PHILIPPINE RICE R&D HIGHLIGHTS 2012

Agronomy, Soils and Plant Physiology Division

TABLE OF CONTENTS

Agronomy, Soils and Plant Physiology

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To contribute to the government's goal of attaining and sustaining rice self-sufficiency, PhilRice, through the ASPP Division, has led national efforts in the conduct of quality research focused toward identifying, evaluating, refining, and facilitating delivery of improved soil, plant, nutrient, and water management practices that are resource efficient and environment-friendly for rice and rice-based ecosystems. The midterm goal is to package a holistic rice agronomy system that will increase yield by 15% in less productive environments and sustain yields in high-yielding environments.

In line with achieving this goal, the Division is composed of creative, innovative and highly trained researcher and scientists that specialize in agronomy, plant physiology, soil and water science, and integrated rice-based farming system. The division's functional objectives, according to its 2010 Interim, are: (1) identify and propagate approaches for integrating management of principal insect pests and disease with compatible nutrient and crop management; (2) develop technologies that will improve soil and water conservation practices; (3) develop practices to manage crop residues for healthy soils in rice ecosystems; (4) strengthen the scientific basis for rice-based cropping system technologies; (5) participate in the efficacy assessment of new agricultural inputs; and (6) assess the impact of developed technologies on environmental quality. Ultimately, the Division will deliver an identified technology component(s) that improves and sustains crop productivity as well as increased resource-use efficiency in less productive environments, and high yielding or favourable environments.

For 2012 however, the main output of the Division's R&D was based on current and approved research studies, the main goal of which was to develop new techniques and methodologies in crop management focused on soil, plant, water, and climate in rice and rice-based farming systems, specifically: to : (1) Assess the long-term effects of continuous use of inorganic and organic fertilizers on the sustainability of rice cropping, soil quality and the environment; (2) Quantify the contribution of functional stay-green characteristic of the rice leaves to drought tolerance ability of rice during the post anthesis drought in rice; (3) Assess the raised bed system as a screening facility for identifying deep rooting genotypes to assist breeding for improved drought resistance in rainfed upland systems; (4) Assess plastic root system development responses to drought during early and late vegetative stage in enhancing nutrient uptake under progressive soil drying; (5) Determine the effectiveness of infrared thermography in phenotyping root traits for breeding purposes; (6) Explore opportunities to improve the use of weather and climate information in rice production; (7) Develop a cost-efficient hydroponic culture method for showing nutrient deficiency and

toxicity symptoms in rice; (8) Determine the influence of radiation-modified Carageenan and Chitosan on the growth promotion of rice;
(9) Assess potential greenhouse gases emissions of irrigated rice fields planted to different rice varieties and other rice-based farming systems; and (10) Develop efficient inoculation strategies and produce bacterial inoculants with high nitrogen fixation capability.

I. Assessment of Soil Fertility, Plant, Water and Nutrient Management
Long-term fertility experiment
WB Collado (PhilRice), EV Laureles and RJ Buresh (IRRI)

The Long Term Fertility Experiment has been ongoing at the Philippine Rice Research Institute in Nueva Ecija since 1968. The study aims to study the sustainability of intensive double rice cropping and provide an early warning indicator of nutrient imbalances and nutrient mining that can occur with intensification in farmer's fields. The study aimed to achieve high and stable rice production on a sustainable basis in the treatment with full application of nitrogen (N), phosphorus (P) and potassium (K). The treatments with combinations of N, P, and K fertilizer enable an assessment of the long-term nutrient supplying capacity of the soil. The control without N, P and K fertilizer application enables an assessment of the long-term indigenous N-supplying capacity.

Findings:
Grain Yield

- The 2012 dry and wet season cropping showed significant mean grain yield differences among the fertilizer treatments (Table 1). Highest mean grain yields were obtained in the LCC-based application of N with P and K, although significantly comparable to the fixed time and rate application of N with P and K. Total N applied was 188 and 90kg N/ha for the LCC-based N treatment, while 210 and 80kg N/ha for the fixed time and rate application of N in the dry and wet seasons, respectively; a saving of 10% in N was obtained in the dry season but an excess of 10 kg N/ha was incurred in the wet season in the LCC-based N management.

- In the omission plots with N, significantly lower grain yields were obtained than the complete NPK treatments; lower grain yield was achieved when K was not applied; this means that K was more limiting than P in the experimental site;

- With the application of P and K only (no N), mean grain yield of the varieties tested was comparable to the control treatment in both seasons, although, lowest mean yields were observed in the control treatment (0-0-0kg NPK/ha);

- The 2012 annual production followed the same yield trend. Highest annual yield of 14.15t/ha was obtained in the LCC-based N management but comparable to the fixed time and rate N management (13.65t/ha). The results showed that N, P and K were needed to attain a high yield level.

- The application of P and K only did not show significant yield advantage over that of the non-NPK treated plants.

Table 1. Mean grain yields (average of 3 varieties) as affected by the different fertilizer treatments. 2012 Dry and Wet Seasons, PhilRice CES, Nueva Ecija.

FERTILIZER TREATMENT	GRAIN YIELD (t/ha)		
	2102 DS	2012 WS	ANNUAL
Control (0-0-0kg NPK/ha)	4.07 a	3.79 a	7.86 a
LCC-based N, +PK	8.55 c	5.55 d	14.15 d
+NP, -K	4.99 ab	4.82 bc	9.81 bc
+NK, -P+3	6.18 b	4.66 b	10.84 c
+NPK (fixed time-adjustable N rate)	8.24 c	5.39 cd	13.63 d
-N, +PK (0-30-50kg NPK/ha)	4.53 a	4.42 ab	8.95 ab

In a column, means followed by a common letter are not significantly different at the 5% level by Scheffe's test.

Agronomic Efficiency of Applied N

- Mean agronomic nitrogen-use efficiency (AEN) of the varieties tested in LCC-based N management (23.8kg grain kg N-1) was higher than the fixed time and rate N management (19.9kg grain kg N-1) in the dry season (Figure 1). In the wet season, AEN was similar to each other. The results showed that application of N using the LCC was more efficient in converting N to more grains than the fixed time and rate approach in the dry season. In the wet season, both N management approach was comparable and can be used;

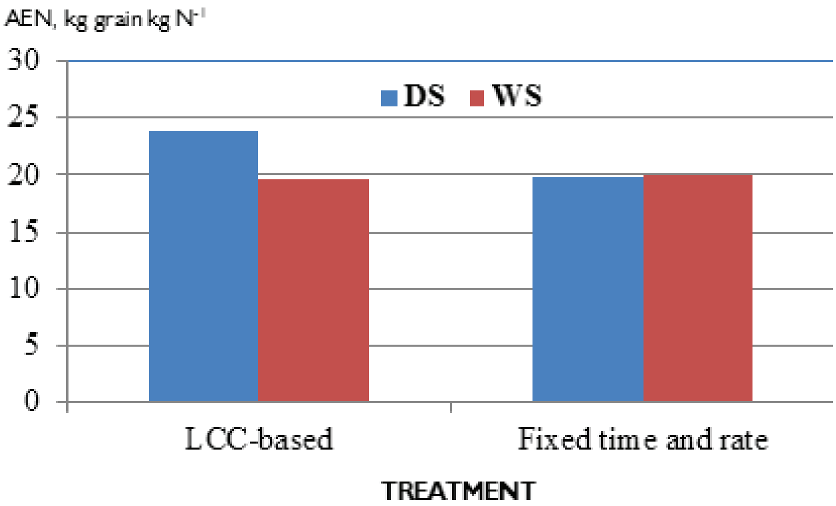

Figure 1. The mean agronomic nitrogen-use efficiency of the varieties tested expressed in kg grain produced per kg N applied during the 2012 Dry and Wet Seasons in the complete NPK-applied treatments. PhilRice CES, Nueva Ecija.

Indigenous Nutrient Supplies

- In the control treatment (no NPK), indigenous nutrient supplies for N (INS), P (IPS) and K (IKS) were slightly higher in the dry season than the wet season but not significantly different;

- In the -N, +PK treatment (0-30-50kg NPK/ha), INS was higher slightly higher than the -NPK (0-0-0kg NPK/ha) treatment; application of P and K did not significantly increased the grain yield of the varieties tested;

- Indigenous P supply (IPS) in the –P treatment was higher than the –NPK treatment, both in the dry and wet seasons;

- Similar to IPS, IKS was higher in the –K, +NP treatment compared to the –NPK treatment; IKS in the –K, +NP treatment in both seasons were comparable;

Table 2. The indigenous nutrient supply of the experimental site during the 2012 Dry Season cropping.PhilRice CES, Nueva Ecija.

