(NOT FOR SALE)

2022 Revised Edition

PalayCheck System

FOR IRRIGATED LOWLAND RICE
(transplanted/ direct wet-seeded)

RICE COMPETITIVENESS
RCEF
ENHANCEMENT FUND
EXTENSION PROGRAM

DEPARTMENT OF AGRICULTURE
PHILRICE
PHILIPPINE RICE RESEARCH INSTITUTE

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Readers, especially farmers and technologists, are encouraged to give feedback on the results of following the PalayCheck System recommendations. Please send them to any PhilRice station (see back cover for the directory).

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"Learning, checking, and sharing
for best farming practices."

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Contents

Foreword

Agricultural economists maintain that for Filipino rice farmers to be at par with their counterparts from other rice-producing countries such as Vietnam and Thailand, they must increase their yield to 6t/ha and reduce their palay production cost by 30% (from P12 to P8/kg). While technologies are available to help them attain the target, they need to employ a more holistic integrated approach that can help them improve their farming practices and ensure high-quality output from-seed-to-seed. After all, producing rice involves a complex series of transformation processes.

The PalayCheck System is geared toward this concept of integration as it adapts and localizes recommendations on the best management strategies at the farm level, taking into account the interactions among practices and other factors contributing to yield, grain quality, and healthy environment. It also promotes experiential group learning where farmers are called to collaborate with their fellow farmers, and are guided by resource persons who shed more light on their understanding of production principles and management skills.

In February 2004, PhilRice and the Food and Agriculture Organization of the United Nations teamed up on a project "Strengthening the Development and Use of RICM for Food Security and Poverty Alleviation." This paved the way for the development of the PalayCheck System, the Philippine adaptation of Australia's Ricecheck System that helped increase its yield from 6t/ha in 1987 to almost 10t/ha in 2000. This localized package of technologies is a result of a series of consultations with rice experts, extension workers, and farmers. The technologies and practices recommended under the System continue to be improved.

This revised edition of the PalayCheck System booklet adopts most of the strategies that had been proven effective in the field even as it introduces some updates anchored on results of researches and actual experiences. With the expanding confluence of various factors challenging local rice production such as climate change, rice trade liberalization, and modernization, PhilRice experts convened in 2019 to come up with the revisions. One of the notable amendments is the composition of the additional Key Check 9, which focuses on Postharvest Management. It tackles proper postharvest practices, from drying to cleaning and storing. This is to accentuate the need for our farmers to produce marketable products such as high-quality seeds and commercially competitive grains. This revised edition will not only help them improve their production, but also enrich their income, which is upheld by the Department of Agriculture's 'new thinking': Food-secure and resilient Philippines with empowered and prosperous farmers and fisherfolk – "Masaganang Ani, Mataas na Kita."

PhilRice is grateful to all field and office workers who have shared their learnings to help develop and refine the PalayCheck System.

This publication is a compelling reference material for agricultural extension workers, trainers, and farmer-leaders to facilitate and guide farmers in their crop management activities. Somehow, it can also help policymakers identify solutions that they can implement for their farmer-constituents.

We hope that by using this material, the farmers, with the help of the government, can sustain a competitive rice production pursuit: productive, reliable, profitable, and environment-friendly.

JOHN C. DE LEON
Executive Director, PhilRice

Abbreviations, acronyms, and symbols used:

AT	-	agricultural technologist
cm	-	centimeter
cav	-	cavan (usually 50kg)
DAS/DAT	-	days after sowing/ transplanting
DS/WS	-	dry season/ wet season
DWSR	-	direct wet-seeded rice
g/ kg	-	gram/ kilogram
GLH	-	green leafhopper
ha	-	hectare
LCC	-	Leaf Color Chart
m/ m^2	-	meter/ square meter
MC	-	moisture content
MOET	-	Minus-One-Element Technique
N/ P/ K	-	Nitrogen/ Phosphorus/ Potassium
No.	-	number
NSQCS	-	National Seed Quality Control Services
PI/ EPI	-	panicle initiation/ early panicle initiation
rpm	-	revolution per minute
S	-	sulfur
t/ha	-	ton per hectare
TPR	-	transplanted rice
wk	-	week
Zn	-	zinc
%	-	percent
≥	-	greater than or equal to

The PalayCheck System

PalayCheck is a dynamic rice crop management system that presents the key technology and management practices as Key Checks; compares farmer practices with best practices; and learns from farmers' discussion groups to sustain improvement in productivity, profitability, and environment safety. PalayCheck is simply "learning, checking, and sharing for best farming practices".

