selected and cultured on regeneration and rooting media. One hundred and fifty putative transgenic plants (transformed with CP) were then acclimatized and potted-out in the biological containment level 2 (BL2) greenhouse. Ninety putative transgenic plants were mechanically inoculated with PRSV. Three lines remained healthy and showed no symptom while others showed various levels of disease severity. The surviving transgenic lines and uninoculated lines are now planted in a contained screenhouse to generate R1 seeds for resistance evaluation and molecular analysis.

Keywords: papaya ringspot virus, transformation, somatic embryo, coat protein, replicase gene, *Agrobacterium tumefaciens*

ASD No. 21

**GLYPHOSATE TOLERANCE OF TRANSGENIC
CORN (ROUNDUP READY CORN HYBRID NK603)
UNDER SCREENHOUSE CONDITIONS**

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The glyphosate-tolerance of Roundup Ready (RR) hybrid NK 603, a transgenic corn, was evaluated for herbicide susceptibility/tolerance in comparison with isohybrid C818 corn under contained screenhouse conditions.

The hybrids were sprayed with glyphosate at application rates of 0.72 or 1.44 kg acid equivalent/ha and at various crop stages, i.e. 15, 30, and 15 and 30 days after planting (DAP) with effects evaluated in comparison with respective untreated checks.

Both hybrids exhibited comparable seedling emergence and vigor. Regardless of dosage rates, the RR hybrid NK 603 corn was not affected in terms of plant height, number of leaves per plant, extended leaf length and degree of chlorosis, while isohybrid C818 corn was adversely affected and died at 7 days after spraying. However, morphological abnormalities such as twisted, curled or constricted outer apical leaf sheath resulting in deterred shoot

development or shortened leaf blades were noted on RR hybrid NK 603 corn sprayed at any rate at 30 DAP. This indicates a weakened glyphosate-tolerance of the transgenic corn to herbicide application when applied at later stage.

The performance of Roundup Ready corn NK 603 should be evaluated under field conditions, along with economic analysis to warrant commercial value.

Keywords: transgenic corn, isohybrid, glyphosate-tolerance, agronomic characters

ASD No. 22

**INSECT PEST MANAGEMENT STUDIES FOR PAK-CHOI
Brassica chinensis L. PRODUCTION IN THE PHILIPPINES**

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Insect pest management studies were conducted against major insect pests of pak-choi such as diamondback moth, *Plutella xylostella* and cabbage webworm, *Hellula undalis*. The studies were: 1) identification of local natural enemies of major insect pests on pak-choi 2) effective crop management studies for pak-choi and 3) use of net barriers to reduce diamondback moth and cabbage webworm damage on pak-choi.

The insect pest found on pak-choi were *Plutella xylostella*, *Hellula undalis*, *Spodoptera litura*, *Spodoptera exigua* and grasshoppers. The major predators of adult Lepidopterous insect pests were dragonflies and damselflies, but larvae predators were pentatomid bug and spiders. Wasps from the family Braconidae and flies from Tachinidae were present. Parasitism of insect pest larvae was nil for *Hellula undalis* and *Plutella xylostella* in all plots however in *Spodoptera litura*, there was one larva infected by a fungus of unknown etiology and unknown pathogenicity and one larva parasitized by a Dipteran. Natural enemies were few and failed to build up in the non-sprayed plot.

Foliage damage by diamond back moth (DBM) and cabbage webworm (CWW) larvae in researcher managed plots was significantly less than on farmer

practice plots and nil pesticide plots. There were no differences in foliage damage between farmer managed and untreated plots. The farmer practice plots received nine pesticide applications; six insecticides and three fungicides. In contrast, the researcher managed plots received four applications; three insecticides and one fungicide. Farmer sometimes mixed two pesticides in the spray tank to economize time, however no additive effect from the mixture was noted. The quantity (li/ha) of pesticide product used in farmer practice plots was 70.6 percent higher than in researcher managed plots.