TREATMENT	Indigenous Nutrient Supply					
	INS		IPS		IKS	
	DS	WS	DS	WS	DS	WS
0-0-0kg NPK/ha	61.1	56.9	10.6	9.9	61.1	56.9
210-30-0kg NPK/ha					74.8	72.2
210-0-50kg NPK/ha			16.1	12.1		
0-30-50kg NPK/ha	67.9	66.3				

Long-term use of organic fertilizers in paddy soils

EF Javier and AE Espiritu

The experiment on the continuous use of organic fertilizers in paddy soils started in 2003 WS at PhilRice Experiment Station. The study aimed to: (1) Determine the long-term effects of different organic fertilizers or amendments on the physico-chemical characteristics and nutrient availability for rice in paddy soils; (2) Assess sustainability of grain yield production and soil health with just the use of organic fertilizers in paddy soils as compared to the use of inorganic fertilizers; (3) Determine the agronomic efficiency due to application of organic fertilizer; and (4) To build-up database and information on the continuous effect of organic fertilizers for the development of an organic-based irrigated rice production management protocol.

The field experiment was laid out in Randomized Complete Block Design (RCBD) with four replications. Treatments included: (1) Pure organic fertilizers; (2) Combination of organic and recommended full rate of inorganic fertilizers and; (3) Combination of organic and half the recommended rate of inorganic fertilizers. Control plot (without any amendment) and plots applied with only inorganic fertilizer were also included as check. Organic fertilizers included fresh rice straw (RS) incorporated 30 days before transplanting, rice straw with Effective Microorganism Base Inoculants (RSEM) incorporated during the first harrowing, chicken manure (CM) applied 7 days before transplanting; wild sunflower (WSF)incorporated 2 days before transplanting; and commercial organic fertilizers (COF) applied 7 days before transplanting. Full recommended rate for inorganic fertilizer is 120-40-60kg NPK/ha for DS and 90-40-40kg NPK/ ha for WS.

Findings:

- In 2012DS, the highest yield among the OF tested was obtained from plots treated with CM (6.89tons/ha) but was not significantly different from RS, RSEM and WSF. The lowest yield was from the COF plots (4.80t/ha).

- From among the different types of organic and inorganic fertilizers tested, high yield was statistically similar to all the plots amended with any of the organic fertilizer use plus the application of the full inorganic NPK fertilizers (RSEM+NPK, COF+NPK, CM+NPK, WSF+NPK, RS+NPK). Lowest yield was recorded from the control.

- Yields in OF alone were significantly higher than in unfertilized plots. Yields in OF + NPK and OF + ½ NPK were significantly higher than in OF alone. On the other hand, comparable yields were observed from OF alone and ½ NPK fertilizer rate applied.

- Likewise, similar trend of yield in DS was observed in the WS although yield is lower than in the DS.

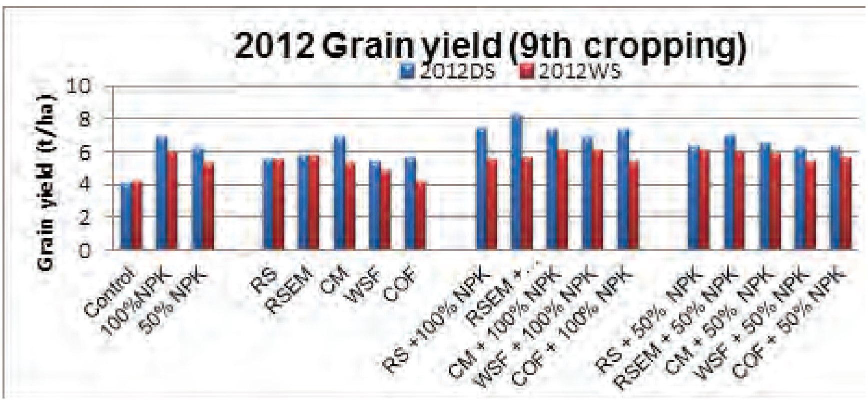

Figure 2. Grain yield (tons/ha) of PSB Rc82 applied with different types of organic and inorganic fertilizers in 2012 cropping season.

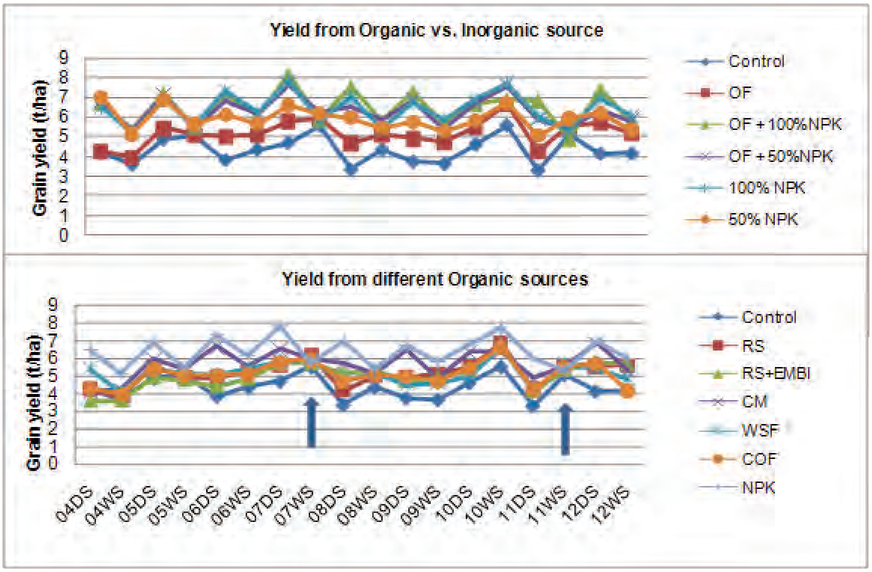

Figure 3. Yield of PSB Rc82 applied with different types of organic and inorganic fertilizers across seasons. Maligaya clay soil series. NuevaEcija (EFJavier, et al, 2012, PhilRice).

Evaluation of different organic source of nutrients to supply rice nutrient demands based on LCC level

AE Espiritu, XXG Sto. Domingo and EF Javier

Nitrogen (N) fertilizers, whether of organic or inorganic source, are essential for high rice yield. The Leaf Color Chart (LCC) is an easy-to-use and inexpensive tool for monitoring crop N status in the field and determine the demand of N top-dress in any of the growth stages of the rice plant. On the other hand, rice varieties have different responses to nutrient application to achieve its optimum yield. Most of the responses of rice varieties are already well-studied as far as inorganic fertilizer application under irrigated lowland areas is concerned. Few had been reported concerning the responses of nutrient management. Most of the current rice varieties now are high yielding and conversely demands higher nutrient requirements. The study looked into the ability of organic-based nutrient management to the sustain yield potential of rice plants.

Two set-ups were established in 2012 with different basal organic treatments as main plots: Rice Straw Compost (RSC) and Rice Straw Compost with Chicken Manure (RSCM) and the different sources as subplots in the factorial split-plot experimental design. The LCC 3 and LCC 4 readings determine the time of top-dress application of fertilizer treatments: Inorganic Foliar Fertilizer (IFF), Organic Foliar Fertilizer (OFF), Urea, and Wild Sunflower (WSF).SPAD reading is also conducted to verify the efficiency of LCC indices to the leaf N concentration in the organic-based nutrient management. PSB Rc82 was used in dry season as test variety to assess and optimize the LCC reading. In wet season three rice varieties (PSB Rc82, NSIC RC160 and Mestiso 20) were used to determine any varietal differences under organic-based nutrient management in irrigated lowland rice ecosystem.

Findings:

- In DS, the highest grain yield came from those topdressed with urea at LCC reading of less than 3. Applying urea and green manure while the LCC reading is at 4 also gave comparative grain yield. In WS, Urea (5.8t ha-1) and WSF (5. 6t ha-1) gave higher yield than IFF (5.0t ha-1) and OFF (4.9t ha-1) (Figure 4).

- In both DS and WS, both the basal organic fertilizer gave statistically similar yield ranging from 6.0 to 6.3t ha-1, and 5 2 to 5.3t ha-1 respectively regardless of variety and top-dress fertilizer applied (Figure 4).

- For varietal response, PSB Rc82 (5.5t ha-1) had the significantly higher grain yield than Mestiso 20 (5. 1t ha-1) and NSIC Rc160 (5.1 t ha-1) regardless of treatments applied (Figure 5).

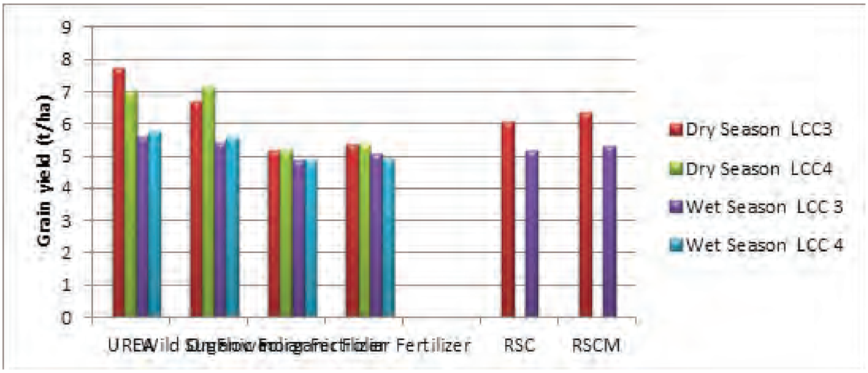

Figure 4. Average grain yield as affected by the treatments applied for dry season and wet season regardless of varieties used.