PalayCheck is a Rice Integrated Crop Management (RICM) System. RICM recognizes that rice-growing is a production system consisting of factors that are interdependent and interrelated in their impact on rice growth, yield, and grain quality, and on the sustainability of the environment. It maintains that technology recommendations for yield improvement be developed and transferred to farmers as a holistic and integrated package, not by components such as integrated nutrient (INM) or pest management (IPM).

PalayCheck covers the principal areas of crop management such as seed quality, land preparation, crop establishment, and the respective management of nutrients, water, pests, harvest, and postharvest.

PalayCheck encourages farmers to manage their rice crop according to targets by measuring crop performance and analyzing results. It provides standards in the form of Key Checks that guide farmers on what to achieve; and how to assess and fulfill the Key Checks. In such a way, PalayCheck will help farmers learn from their experiences while improving their crop management practices.

PalayCheck Strategy

Group and experiential learning through farmers' meetings and participative interactions are necessary to help farmers learn and apply the PalayCheck System by comparing farming practices, management options, and yield/quality in the technology demonstration plot with those of other farmers' fields (see Box 1).

PalayCheck employs the following strategies:

- Packaging key technologies as Key Checks
- Working with groups of farmers to identify rice-farming problems, demonstrate the Key Checks, and help farmers learn PalayCheck by comparing the practices, management options, and yield/quality as well as profit with those of other farmers' fields
- Teaching farmers how to evaluate their current practices, and improve the management of their fields using the Key Checks
- Monitoring and recording management inputs and achievement of Key Checks per growth stage
- Helping farmers assess the Key Checks and identify the reasons for achieving or not achieving them

BOX 1.

THE PALAYCHECK SYSTEM

1

Problem Identification thru Participatory Rural Appraisal

2

Farmers' Meetings

Current Farmers' Crop Management Practices

Recommended Crop Management Technologies and Key Checks to Achieve

Monitoring, Recording, and Assessment at the following crop stages:

- Pre-planting
- Land preparation and crop establishment
- Early to mid-tillering
- Maximum tillering
- Panicle initiation
- Flowering to grain-filling
- Maturity
- Harvest and postharvest

3

Productivity, Profitability, and Safety for Self & Environment

Areas of improvement

Implementing the PalayCheck System

Each site will consist of: a PalayCheck demonstration field to showcase the recommended practices; a group of rice farmers; and a facilitator or resource person. The demo field is a selected farmer's field (farmer-partner). Preferably, the field should be at least 0.5 ha located along the roadside, beside a non-technology-intervened field, and near the farmers' meeting area.

Seed and fertilizer inputs may be provided to the farmer-partner to ensure that the recommended practices are followed. The demo field will be the basis for evaluating the strengths and weaknesses of the farmers' management approach, and for discussing as well as learning the necessary adjustments to improve yield and profit. The neighboring members of the group (farmer-cooperators) may or may not adopt PalayCheck recommendations.

The participants of PalayCheck are a group of 15-25 farmers belonging to a community or neighborhood. The group will meet before, during, and after the cropping season to review the management practices, pest incidence, growth and yield results, and weather conditions; compare the PalayCheck demo field with the farmer-cooperators' fields; discuss reasons for achieving or not achieving

Key Checks based on their knowledge and experiences; plan for the next meeting's activities; and record the activities and results of the demo field and the farmer-cooperators' fields.

The management practices, achievement or non-achievement of Key Checks, and yield results will be evaluated per site. The evaluation summary will be presented during the last meeting (after harvest) to expedite the ultimate analysis and interpretation of the achievement of Key Checks and the yield results of each farmer-cooperator and farmer-partner.

Though the PalayCheck System helps farmers attain high yield through proper crop management, it is essential that the learning process be highlighted. The learning process takes place before, during, and after each planting season. Farmers can compare their actual performance and management efforts with the expected outputs (yield, quality, and environmental outcomes) as indicated by the achieved Key Checks. Due to limited resources, farmer-cooperators can not always adapt PalayCheck recommendations. Successes, problems, and failures need to be identified to ensure improvements in the next season.