The number of DBM and CWW larvae inside the net barriers was less than the number in the open field. Infestation of DBM was observed 14 days after seeding (DAS) in the open field while in the net barriers DBM was noted 28 DAS. Percentage damaged plant increase in time in the open field. Pak-choi inside the nylon net barrier house were prevented from insect infestation and plant damages compared to the open field. However, adult flea beetles were able to pass through the holes of 16 mesh, therefore this mesh is not suitable for flea beetle control.

Diseases and insect pests must be correctly identified to improve crop management. Net barrier, using 32 mesh significantly reduced thrips, DBM and CWW populations.

Keywords: banana bunchy top virus, transformation, somatic embryo, coat protein, particle bombardment

ASD No. 23

**WOCAT AS A TOOL FOR EFFECTIVE PLANNING,
MONITORING, AND EVALUATION OF
SOIL AND WATER CONSERVATION PRACTICES**

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The World Overview of Soil and Water Conservation Approaches and Technologies (WOCAT) programme, which was launched in 1992 by the World Association of Soil and Water Conservation (WASWC), has developed a standardized framework for the assessment and evaluation, as well as promotion of exchange of knowledge, of soil and water conservation (SWC) technologies and approaches world-wide. WOCAT results and outputs are accessible via the Internet (www.wocat.net), in the form of books and maps, or on CD-ROM.

WOCAT examines advantages and disadvantages of SWC systems and why technologies were accepted or rejected by local users. Data are collected through three comprehensive questionnaires: on SWC Technologies, on SWC Approaches, and on SWC maps. The resulting information system and analytical tools, through the WOCAT database, overviews and maps, provides a useful framework and a tool for decision-makers and project planners responsible for SWC project design, implementation, monitoring and evaluation. Through the global network involving international and national institutions and programs, the valuable knowledge on SWC is being exchanged and made available.

In the Philippines, the Philippine Overview of Conservation Approaches and Technologies (PHILCAT) was organized through a Special Order by the Secretary of the Department of Agriculture in September 1999. It is an interagency committee of eleven member agencies/institutions and two professional societies/organizations for WOCAT and Asia Soil Conservation Network (ASOCON) in the Philippines.

In Thailand, the Thailand Overview of Conservation Approaches and Technologies (THAICAT) is based at the Land Development Department of the Ministry of Agriculture and Cooperative in partnership with other government and non-government agencies. A number of approaches has been collected since the a workshop in September 1996. With present updating, it is expected that up to 12 technologies and 12 approaches would be completed within 2001.

The presentation and the paper will demonstrate the program, its tools and how they can be applied, and some of the results obtained from different countries in the world.

Keywords: soil and water conservation, WOCAT, SWC technologies, SWC approaches, SWC maps

ASD No. 24

CONSERVATION TILLAGE SYSTEMS IN CORN PRODUCTION

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The potential of conservation tillage systems to improve corn yields while reducing production costs and conserving soil and water resources was tested through on-farm trials in three sites, namely: San Jose, Mindoro Occidental, Calabanga, Camarines Sur and Mahaplag Leyte. A total of 11 farmer-partners cooperated in the conduct of the trial. Treatments include conventional tillage, minimum tillage, zero tillage and farmer's tillage practices, which are tested either as single factor or in factorial with variety or fertilizer. Results in Mindoro and Leyte reveal that variation in grain yield is mainly due to tillage practices. Moreover, conservation tillage practices i.e., zero and minimum tillage, resulted to the higher grain yield of about 5.29 t ha⁻¹ and 3.95 t ha⁻¹ for both

Mindoro and Leyte, respectively. In the case of Camarines Sur, yield was not significantly affected by any of the treatments combinations applied (tillage x variety). Zero tillage obtained higher grain yield (2.88 t ha⁻¹) followed closely by minimum tillage with 2.79 t ha⁻¹. From these trials it is evident that conservation tillage management generally resulted to higher grain yield compared with the farmer's tillage practice. Conservation tillage practice is thus a viable option for corn production. Benefits obtained in adopting conservation tillage will be further realized in terms of economic returns, where highest net benefit is obtained due to lower production costs. In addition, when the soil surface is left undisturbed, soil moisture is conserved at a time when dry periods are a problem.