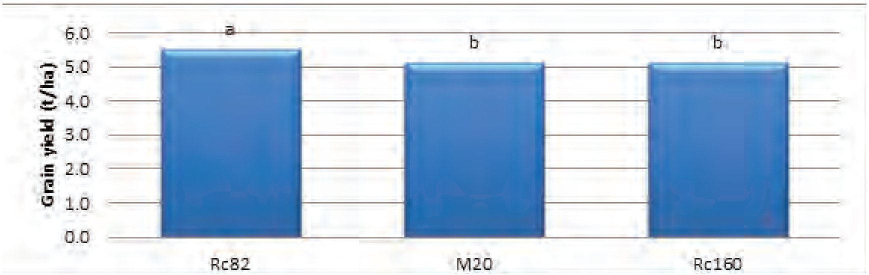

Figure 5. Grain yield of rice varieties regardless of treatments applied. 2012 WS. PhilRice CES.

Evaluation of nutrient diagnostic techniques based on yield and nutrient-use efficiency of rice
MVR Bascon and RT Cruz

Currently, there are a number of nutrient diagnostic techniques (NDTs) used as bases for fertilizer recommendation. These are: (1) PalayCheck System of integrated crop management that uses the Leaf Color Chart (PCheck-LCC) for in situ assessment of leaf N status and Minus-One Element Technique (MOET) for determining N, P, K, Zn, and S deficiencies by visually assessing plant nutrient deficiency symptoms for the particular fertilizer element not applied (while applying the rest of the required elements) in the pot of soil under irrigated lowland condition at the vegetative stage, (2) Soil Test Kit (STK) which uses a prepared solution for a fairly dry soil sample to determine soil pH and NPK levels by colorimetric method, and uses a table for the fertilizer recommendation, and (3) Nutrient Manager (NM), a software program providing fertilizer recommendation based on standard soil and crop input data. However, the availability of many NDTs can be confusing to farmers and technicians. Thus, evaluation of the NDTs based on grain yield and nutrient-use efficiency can aid farmers and technicians in choosing which NDT to use.

PSB Rc82 variety was used with the following fertilizer treatments: (a) Control or No fertilizer application; (b) PalayCheck System aided by LCC and MOET (LCC-based N application-42-42kg NPK/ha at 14 DAT during dry season or DS and LCC-based N application-28-28 kg NPK/ha at 14 DAT during wet season or WS); (c) STK (120-60-0kg NPK/ha with 50% N and all P at 14 DAT, 25% N at active tillering and panicle initiation or PI during DS and 60-30-0kg NPK/ha with 50% N and all P at 14 DAT, 50% N at PI during WS); (d) Nutrient Manager (52-20-15kg NPK/ha with 20% N and all PK at 14 DAT, 40% N at active tillering and PI during DS and 93.5-24.5-24.5kg NPK/ha with 20% N and all PK at 14 DAT, 40% N at active tillering and PI during WS) and (e) Farmer's Fertilizer Practice (106-14-14kg NPK/ha with 56% N and all PK at 14 DAT, 22% N at panicle initiation or PI and 22% N flowering during Ds and 60-30-20kg NPK/ha with 50% N and all PK at 14 DAT, 25% N at active tillering and PI);

Findings:

- In both 2012 dry and wet seasons (DS and WS), diagnosis of different NDTs showed that N is the most limiting nutrient. However, diagnosis of P and K levels varied among NDTs. Low P level was diagnosed by STK and NM while low K level was diagnosed only by NM. In PCheck, application of PK fertilizers was still done even at sufficient P and K levels as maintenance dose. STK did not recommend K application when level is sufficient.

- All NDT treatments showed lower LCC readings at 28 and 63 DAT during DS and 49 and 63 DAT during WS. LCC readings for PCheck had an interval of one-two weeks (7-14 days) during DS and two weeks (14 days) during WS to reach critical levels.

- Based on Table 3, the average grain yields for both seasons showed that PCheck (8.1t/ha) was significantly higher than NM (6.9t/ha) and FFP (7.3t ha-1), On the other hand, PCheck and STK (7.8t/ha) showed no yield differences. In comparison with the FFP (7.3 ton/ha), PCheck and STK had no yield differences while NM had lower grain yield.

- In terms of Agronomic-use Nitrogen Efficiency (ANUE), PCheck showed higher values for NPK compared to other treatments. However, ANUE of PCheck, STK, and FFP were lower than the usual 30-60kg grain/kg N/applied. Only NM (37.8) showed higher ANUE, This can be due to low N applied.

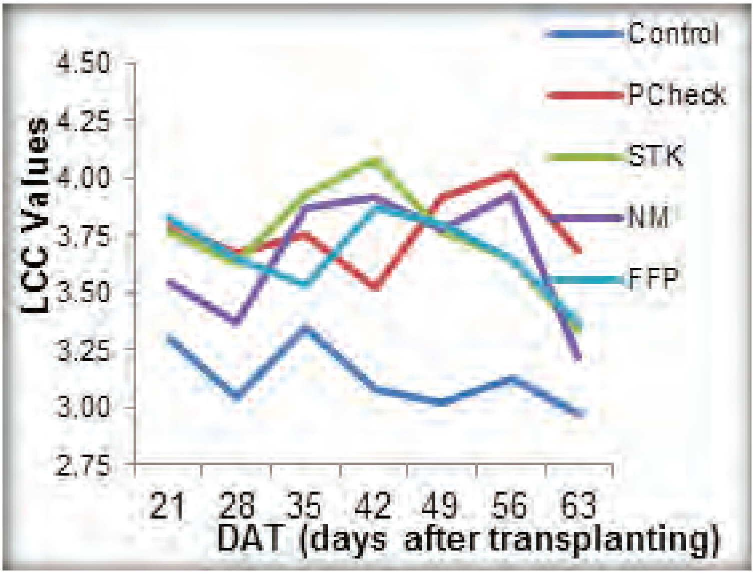

Figure 6. LCC Reading of different NDT recommendation from 21 to 63 days after transplanting (DAT) during DS

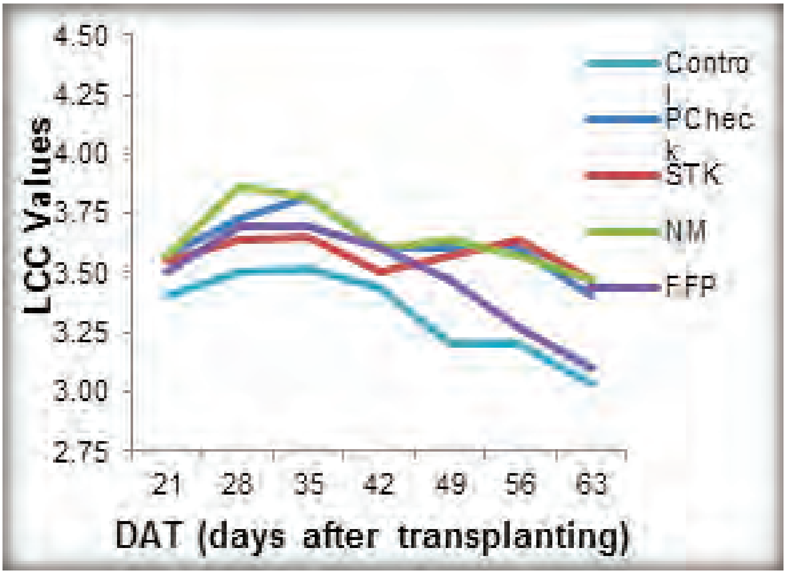

Figure 7. LCC Reading of different NDT recommendation from 21 to 63 days after transplanting (DAT) during WS

Table 3. Grain yield (ton/ha) and Agronomic Nitrogen Use Efficiency or ANUE (kg grain/kg nutrient applied) of different NDT recommendation during 2012 dry and wet season

Treatment	DS		WS		Average GY	Average ANUE
	GY	AE	GY	AE		
Control	5.7a		5.1a		5.4a	
Pcheck	9.7b	25.4a	6.6b	23.1a	8.1d	24.2ns
STK	9.4bc	28.2a	6.3bc	22.3a	7.8d	25.2ns
NM	7.9c	37.8b	5.9c	10.6b	6.9b	24.2ns
FFP	8.7b	25.9a	6.0b	18.6c	7.3c	25.9ns

Yield potential, nitrogen-use efficiency and grain quality of irrigated lowland rice varieties

HAF Makahiya, HM Corpuz, MV Romero, EC Arocena and RT Cruz

Yield potential is the maximum yield of a variety in an environment where nutrient and water are non-limiting and with minimum pests under favourable weather condition. The study showed that yield potential and grain quality, such as protein content, are negatively correlated. This study aimed to assess the yield potential, nitrogen use efficiency and grain quality of different varieties in response to varying nitrogen management. Field experiment was conducted at PhilRice Central Experiment Station in 2012 wet season (WS). The varieties tested were NSIC Rc148 (111 days), NSIC Rc222 (114 days), NSIC Rc240 (115 days), NSIC Rc13 (120 days), Balatinaw (115 days) and Dinorado (117 days). Fertilizer treatments used were (1) N-omission plot where 30kg P/ha and 30kg K/ha were applied at 14 DAT and (2) LCC-based N fertilizer application where 4 bags/ha of 14-14-14-12S were applied at 14 days after transplanting (DAT) and 23kg N/ha was applied when LCC reading was below critical value of 4. LCC readings were done weekly starting at 21 DAT until first flowering. Grain yield (t/ha) was obtained from 5m2 area and adjusted to 14% moisture content. Agronomic Nitrogen Use Efficiency (ANUE) was estimated from difference between grain yields in N fertilized plot and plot that did not receive N fertilizer divided by total amount of N fertilizer applied considering that levels of P and K were adequate. Partial factor productivity of applied N (PFPN) was determined from the ratio of grain yield in N fertilized plot and total amount of N fertilizer applied.