Steps in using the PalayCheck System

1. Manage the rice crop using the Key Checks.

PalayCheck develops a package of technology recommendations. Emphasize to farmers that the Key Checks are the most important recommendations toward attaining high yield. Each principal area of crop management can have one or more Key Checks. Each Key Check is expressed in a structured way. Therefore, each of them has the following:

- *Crop Management Area*. In variety and seed selection, for example, the Key Check is "Used high-quality seeds of a recommended variety."
- *Importance*. This indicates why the Key Check is so necessary in achieving the field output, or growth-and-yield output of the crop. For example, high-quality seed is pure, clean, full and uniform in size, and has a germination rate of at least 85%.
- *Assessment of Key Check*. This is the indicator or method to determine if the Key Check has been achieved.

  For example, the seed is either certified by NSQCS as evidenced by a tag on the sack, or comes from reliable sources (e.g. PhilRice, UPLB, accredited seed growers) or own-produced. If achieved, it is given a check (☑). If not achieved, it is given a cross (x).
- *Recommendation to achieve Key Check.* The practices required to achieve the Key Check as well as other associated practices needed to manage the crop are laid down. For

example, "choose a variety with high market demand, and performed well in adaptability trials". The recommended practices are the inputs, the Key Checks are the outputs.

2. **Observe, measure, and record crop growth and management performance.**

   Encourage and guide farmers into observing the rice crop closely and regularly by walking through the plots and showing them how to measure crop growth and management performance. Use a ruler, count, or weigh. Do not guess or estimate. Record the measurements to ensure that the information is available for later use. Use the forms provided to you or a field notebook. Do not rely on your memory; write down notes.

3. **Compare and interpret results to identify problem areas.**

   Guide farmers in interpreting and analyzing the relationships among management practices, measurements, and yield results to identify those areas that may have limited yields but can be improved upon. Ask them how they achieved their yields.

4. **Take action to correct management problems next season.**

   Help farmers improve their crop management practices to overcome poor results, or repeat practices that resulted in good yields. Learn from your experiences.

BOX 2.

POINTS TO REMEMBER ON THE PALAYCHECK SYSTEM

It is not simply putting a check (✓) or a cross (x) on the Key Checks.

It is important for farmers to understand why a Key Check has been achieved or not achieved (output) given a crop management practice (input). It is not the same as the “12 Steps in Rice Production” in the 1990s or similar schemes.

It is not a prescription for successful rice production.

Farmers and technicians should recognize that the PalayCheck System integrates and balances crop management technologies with group learning to improve and sustain gains in rice production.

It is an advantage if farmer groups implement PalayCheck.

After close monitoring of the rice crop, farmers share experiences, discuss possible reasons for achieving or not achieving the Key Checks. Hence, farmers themselves recognize weaknesses in their crop management and ways to improve in the next cropping season.

Variety and Seed Selection

Key Check 1

Used high-quality seeds of a recommended variety

Importance. High-quality seeds are relatively pure, have fewer weed seeds, free from visible seed-borne diseases, full and uniform in size, and have at least 85% germination rate. As crops from high-quality seeds grow, mature, and ripen uniformly, harvesting activities become more efficient. All of these can contribute to an increase in yield of 10% or more.

Recommended varieties are adapted to local conditions. They are resistant to biotic and abiotic stresses (e.g. prevalent pests and diseases, drought) in the area, have produced relatively stable and high yields, and are preferred by farmers and local consumers.

Assessment of Key Check

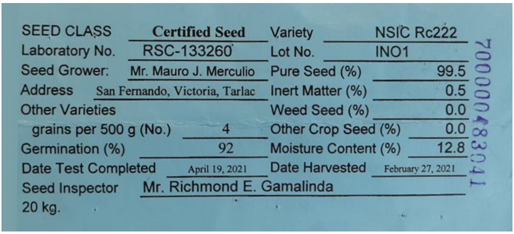
- ✓ Seeds are certified by the Bureau of Plant Industry - National Seed Quality Control Services (BPI-NSQCS).

  If there are no accredited seed growers in the locality, high-quality seeds are accessed from reliable sources or own-produced.

- ✓ The variety suits the environment, addresses a prevailing local field problem, or has performed well in at least two seasons of adaptability trials.