Keywords: conservation tillage, conventional tillage, minimum tillage, zero tillage, on-farm trials, corn

ASD No. 25

CLONING OF THE PETUNIA *Restorer of Fertility (Rf)* GENE: IMPLICATIONS IN BASIC AND APPLIED PLANT RESEARCH

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Cytoplasmic male sterility (CMS) and fertility restoration are active areas of plant research because they offer a unique opportunity to elucidate the molecular interaction between the nuclear and mitochondrial genomes, and are crucial in enhancing crop productivity by exploiting heterosis in hybrid crops. While a number of mitochondrial CMS-causing genes have been cloned and characterized, corresponding nuclear *Restorer of fertility (Rf)* genes have remained elusive. Using map-based and candidate gene approaches, the *Petunia Rf* gene was cloned and designated as *Rf-PPR592*, the first cloned restorer gene that directly suppresses the expression of a mitochondrial CMS gene.

Rf-PPR592 encodes a 592-amino acid (AA) protein, which includes a stretch of 29-AA mitochondrial-targeting sequence. Almost the entire protein

is arranged into 14 copies of the pentatricopeptide repeat (PPR) motif, a recently discovered motif found in a large gene family in *Arahidopsis*. An adjacent homologous gene, *Rf-PPR591*, did not restore fertility. The non-restoring recessive allele, *Rf-PPR592*, has a 530-nucleotide deletion in its promoter region. However, open reading frame swapping indicates that its inability to restore is due to changes in the coding region.

The cloning of the petunia *Rf* gene would facilitate studies on the origin and other possible functions of *Rf* genes in plant development. In addition to map position, our results provide other important clues for cloning *Rf* genes in other species, including the presence of mitochondrial targeting signal and PPR motif, and the reduction of proteins encoded by the CMS genes. Cloning of *Rf* genes in major crops would greatly facilitate the production and identification of suitable and improved restorer lines by marker-aided selection and/or DNA transformation, as well as modification of the current 3-line method of hybrid seed production into a simpler 2-line method by putting the *Rf* genes under the control of inducible promoters.

Keywords: mitochondrial cytoplasmic male sterility, *Oryza sativa*, petunia restorer gene

ASD No. 26

**ANALYSIS OF TUNGRO VIRUS-RICE INTERACTION BY
DIFFERENTIAL DISPLAY RT-PCR AND ISOLATION OF cDNA
FRAGMENTS ASSOCIATED WITH TUNGRO RESISTANCE**

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Rice tungro disease (RTD), characterized by stunting and discoloration of the leaves, is known to be the most widespread and destructive disease of rice in the Philippines and Southeast Asia. The RTD is a composite disease caused by two kinds of viruses - rice tungro spherical virus (RTSV) and rice tungro bacilliform virus (RTBV), which are commonly transmitted by the greenleafhopper (GLH) vector insect (*Nephotettix virescens*). The use of rice

tungro virus (RTV) resistant rice varieties is an important approach to control the RID.

Current knowledge and information on rice-tungro virus interaction at the molecular level is still very limited. The specific host genes that are expressed during the viral infection process and the role of these genes in pathogen recognition and elicitation of the resistance reaction in the host plant have not been specifically identified. Therefore, research on gene expression in *planta* during rice tungro virus infection will provide substantial answers to the questions regarding the nature and mechanism of RTV resistance in rice. Based on the knowledge of the molecular basis of this interaction, it is possible to design an effective approach for breeding against the RTV resistance.