Findings:

- In 2012 WS, NSIC Rc222 had significantly higher grain yields of 5.3-6.0t/ha among the varieties tested (Table 4). NSIC Rc148(4.6-5.2t/ha), NSIC Rc240 (4.6-5.6t/ha) and NSIC Rc13 (4.7-4.8t/ha) were not significantly different across treatments. However, the traditional variety Dinorado with yields of 2.7t/ha in N-omission plot and 4.0t/ha in LCC-based N application and pigmented rice variety Balatinaw with yields of 1.6t/ha in N-omission plot and 1.9t/ha in LCC-based N application had the lowest yields among varieties. This could be due to lower harvest indices and lodging effect in 2012 WS. Grain yields in the LCC-based N fertilizer application were significantly higher than yields in N-omission plot.

- For LCC-based N application, NSIC Rc240 had the highest ANUE of 19.6kg grain/kg N applied but did not differ significantly with 12.5, 7.6, 7.2, 4.6 and -1.2kg grain/kg N applied ANUE in Dinorado, NSIC Rc148, NSIC Rc222, Balatinaw and NSIC Rc13, respectively. The negative ANUE value of -1.2kg grain/kg N applied in NSIC Rc13 resulted from higher yield obtained in N-omission plot.

- NSIC Rc240 had significantly higher PFPN of 106.5kg grain/kg N among varieties tested in LCC-based N application. This was followed by NSIC Rc13 with PFPN of 88.9kg grain/kg N, NSIC Rc148 with PFPN of 68.4kg grain/kg N, NSIC Rc222 with PFPN of 60.3kg grain/kg N, Dinorado with PFPN of 40.0kg grain/kg N and Balatinaw with PFPN of 25.0kg grain/kg N. Varietal differences in PFPN were due to differences in grain yield, harvest index and amount of total N applied.

Table 4. Grain yield (t/ha), ANUE (kg grain/kg N applied) and PFPN (kg grain/kg N) of NSIC Rc148, NSIC Rc222, NSIC Rc240, NSIC Rc13, Balatinaw and Dinorado in N-omission plot and LCC-based N fertilizer application in 2012 WS.

Variety	Grain Yield* (t/ha)		ANUE* (kg grain/kg N applied)	PFP_N* (kg grain/kg N)
	N-omission plot	LCC-based N fertilizer application	LCC-based N fertilizer application	LCC-based N fertilizer application
NSIC Rc148	4.6 b	5.2 b	7.6 a	68.4 c
NSIC Rc222	5.3 a	6.0 a	7.2 a	60.3 c
NSIC Rc240	4.6 b	5.6 ab	19.6 a	106.5 a
NSIC Rc13	4.8 b	4.7 b	-1.2 a	88.9 b
Balatinaw	1.6 d	1.9 d	4.6 a	25.0 e
Dinorado	2.7 c	4.0 c	12.5 a	40.0 d

*Means followed by similar letter in a column were not significantly different at 5% level using LSD. Note: Total NPK applied with –N, +P, +K was 0-30-30 kg/ha. Total NPK applied with LCC-based N fertilizer application with was 76-30-30 kg/ha in NSIC Rc148 and Balatinaw, 99-30-30 kg/ha in NSIC Rc222 and Dinorado, 53-30-30 kg/ha in NSIC Rc240 and NSIC Rc13. First application of 4 bags of 14-14-14-12S in LCC-based N application was done at 14 DAT.

- Generally, varieties differed significantly in grain yield and PFPN. Varieties did not differ significantly in ANUE due to high grain yield obtained in N-omission plot.

- Grain samples were aged and ready for grain quality analysis. Grain quality that includes milling potentials (brown rice, total milled rice and head rice percentage), physical attributes (grain length and shape, chalky grains percentage) and physico-chemical properties (amylose content, crude protein content and gelatinization temperature) will be determined in 2013 DS.

II.Development and Assessment of Soils, Water and Nutrient Diagnostic Tools

The use of Decision Support System for Agrotechnology Transfer (DSSAT) rice crop model to evaluate the potential yield of irrigated lowland rice under different nutrient management levels and climate types in the Philippines. I. Nueva Ecija (Type II climate)

HAF Makahiya, FH Bordey and RT Cruz

The Decision Support System for Agrotechnology Transfer (DSSAT) is a software developed to integrate the effects of crop genotype, soil, weather, and management options. In the calibration of the model, a set of genetic coefficients of the rice varieties will be obtained. Genetic coefficients are values that describe the phenology and growth stages of the varieties. Once the model is calibrated, DSSAT can be used to simulate the potential yield of varieties under optimum crop management in different locations with varying weather conditions. Observed yield potential in experimental field and simulated potential yield will be compared for validation of the model. Hence, the DSSAT CERES-rice crop model was utilized in this study to establish a new protocol to determine the yield potential of different inbred and hybrid rice varieties, determine the nitrogen management practice that will optimize the yield potential and nitrogen use efficiency of the test varieties, and determine the optimum nitrogen management practice of similar varieties under different climate types in irrigated lowland rice areas in the Philippines.

The field experiment was conducted in 2012 dry and wet seasons to assess the yield potential and agronomic nitrogen use efficiency (ANUE) of three varieties namely, PSB Rc82 (110 days), NSIC Rc160 (122 days) and Mestiso 20 (111 days) under varying NPK ratios. Fertilizer treatments were: (1) Control or no fertilizer, (2) -N, +P, +K where 30kg/ha in DS and 40kg each in DS of P and K fertilizers, (3) LCC-based N fertilizer application with 4:2:1 NPK ratio where 35kg N/ha in DS and 23kg N/ha in WS were applied when LCC reading was below 4, (4) LCC-based N fertilizer application with 4:1:2 NPK ratio where 35kg N/ha in DS and 23kg N/ha in WS were applied when LCC reading was below 4, and (5) growth stage-based N fertilizer management where N was applied in three splits: 35kg N/ha (DS) and 23kg N/ha (WS) each at mid-tillering, panicle initiation (EPI), and flowering stages. All P and K fertilizers were applied at 14 days after transplanting (DAT). LCC reading was done every week which began at 21 DAT until early flowering. Grain yield (t/ha) was obtained from 5m2 area and adjusted to 14% moisture content. Agronomic nitrogen use efficiency was estimated from grain yields in N fertilized plot and plot that did not receive N fertilizer considering that levels of P and K were adequate.

Findings:

- In DS, Mestiso 20 had significantly higher grain yields of 6.6-10.4t/ha than PSB Rc82 with 5.2-9.5 and NSIC Rc160 (5.0-8.9t/ha) across fertilizer treatments. In WS, PSB Rc82 with yield of 4.5-6.4t/ha did not differ significantly with NSIC Rc160 (4.6-6.3t/ha) but was significantly higher than Mestiso 20 (4.1-5.8t/ha) across treatments due to stem borer damage.

- Grain yields of 5.0-6.8t/ha in DS and 4.1-4.5t/ha in WS in the control with no fertilizer did not differ with the 5.2-6.6t/ha yields in DS and 4.4-4.6t/ha in WS in N omission plot (-N, +P, +K) (Table 5). This shows that P and K supply in the soil were adequate and N was commonly limiting across seasons under Maligaya clay soil.

- Grain yields of 8.2-9.9t/ha in DS and 5.8-6.3t/ha in WS for LCC-based N fertilizer application with 4:2:1 NPK ratio, 8.2-10.1t/ha in DS and 4.5-6.4t/ha in WS for LCC-based N fertilizer application with 4:1:2 NPK ratio, and 7.2-9.9t/ha in DS and 5.1-5.3t/ha in WS for growth stage-based N application with 3:1:1NPK ratio were not significantly different. Considering that indigenous P and K supplies were adequate, varying the P and K ratio did not affect the yields of inbreds PSB Rc82 and NSIC Rc160, and hybrid Mestiso 20 under LCC-based N application.

- In DS, ANUE of 30.7-37.0kg grain/kg N applied in Mestiso 20 were higher than 19.8-31.7kg grain/kg N applied ANUE in PSB Rc82 and 17.6-23.0kg grain/kg N applied ANUE in NSIC Rc160 (Table 6). In WS, Mestiso 20 had lower ANUE than PSB Rc82 and NSIC Rc160 due to stemborer damage. Generally, LCC-based N application had higher ANUE than growth stage-based N application across seasons. However with LCC, NPK ratios 4:2:1 and 4:1:2 did not differ in ANUE.