Recommendations to Achieve Key Check 1

1. **Source seeds preferably from accredited seed growers. Check if the attached NSQCS tag is valid.**



SEED CLASS	Certified Seed	Variety	NSIC Rc222
Laboratory No.	RSC-133260	Lot No.	INO1
Seed Grower:	Mr. Mauro J. Merculio	Pure Seed (%)	99.5
Address	San Fernando, Victoria, Tarlac	Inert Matter (%)	0.5
Other Varieties		Weed Seed (%)	0.0
grains per 500 g (No.)	4	Other Crop Seed (%)	0.0
Germination (%)	92	Moisture Content (%)	12.8
Date Test Completed	April 19, 2021	Date Harvested	February 27, 2021
Seed Inspector	Mr. Richmond E. Gamalinda		
20 kg.			

70000483041

Sample tag for certified seeds

If seeds are old stock or carry-over from the previous season, these should have passed the germination re-test to be done by the farmer before sowing.

If there are no accredited seed growers:

- source seeds from reliable farmers in the area (i.e. from farms that have uniform crop growth)
- produce own high-quality seeds following proper procedures, particularly in roguing or removing off-types
- ensure that farmer-produced seeds have passed a germination re-test to determine their quality, which may be done by the farmer or NSQCS

2. Choose a variety that:

a. *suits the environment (irrigated or rainfed) or planting season (DS or WS).* In rainfed areas, it is best to prioritize varieties intended for the rainfed environment. During the wet season, beware of prevalent pests in the area and consider the shattering and lodging characteristics of a variety.

b. *addresses a prevailing local field problem.* For example, in areas that are usually affected by destructive typhoons, drought, or floods, especially during the WS, use a variety with suitable maturity that can escape potential abiotic stresses. Consider also regionally recommended varieties as these are most likely adapted in the locality.

NSIC Rc 222 is recommended for DS & WS in Central Luzon. PSB Rc 10 is an early-maturing variety (106 days) that can fit the crop calendar before the typhoon months.

c. *has performed well in at least two seasons of adaptability trials made by PhilRice or local DA office.*

d. *has high market demand.*

TIP:

Use the Binhing Palay mobile application to search for registered rice varieties and their characteristics. Download the app for free at Google Playstore.)

Land Preparation

Key Check 2

Well-leveled field

Importance. A well-leveled field is a pre-requisite to good crop growth and management. It helps achieve the following:

- efficient water management
- less weed incidence
- better snail management
- efficient nutrient utilization
- uniform crop growth and maturity
- efficient use of farm machinery

To achieve a well-leveled field, weeds, rice straw, and stubbles must be thoroughly decomposed and land is well-puddled. A poorly prepared field could yield 5% less.

Assessment of Key Check

✓ No high and low soil spots after final leveling:
- no portion has deeper than 5cm water (≈ thumb length)
- no mound of soil can be seen above the 5cm water surface after final leveling

Recommendations to achieve Key Check 2

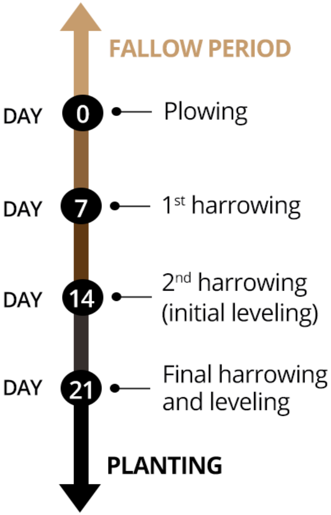
1. **Clean and repair dikes and ditches.**
    - Clean dikes help prevent or reduce pest infestation.
    - Compacted dikes prevent seepage.
    - Dikes maintained at 15cm high x 20cm wide discourage rat-burrowing.
    - Clean ditches ensure water efficiency and facilitate drainage.

2. **Plow or rotovate field 21 - 30 days before planting to:**
    - allot time for the germination of weeds and drop seeds
    - incorporate weeds, rice straw, and stubbles in the soil to allow time for decomposition
    - apply organic fertilizers to increase the population of beneficial microbials in the soil. This will help hasten the full decomposition of plant residues, otherwise the soil turns acidic and some nutrients become less available

3. **Harrow the field every 7 days after plowing. The first harrowing is along the plowing pattern; the second or initial leveling is crosswise. This will:**
    - break the clods
    - incorporate stubbles in the soil
    - allow weed seeds and drop seeds to germinate
    - help reduce initial pest population
    - maintain the soil's hard pan

4. **Final-harrow and level the field using a wooden plank or tiller-attached leveler.** Water depth must be 5cm to ease field-leveling.