Recently, we have embarked on the isolation of genes involved in RTV resistance mechanism through a gene expression-based approach. RTV-resistant and RTV-susceptible near isogenic lines were analyzed by differential display RT-PCR (Liang and Pardee, 1990). RNA was extracted from the RTV-infected and uninfected resistant and susceptible isolines. At 72 hours after inoculation by virus-carrying GLH, at least 20 RT-PCR bands were identified as RTV-rice interaction specific from amplifications involving 40 primer combinations, i.e. cDNA fragments that were present only in RTV-infected resistant line. The differential PCR products were isolated and purified for further characterization and sequence analysis to establish their identity and possible roles in RTV resistance.

Keywords: rice tungro virus resistance, differential display RT PCR

ASD No. 27

**BIOACCUMULATION AND BIOCONCENTRATION OF
PB IN THE TISSUES OF *Zea mays* L. IPB VAR. 911**

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Plants selectively take up and accumulate heavy metals at varying mobilities. The bioaccumulation and bioconcentration of heavy metals are greatly affected by the intrinsic capabilities of plants to uptake and store heavy metals in their tissues, and their interaction with the physico-chemical environment. The bioaccumulation (BA) and bioconcentration factor (BCF) of Pb in the root and shoot tissues of *Zea mays* L. IPB var. 911 seedlings were investigated in potted field conditions and were analyzed using Atomic Absorption Spectrophotometry (AAS). Results indicated significant difference on the BA of Pb in the root and shoot tissues of corn in various $Pb(NO_3)_2$ treatments. Significant ($P < 0.05$) increase of Pb accumulation ($2930 \mu g g^{-1}$) in the root tissue was observed at $5000 mg kg^{-1}$ treatment. Moreover, significant ($P < 0.05$) BA values of 46.67, 43.54 and $50.93 \mu g g^{-1}$ of Pb in the shoot tissues were recorded at 100, 2000 and $5000 mg kg^{-1}$ treatments, respectively. Bioconcentration factors (BCF) of 0.760, 0.450, 0.697 and 0.935 at control, 100, 2000 and $5000 mg kg^{-1}$ treatments were determined in the root tissues, respectively. Likewise, the highest root BCF of 1.25 was registered at $500 mg kg^{-1}$ treatment. Compared to root, much lower BCF values of 0.205, 0.746, 0.038, 0.035, 0.016 in the shoots were recorded at the control, 100, 500, 2000 and $5000 mg kg^{-1}$ treatments, respectively. Greater bioaccumulation values and enhance BCF suggest that *Zea mays* L. IPB var. 911 might be used for the clean-up of Pb-contaminated soils.

Keywords: bioaccumulation, bioconcentration, corn, heavy metals

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**MECHANIZING THE PROCESSES IN DEVELOPING
BIOBASED FARM INPUTS**

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Rice and rice-based farming system in the Philippines are becoming cost-intensive due to increasing cost off-farm and non-renewable inputs. Indigenous materials in the farm and household that are sustainable should be recovered from a biobased system of developing ecological farm inputs.

PhilRice has developed a system in converting (physical, thermal & biological) indigenous materials from farm biomass and biodegradable household wastes. Physically, a drum-type manually operated chopper/mixer-cum composter was developed for a cluster of households. Also a convertible thresher-shredder/chopper was improved by sharpening both sides of the threshing teeth and disconnecting the blower. Result showed the acceptable chopping length of 9.6, 7.0, 6.2 cm of rice straw, kangkong and ipil-ipil branches, respectively.

Thermally, rice hull is carbonized by simple open-type carbonizer using a perforated oil drum with chimney, producing a black colored substance with uniform particle size. Ten bags of rice hull make 6~7 bags carbonized rice hull (CRH) in four hours.

Biologically, a biogas digester was designed to produce methane or alcohols. The system uses a 150-L plastic container and commercial gas control mechanism. The process anaerobically ferments a mixture of farm biomass and kitchen garbage to produce gas for cooking.

Keywords: indigenous materials, physical, biological and thermal conversions