Table 5. Grain yield (t/ha) of PSB Rc82, NSIC Rc160 and Mestiso 20 in control with no fertilizer, 0 N, 0 P, 0 K, LCC-based N with 4:2:1 NPK ratio, LCC-based N with 4:1:2 NPK ratio and growth stage-based N with 3:1:1 NPK ratio in 2012 dry and wet seasons.

Treatments	Dry Season+			Wet Season+		
	PSB Rc82	NSIC Rc160	Mestiso 20	PSB Rc82	NSIC Rc160	Mestiso 20
Control or no fertilizer	5.2 c	5.0 b	6.8 b	4.5 b	5.4 a	4.1 b
-N, +P, +K	5.2 c	5.8 b	6.6 b	4.6 b	4.6 b	4.4 b
+N, -P, +K*	9.3 a	8.2 a	10.0 a	-	-	-
+N, +P, -K*	9.5 a	8.9 a	10.4 a	-	-	-
LCC-based N (4:2:1 NPK)	8.7 a	8.2 a	9.9 a	6.3 a	6.3 a	5.8 a
LCC-based N (4:1:2 NPK)	9.2 a	8.2 a	10.1 a	6.4 a	6.1 a	4.5 b
Growth stage-based N (3:1:1 NPK)	7.2 b	8.0 a	9.9 a	5.1 a	5.3 a	5.2 a

*P and K omission plots were not used during wet season since indigenous P and K supplies in the soil were adequate in Maligaya clay soil.
+Means followed by similar letter in a column did not differ by 5% level of significance using LSD.

Table 6. Agronomic N use efficiency or ANUE (kg grain/kg N applied) of PSB Rc82, NSIC Rc160 and Mestiso 20 in 0 P, 0 K, LCC-based N with 4:2:1 NPK ratio, LCC-based N with 4:1:2 NPK ratio and growth stage-based N with 3:1:1 NPK ratio in 2012 dry and wet seasons.

Treatments*	Dry Season			Wet Season		
	PSB Rc82	NSIC Rc160	Mestiso 20	PSB Rc82	NSIC Rc160	Mestiso 20
+N, -P, +K	29.6 a	17.6 a	30.7 a	-	-	-
+N, +P, -K	31.7 a	23.0 a	37.0 a	-	-	-
LCC-based N (4:2:1 NPK)	26.8 a	18.9 a	34.4 a	29.6 a	28.4 a	25.1 a
LCC-based N (4:1:2 NPK)	30.9 a	18.5 a	36.3 a	32.0 a	25.8 ab	2.6 b
Growth stage-based N (3:1:1 NPK)	19.8 b	21.3 a	31.9 a	11.5 b	13.9 b	17.8 a

* Total NPK applied with –N, +P, +K was 0-40-40 kg/ha (DS) & 0-30-30 kg/ha (WS). Total NPK applied with +N, -P, +K was 140-0-40 kg/ha (DS). Total NPK applied with +N, +P, -K was 137-40-0 kg/ha (DS). Total NPK applied with LCC-based N management with 4:2:1 NPK ratio was 131.25-52.5-26.25 kg/ha (DS) & 57.5-23-11.5 kg/ha (WS) in PSB Rc82 & NSIC Rc160 but 96.25-52.5-26.25 kg/ha (DS) & 57.5-23-11.5 kg/ha (WS) in Mestiso 20. Total NPK applied with LCC-based N management with 4:1:2 NPK ratio was 131.25-26.25-52.5 kg/ha (DS) & 57.5-11.5-23 kg/ha (WS) in PSB Rc82 & NSIC Rc160 but 96.25-26.25-52.5 kg/ha (DS) & 57.5-11.5-23 kg/ha (WS) in Mestiso 20. Total NPK applied with growth stage-based N management with 3:1:1 NPK ratio was 105-35-35 kg/ha (DS) & 46-15.3-15.3 kg/ha (WS)

III. Assessment and Evaluation of Crop Intensification and Resource Use Efficiency in Rice Production

Effect of nitrogen application before the onset of drought on the plastic root system development responses to progressive water deficit in rice

RR Suralta and N Lucob

Maximal soil moisture capture under drought stress reflects plant production. This, however, depends on the degree of plastic root system response during progressive drying of soil. We hypothesize that N fertilizer applied before the onset of drought could enhance plastic root system development in rice.

Findings:

- There was an interaction between the genotype and N source applied before the onset of drought on the shoot dry matter production (Table 7). Shoot dry weights(SDW) in DRS111 and DRS66 were significantly increased with application of N regardless of sources. On the other hand, SDW of IR64 and NSICRc11 was not positively affected by N application.

- The trend in response of transpiration was similar with those in shoot dry matter production wherein only DRS111 and DRS66 showed a maintained transpiration rate with N application regardless of source.

- Root system development response based on total root length (TRL) tended to increase with the availability of N fertilizer before the onset of drought. Among genotypes, DRS111 and DRS66 had longer total root length with N application especially ammonium sulfate.

- Shoot dry weight was highly correlated with Ts and TRL. (Table 8). Variations on the shoot dry weight was attributed to 56% and 64 % variations on Tr and TRL, respectively.

- The results implied that N fertilizer application before the onset of drought could enhance plastic root system development for increased water uptake and dry matter production but it depends on the source of N and genotypes used. In the study, application of ammonium sulfate enhanced plastic root system development more than urea fertilizer.

Table 7. Shoot dry weight, transpiration and total root length of the different genotypes grown under transient waterlogged for 14 days followed by progressive drying maintained at 10% SMC at various N sources applied at 80kg ha-1 before the onset of drought.

Genotypes	N Sources	Shoot dry weight (g)	Transpiration	Total root length (cm plant^{-1})
DRS111	Control	1.09 d	0.14 cd	7651.02 b
	Ammonium sulfate	**3.04 a**	**0.30 a**	**14430.40 a**
	Urea	1.68 b	0.24ab	8835.85ab
DRS66	Control	0.68 e	0.10 d	5926.40 b
	Ammonium sulfate	1.57bc	0.20bc	8041.30ab
	Urea	0.98 de	0.15bcd	5600.13 b
IR64	Control	1.64 b	0.19bcd	10818.70ab
	Ammonium sulfate	1.52bc	0.20bc	10350.80ab
	Urea	1.71 b	0.23abc	10031.71ab
NSIC Rc11	Control	1.27 cd	0.20bc	9135.29ab
	Ammonium sulfate	1.56bc	0.22abc	10156.90ab
	Urea	0.98 de	0.13abc	6469.94 b

Values followed by the same letter in a column within each treatment are not significantly different at 5% by Fisher's LSD test.

Table 8. Correlation result of the different genotypes grown under transient waterlogged for 14 days followed by progressive drying maintained at 10% SMC at various N sources applied at 80 kg ha-1 before the onset of drought.

	Shoot dry weight	Transpiration
Shoot dry weight		
Transpiration	0.75	
TRL	0.80	0.61

Calibration of raised bed as a facility for screening drought resistant lines for upland rice breeding
RR Suralta and NB Lucob

Rooting depth allows the plant to extract more water available at deeper soil layer during drought. It has been widely recognized that genotypic variation on growth response to water availability may arise from genotypic variation on rooting depth during water deficit. Such trait is important in upland rice farming wherein fluctuating soil moisture regimes are inevitable. Thus, the study aims to calibrate raised bed system as a screening facility for identifying deep rooting genotypes, and assist breeding for improved drought resistance in rainfed upland systems.

Findings

- In 2012 DS, raised bed was constructed 35cm above the ground level by adding 30cm-thick layer of topsoil above 5cm-thick sand gravel layer. A normal bed (without gravel layer), which received well-watering, served as control. Twenty genotypes (upland varieties and double haploid lines (DHLs) from CT9993 and IR62266 crosses) were commonly grown in each bed.

- Thermal image analysis during one of the drought periods showed that genotypes in raised bed had higher leaf temperatures than in the well-watered bed (Figure 8).

- Soil moisture dynamics in the raised bed showed that the soil above the gravel layer was constantly higher than those below the gravel layer (Figure 9). This indicates that the gravel layer embedded at 30cm below the soil layer blocked the capillary rise of water underneath.

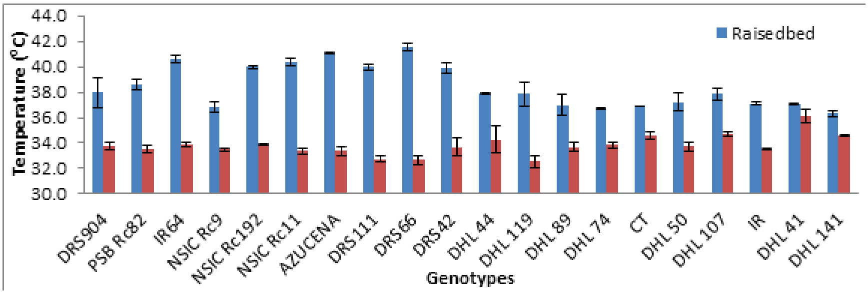

Figure 8. Thermal image analysis of raised bed and well-watered bed.