Example:



5. **For DWSR, construct small canals (25cm wide and 5cm deep) surrounding the field near the dikes and at the middle of the field to:**
   - provide path for excess water
   - facilitate collection of snails and field operations (i.e. replanting, weeding)

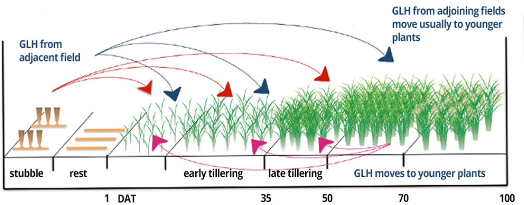
Crop Establishment

Key Check 3

Practiced synchronous planting after a rest period

Importance. Synchronous planting after a fallow or rest period enables efficient use of irrigation water and avoids overlapping incidences of insect pest and disease populations, thereby preventing yield loss.

e.g. occurrence of tungro disease spread by GLH

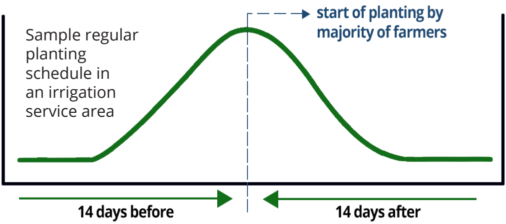


If farmers in an area plant synchronously, crops can be harvested almost simultaneously, leaving no food source for insect pests to survive on and multiply.

Assessment of Key Check

✓ Allowed the field to rest for at least 30 days after harvest before the next cropping season begins.

✓ Planted within 14 days before or 14 days after the regular planting schedule in the irrigation service area or applicable vicinity.



Recommendations to achieve Key Check 3

1. **After harvesting, allow the field to rest. Do not plant the area with rice for at least 30 days.**

   Benefits of allowing the rest period:
   - *It breaks the insect pest cycle.* Most insect pests have an average life cycle of 30 days. During the rest period, they will have no place to stay and most of them will starve to death.
   - *It destroys disease host and reduces inoculum in the field.* By leaving the field idle, the source of diseases that developed during the previous cropping season will die before the start of the next season.
   - *It allows good decomposition* of the rice straw and/or organic materials that can serve as fertilizer.

2. **Follow the local planting calendar to make full use of irrigation water within the community. Practice synchronous planting at least within the applicable vicinity (e.g. turnout, division, barangay).**

Key Check 4

Sufficient number of healthy seedlings

Importance. Healthy seedlings have short leaf sheaths, long and dense roots, and even height. They grow uniformly and have no pest damage.

With uniform growth, healthy seedlings produce a good canopy and every plant can avail of sufficient sunlight and soil nutrients. They can also easily recover from transplanting shock, and have higher survival rate. They produce productive tillers that translate to increased potential for higher yield.

Assessment of Key Check

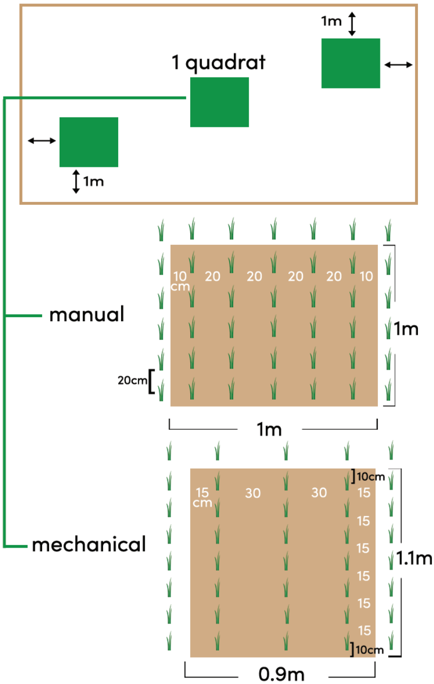
For Transplanted Rice (TPR):

✓ Followed the recommended seeding rate of 20-40kg/ha high-quality rice seeds.

- ✓ Ensured hill density of at least 25 hills/m^2 if manually transplanted, or at least 21 hills/m^2 if mechanically transplanted.
- ✓ Ensured one healthy seedling per hill.