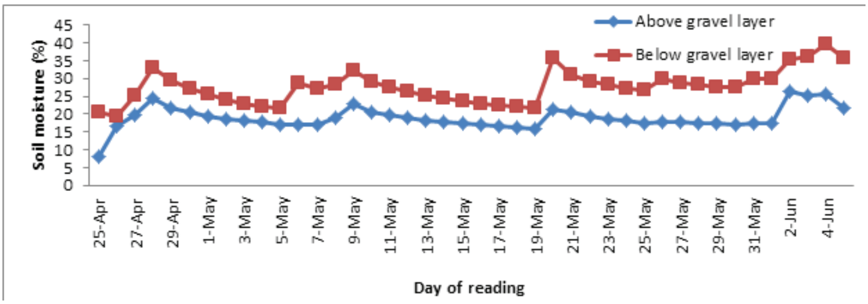

Figure 9.Soil moisture dynamics of layers above and below the gravel layer in raised bed.

- Upon harvest, the result showed that no roots penetrated the gravel layer. This indicates that in the next set-up, gravel layer will be embedded at shallower soil depth. Thus, in 2012 WS, gravel layer was imposed at 25cm below the soil surface. The same set of genotypes was used. There were some genotypes whose roots penetrated the gravel layer. The root system scanning, measurements and analysis are on-going. Thereafter, the association of deep rooting and lateral root branching ability with the above ground dry matter production and yield will be analyzed.

- Raised bed system with gravel embedded at 30 cm soil depth was simulated in mylar tubes to evaluate the functional contribution of deep rooting ability to soil water uptake and dry matter production. The three water treatments were: WW-well watered with SMC maintained at 20%, D0-drought without gravel layer and D30-drought with 5cm-thick gravel layer at 30cm soil depth. The genotypes used were selected DHLs. At 0-15 and 15-30cm soil depth, the SMC in D0 (drought without gravel layer) was higher than in D30 (drought with gravel layer at 30cm soil depth), a solid evidence for blocking of capillary rise of water using gravel (Figure 10).

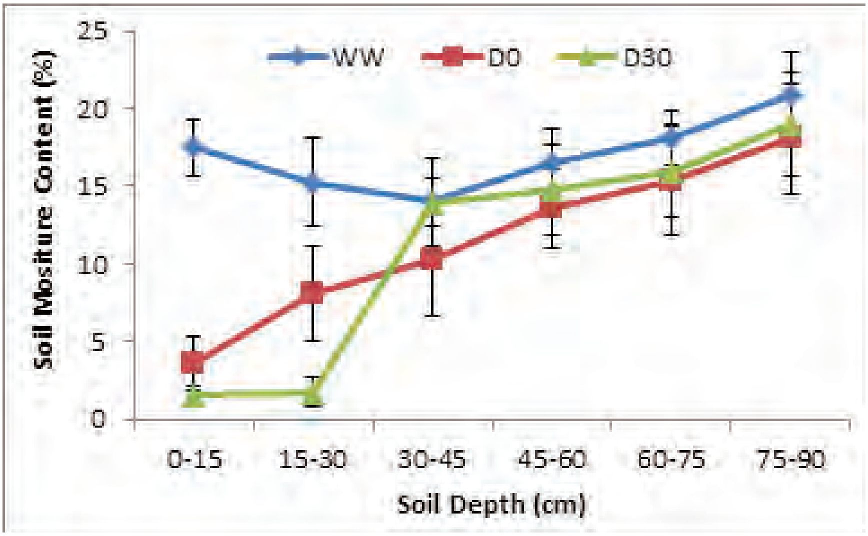

Figure 10. Soil moisture dynamics at different depths as influenced by soil moisture treatments.

- There were no significant variations in total lateral root length (TLRL) of the whole root system. However, significant genotypic variations in TLRL below the gravel layer (30cm soil depth and below) were observed (Figure 11). These variations in TLRL below 30cm depth where soil moisture is more available contributed to about 52% in the genotypic variation in transpiration rates during drought period (Table 9).

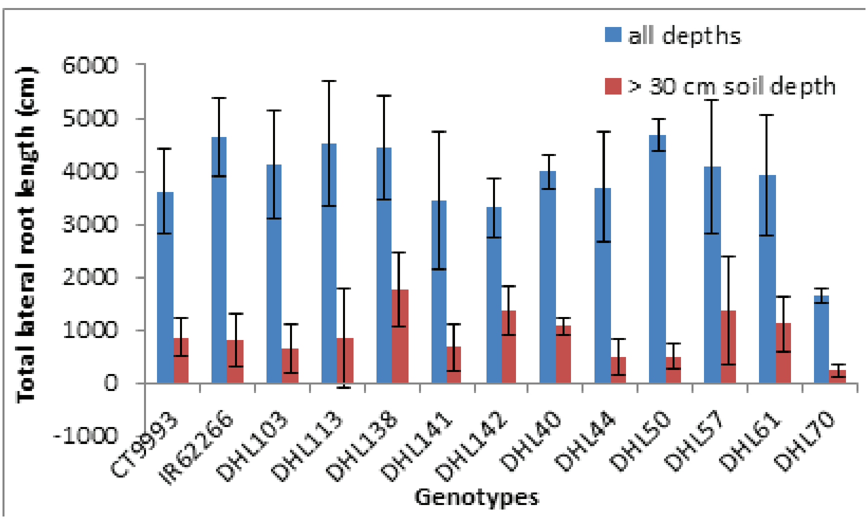

Figure 11.Total lateral root length and lateral root length below 30 cm soil depth of different DHLs grown under D30

Table 9. Correlation matrices among root parameters, transpiration, water use and shoot dry weight of different rice genotypes grown under well watered (WW) conditions.

Traits	Transpiration	Water use	Shoot dry weight
TRL (whole root)	0.64 ***	0.45 **	0.28 ns
TRL (> 30 cm soil depth)	0.52 ***	0.04 ns	0.11 ns
TNRL (whole root)	-0.12 ns	-0.22 ns	0.02 ns
TNRL (> 30 cm soil depth)	0.22 ns	0.19 ns	0.16 ns
TLRL (whole root)	0.64 ***	0.47 **	0.51 ***
TLRL (> 30 cm soil depth)	**0.52 *** **	0.03 ns	0.10 ns
Mean NRL	-0.18 ns	-0.24 ns	-0.11 ns
Deepest NRL	0.28 ns	0.11 ns	0.06 ns
Transpiration		0.61 ***	0.51 ***
Water use			0.52 ***

ns-not significant; **, *** -significant at P0.01 and P0.001, respectively

Ratooning ability of irrigated lowland rice: response to water and nitrogen management for two rice genotypes under transplanted system
RT Cruz, MVR Bascon and MJC Regalado

Rice ratooning is one practical way of intensifying crop production per unit area and per unit time. Ratooning is the ability of the plant to regenerate new tillers from the main crop stubbles. To make ratooning more productive and economic, cultivars with good ratooning ability and a package of main- and ratoon crop management system must be developed. Thus, the study aims to determine the optimum water and nutrient management for rice ratooning and assess the ratooning ability of two rice genotypes, which are both widely used by farmers.

PSB Rc82 and NSIC Rc160 varieties were used with the following treatments: (1) Water/Irrigation System – a) early flooding (continuously flooded, immediately after harvest with a depth of 2-3cm until 1-2 week before harvest) and b) delayed flooding (drained but moist for 10 days after main crop harvest; then flooded continuously with a depth of 2-3cm until 1-2 weeks before harvest): (2) N fertilizer levels - a). Control or No fertilizer, b) 30kg N/ha, c) 60kg N/ha, d) 90kg N/ha and e) LCC-based N application at 35kg N/ha per critical reading in dry season (DS) and 23kg N/ha per critical reading in wet season (WS): (3) Cutting height – a) 15cm (during WS), b) 20 cm and c) 30cm.

Findings:

- In DS, the following factors showed significant differences in percent missing hill: early flooding (33%) had a lower percentage of missing hills than late flooding (40%), PSB Rc82 (30%) was lower compared to NSIC Rc160 (43%). Control or no fertilizer (8%) was lower than 30 kg N/ha (42%), 60kg N/ha (25%) and 90kg N/ha (75%). No significant differences occurred during WS. In terms of cutting height, the same effect on number of missing hills was observed. 30 cm cutting height (63% during DS and 15% during WS) had the highest number of missing hills compared to 20cm (37.0 % during DS and 7.7% during WS) and 15cm (5.2% during WS).

- During WS, increasing the cutting height with 0-60 kg N/ha application by 5-15cm from 15cm resulted to an increase of 9-15% missing hills. Regardless of flooding, increasing the cutting height by 5-15cm from 15cm resulted to 17-20% missing hills. However, regardless of factors, the high ratoon rating of less than 5% missing hills was not achieved.

- In DS, no significant difference was observed in two flooding. The application of 90kg N/ha showed excellent vigor with 19 ratoon tillers/hill. An increase of 5 tillers/hill from no fertilizer application (14 tillers/hill) was observed. No significant difference in ratoon tillers/hill was observed for 30 kg N/ha, LCC-based N application and 60kg N/ha (all 16 tillers/ha). PSB Rc82 (18 tillers/hill) had more ratoon tillers/hill than the NSIC Rc160 (14 tillers/hill). 30 cm cutting height had higher number of ratoon tillers (19 tillers/hill) than 20 cm (15 tillers/hill) cutting height. In WS, no significant difference was observed in different factors except cutting height. 30cm cutting height (10 tillers/hill) had the highest number of ratoon tillers/hill compared to 15cm (8 tillers/hill).

- Based on Table 10, ratoon crop yield of NSIC Rc160 was higher compared to PSB Rc82 despite higher main crop yield of PSB Rc82. Main crop yield was also higher with NSIC Rc160 than PSB Rc82. Better ratooning performance during WS was observed as shown below, with 21% of main crop yield during DS compared to 9% during WS. This could be due to the higher amount of rainfall available during wet season (October-December).

Table 10. Grain yield from main crop (MC) and ratoon crop (RC) with % yield of main crop, 2012 DS and WS.

Varieties	Yield ($t\ ha^{-1}$)				% Yield of MC		Days to Maturity	
	DS		WS					
	MC	RC	MC	RC	DS	WS	DS	WS
NSIC Rc160	7.4	0.7	5.8	1.2	9.0	21.0	45	60
PSB Rc82	8.0	0.5	6.2	1.1	6.8	18.0	43	60

- In DS, no significant differences were observed on flooding with comparable grain yields, early flooding (0.6ton/ha) and late flooding (0.6ton/ha). Grain yields from 60kg N//ha and 90kg N/ha application

(0.7ton/ha) were significantly higher than no fertilizer or control (0.5ton/ha). NSIC Rc160 (0.7ton/ha) and 20 cm cutting height (0.7ton/ha) had higher average grain yields than PSB Rc82 (0.5ton/ha) and 30 cm cutting height (0.5ton/ha).

- On the other hand, average grain yield during WS showed significant differences in nitrogen levels, variety and cutting height. Nitrogen application from 30-90kg N/ha application showed significantly higher grain yields than control or no fertilizer (0.9ton/ha). 60kg N/ha application was observed to be the optimum N application with grain yield of 1.3ton/ha. It was higher with 30kg N/ha (1.1ton/ha) and LCC-based N application (1.1ton/ha) but comparable with 90kg N/ha (1.4ton/ha). NSIC Rc160 (1.2ton/ha) was higher than PSB Rc82 (1.1ton/ha). 20cm and 15cm cutting heights had the same average grain yield of 1.2ton/ha. This was higher than with 30cm cutting height (1.0ton/ha). This indicates that an increase of 5-10cm in cutting height had no increasing effect to grain yield.

- Based on the results of the two seasons, the following points can be made: Water management for ratoon crops can either early flooding or late flooding since no significant difference in grain yield. 60kg N/ha and 20cm were the optimum N rate and cutting height for ratoon crops, respectively. NSIC Rc160 had higher ratoon grain yield than PSB Rc82. However, further selection trial for varieties with better ratooning ability, particularly the new rice varieties, is needed.

Utilizing resource efficient technologies for higher rice productivity
WB Collado, MD Malabayabas, AJ. Espriritu and MJC Regalado

With the enduring effort to attain rice self-sufficiency and increased productivity, PhilRice continuously develops rice production technologies that can readily be used by farmers and other rice stakeholders. Recently, technological progress has enabled multi-cropping per unit area. The adoption of high-yielding rice varieties, appropriate machinery and fertilizers has generally enhanced soil productivity. However, these schemes have increased the energy input per unit area. The utilization of technologies should be appropriately evaluated to ensure high energy efficient production. Thus, the study was conducted to evaluate the performance of selected newly-released high-yielding rice varieties using resource-efficient rice technologies like the drum-seeding method of crop establishment, the LCC-based nitrogen fertilizer application and the controlled irrigation scheme.

Findings:

2012 Wet Season

- The 2012 Wet Season cropping showed no significant mean grain yield differences among the rice varieties tested (Figure 12). Average grain yield of the varieties tested was 6.0t/ha.

- All the components of yield showed no significant differences among the varieties tested (Table 11). Among the components of yield that contributed significantly to the increase in grain yield was the number of spikelets/panicle; higher number of spikelets/panicle (105-128 spikelets/panicle) were obtained by all the varieties tested during this season, lower number of panicles per unit area were obtained by the varieties (259-285 panicles/m2).

- The total N applied following the LCC-based application differed significantly (Figure 13); IL-035, Mestiso 20 and NSIC Rc240 utilized comparable N (50-58 kg N/ha), while NSIC Rc224 utilized higher N (81kg N/ha); this result showed that the varieties tested except NSIC Rc224 required lesser N to produce a 6 t/ha yield during the season.

- Partial factor productivity from the applied N was highest with NSIC Rc240 at 119.2kg grain produced/kg N applied and lowest with NSIC Rc224 at 72.8kg/kg N (Figure. 14); all the PFPs of the test rice varieties were extremely above the optimum value of ≥50kg grain/kg N applied measured in the irrigated lowland rice fields in Asia.

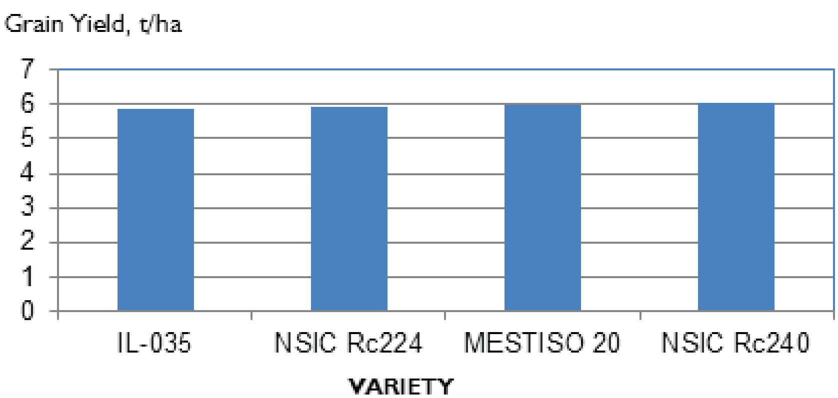

Figure 12. Mean grain yield of the varieties tested. 2012 Wet Season, PhilRice CES, Nueva Ecija.

Table 11. The components of yield of the rice varieties tested. 2012 Wet Season cropping, PhilRice-CES, Maligaya, Science City of Muñoz, Nueva Ecija, Philippines.

VARIETY	Panicle/m^2	Spikelets/panicle	Filled Spikelets (%)	1,000-Grain Weight (g)
NSIC Rc224	285 a	114 a	75.2 a	23.97 a
IL-035	278 a	105 a	79.1 a	24.50 a
Mestiso 20	270 a	107 a	77.6 a	23.93 a
NSIC Rc240	259 a	127 a	81.9 a	24.50 a

In a column, means followed by a common letter are not significantly different at the 5% level by Scheffe's test.

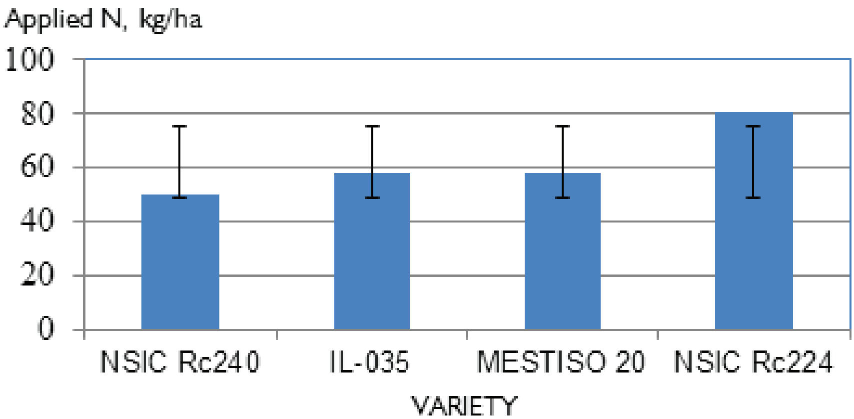

Figure 13. Average nitrogen applied on the varieties tested based on the leaf color chart. 2012 Wet Season, PhilRice CES, Maligaya, Science City of Muñoz, Nueva Ecija, Philippines.

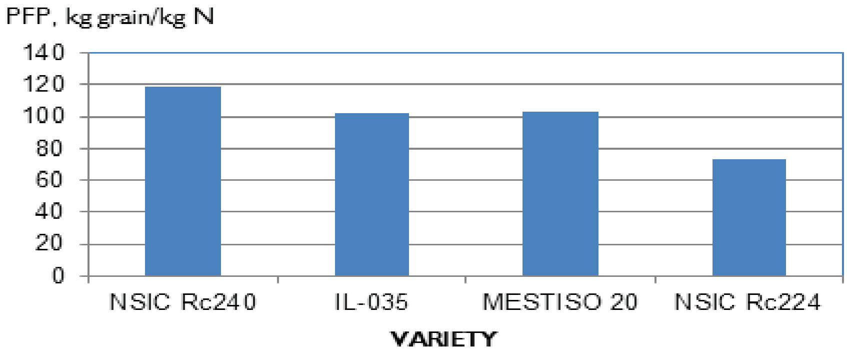

Figure 14. The partial factor productivity (PFP) from the applied N of the test rice varieties.2012 Wet Season, PhilRice-CES, Maligaya, Science City of Muñoz, Nueva Ecija, Philippines.

IV.ASPPD Research and Analytical Laboratory Systems and Maintenance
AE Espiritu and EF Javier

The project on ASPPD Research and Analytical Laboratory Systems and Maintenance was proposed and funded in 2012 DS. Its main goal is to capacitate the ASPPD laboratory system for its R&D. Its purpose is to improve or upgrade the ASPPD laboratory system and maintenance. The existence of the laboratory was usually supported from little contributions of some research projects housed in the division but these research projects have minimal approved budget, hence, laboratory management had been sourcing out funds from external sources. This project was established to: (1) provide assistance in the improvement/upgrade of the laboratory facilities for better quality research output; (2) constantly optimize laboratory/chemical procedures for soils and plant samples; and (3) build-up database and inventory of information on the chemical and laboratory supplies and usages. Activities in this project include: (1) chemical and laboratory supplies inventory and purchase; (2) annual equipment preventive maintenance service and calibration; (3) data-based management system; and (4) consultation, technical networking and inter-laboratory collaboration.

Accomplishments:

- Updated the inventory of incoming and outgoing of chemicals which prevented the over-supply of chemicals

- Submitted updated semi-annual report on the requirement of “Permit to Purchase” to Supply Property Office on the procurement and usage of chemical supplies in our research activities controlled by the Philippine Drug Enforcement Agency (PDEA)

- All equipment due for annual preventive maintenance service and calibration had undergone PMS.

- Processed repair of several laboratory equipment.

- Acquired 12 new laboratory chairs to replaced worn-out office chairs.

- Provided technical advice and laboratory assistance to 3 thesis students from Honorato C. Perez, Sr. Memorial Science High School in Cabanatuan.

Abbreviations and acronymns

ABA – Abscicic acid
Ac – anther culture
AC – amylose content
AESA – Agro-ecosystems Analysis
AEW – agricultural extension workers
AG – anaerobic germination
AIS – Agricultural Information System
ANOVA – analysis of variance
AON – advance observation nursery
AT – agricultural technologist
AYT – advanced yield trial
BCA – biological control agent
BLB – bacterial leaf blight
BLS – bacterial leaf streak
BPH – brown planthopper
Bo - boron
BR – brown rice
BSWM – Bureau of Soils and Water Management
Ca - Calcium
CARP – Comprehensive Agrarian Reform Program
cav – cavan, usually 50 kg
CBFM – community-based forestry management
CLSU – Central Luzon State University
cm – centimeter
CMS – cystoplasmic male sterile
CP – protein content
CRH – carbonized rice hull
CTRHC – continuous-type rice hull carbonizer
CT – conventional tillage
Cu – copper
DA – Department of Agriculture
DA-RFU – Department of Agriculture-Regional Field Units
DAE – days after emergence
DAS – days after seeding
DAT – days after transplanting
DBMS – database management system
DDTK – disease diagnostic tool kit
DENR – Department of Environment and Natural Resources
DH L– double haploid lines
DRR – drought recovery rate
DS – dry season
DSA - diversity and stress adaptation
DSR – direct seeded rice
DUST – distinctness, uniformity and stability trial
DWSR – direct wet-seeded rice
EGS – early generation screening
EH – early heading
EMBI – effective microorganism-based inoculant
EPI – early panicle initiation
ET – early tillering
FAO – Food and Agriculture Organization
Fe – Iron
FFA – free fatty acid
FFP – farmer's fertilizer practice
FFS – farmers' field school
FGD – focus group discussion
FI – farmer innovator
FSSP – Food Staples Self-sufficiency Plan
g – gram
GAS – golden apple snail
GC – gel consistency
GIS – geographic information system
GHG – greenhouse gas
GLH – green leafhopper
GPS – global positioning system
GQ – grain quality
GUI – graphical user interface
GWS – genomwide selection
GYT – general yield trial
h – hour
ha – hectare
HIP - high inorganic phosphate
HPL – hybrid parental line
I - intermediate
ICIS – International Crop Information System
ICT – information and communication technology
IMO – indigenous microorganism
IF – inorganic fertilizer
INGER - International Network for Genetic Evaluation of Rice
IP – insect pest
IPDTK – insect pest diagnostic tool kit
IPM – Integrated Pest Management
IRRI – International Rice Research Institute
IVC – in vitro culture
IVM – in vitro mutagenesis
IWM – integrated weed management
JICA – Japan International Cooperation Agency
K – potassium
kg – kilogram
KP – knowledge product
KSL – knowledge sharing and learning
LCC – leaf color chart
LDIS – low-cost drip irrigation system
LeD – leaf drying
LeR – leaf rolling
lpa – low phytic acid
LGU – local government unit

LSTD – location specific technology development
m – meter
MAS – marker-assisted selection
MAT – Multi-Adaption Trial
MC – moisture content
MDDST – modified dry direct seeding technique
MET – multi-environment trial
MFE – male fertile environment
MLM – mixed-effects linear model
Mg – magnesium
Mn – Manganese
MDDST – Modified Dry Direct Seeding Technique
MOET – minus one element technique
MR – moderately resistant
MRT – Mobile Rice TeknoKlinik
MSE – male-sterile environment
MT – minimum tillage
$mtha^{-1}$ - metric ton per hectare
MYT – multi-location yield trials
N – nitrogen
NAFC – National Agricultural and Fishery Council
NBS – narrow brown spot
NCT – National Cooperative Testing
NFA – National Food Authority
NGO – non-government organization
NE – natural enemies
NIL – near isogenic line
NM – Nutrient Manager
NOPT – Nutrient Omission Plot Technique
NR – new reagent
NSIC – National Seed Industry Council
NSQCS – National Seed Quality Control Services
OF – organic fertilizer
OFT – on-farm trial
OM – organic matter
ON – observational nursery
OPAg – Office of Provincial Agriculturist
OpAPA – Open Academy for Philippine Agriculture
P – phosphorus
PA – phytic acid
PCR – Polymerase chain reaction
PDW – plant dry weight
PF – participating farmer
PFS – PalayCheck field school
PhilRice – Philippine Rice Research Institute
PhilSCAT – Philippine-Sino Center for Agricultural Technology
PHilMech – Philippine Center for Postharvest Development and Mechanization
PCA – principal component analysis
PI – panicle initiation
PN – pedigree nursery
PRKB – Pinoy Rice Knowledge Bank
PTD – participatory technology development
PYT – preliminary yield trial
QTL – quantitative trait loci
R - resistant
RBB – rice black bug
RCBD – randomized complete block design
RDI – regulated deficit irrigation
RF – rainfed
RP – resource person
RPM – revolution per minute
RQCS – Rice Quality Classification Software
RS4D – Rice Science for Development
RSO – rice sufficiency officer
RFL – Rainfed lowland
RTV – rice tungro virus
RTWG – Rice Technical Working Group
S – sulfur
SACLOB – Sealed Storage Enclosure for Rice Seeds
SALT – Sloping Agricultural Land Technology
SB – sheath blight
SFR – small farm reservoir
SME – small-medium enterprise
SMS – short message service
SN – source nursery
SSNM – site-specific nutrient management
SSR – simple sequence repeat
STK – soil test kit
STR – sequence tandem repeat
SV – seedling vigor
t – ton
TCN – testcross nursery
TCP – technical cooperation project
TGMS – thermo-sensitive genetic male sterile
TN – testcross nursery
TOT – training of trainers
TPR – transplanted rice
TRV – traditional variety
TSS – total soluble solid
UEM – ultra-early maturing
UPLB – University of the Philippines Los Baños
VSU – Visayas State University
WBPH – white-backed planthopper
WEPP – water erosion prediction project
WHC – water holding capacity
WHO – World Health Organization
WS – wet season
WT – weed tolerance
YA – yield advantage
Zn – zinc
ZT – zero tillage

List of Tables

List of Tables

List of Figures

Department of Agriculture

PHILRICE

PHILIPPINE RICE RESEARCH INSTITUTE

We are a chartered government corporate entity under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding, cost-reducing, and environment-friendly technologies so farmers can produce enough rice for all Filipinos.

We accomplish this mission through research and development work in our central and seven branch stations, coordinating with a network that comprises 58 agencies and 70 seed centers strategically located nationwide. To help farmers achieve holistic development, we will pursue the following goals in 2010-2020: attaining and sustaining rice self-sufficiency; reducing poverty and malnutrition; and achieving competitiveness through agricultural science and technology.

We have the following certifications: ISO 9001:2008 (Quality Management), ISO 14001:2004 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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