How to assess hill density and health status of TPR:

1. At 10 DAT, randomly select three sampling locations at least 1m from the dike and in a diagonal line across the field.
2. Count the hills from each location using a 1m x 1m quadrat for manual transplanting. For mechanical transplanting, measure a 1.1m x 0.9m quadrat.



3. Add the counts and divide the total by three to get the average number of hills/m^2.

4. In every parcel, randomly select 10 hills. Each hill should have at least one healthy seedling.

Manual	at least 25 hills/m^2 with at least one healthy seedling per hill
Mechanical	at least 21 hills/m^2 with at least one healthy seedling per hill

For Direct Wet-Seeded Rice (DWSR):

✓ Followed the recommended seeding rate of 40-60kg/ha for row seeding and 60-80kg/ha for broadcast seeding.

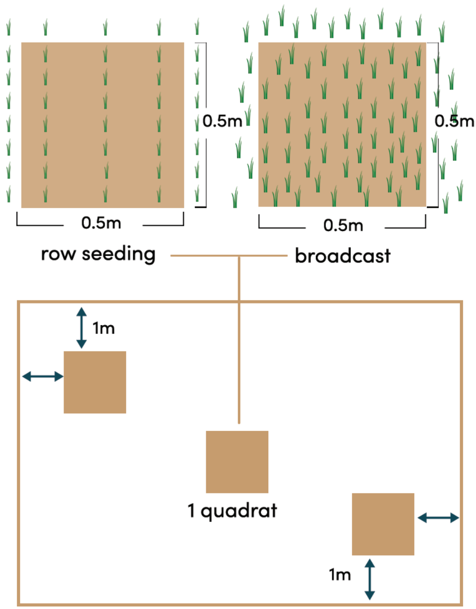
✓ Ensured plant density of at least 150 plants/m^2 if row seeding, or at least 225 plants/m^2 at 60kg/ha seeding rate or at least 300 plants/m^2 at 80kg/ha seeding rate if broadcast seeding.

✓ Plants in each quadrat have no pest damage and are uniform in leaf color and plant height.

Direct wet-seeded rice

How to assess plant density and health status of DWSR:

1. At 15-18 DAS, randomly select three sampling sites at least 1m from the dike and in a diagonal line across the field.
2. Use a 0.5m x 0.5m quadrat. Count the plants in each quadrat, compute the average number of plants per quadrat, then multiply by four to determine the average number of plants/m^2.



3. In every quadrat, visually inspect plants for uniformity in leaf color and plant height, and for pest damage.

Recommendations to achieve Key Check 4

For TPR:

1. Follow these recommendations

Method	Seeding rate	Seedbed area	Age of seedlings (days)	No. of seedlings per hill	Planting distance (cmxcm)
Manual	20-40 kg/ha	400m^2	18-21	2-3	20x20 (WS) 20x15 (DS)
Mechanical (Tray method)	70-160 g/tray* (20-40kg/ha)	250-300 trays	14-18**	3-6	30x15 (WS/DS)
Mechanical (Modified wet dapog method)	420-960g/m^2 (20-40kg/ha)	50m^2	14-18	3-6	30x15 (WS/DS)

**Size of tray: 28cm x 58cm*
***Can use 12-day-old seedlings if height is not less than 15cm*
Lower seeding rate in mechanical transplanting is recommended for hybrid commercial rice production because of high price of seeds.

- Sowing the right amount of seeds results in strong and healthy seedlings.
- A 20m x 1m seedbed provides enough space for seedlings to grow.

- Apply organic fertilizer or carbonized rice hull before leveling the seedbed. This helps loosen the soil, making pulling of seedlings easier with less root damage.

Type of soil	Rate of application
Fine-textured	3-4 bags commercial organic fertilizer
Medium-textured	no need to apply organic fertilizers

- Young seedlings are susceptible to invasive apple snails, also known as golden apple snails (GAS). Seedlings older than 25 days will have difficulty recovering from transplanting stress and will produce less tillers.

- Close spacing results in mutual shading and less tillers. Tall plants are susceptible to lodging.

- Do not cut the leaves of seedlings before transplanting. The cut area can be an entry point for disease-causing organisms.

2. Replant missing hills within 7 DAT. Use seedlings from the same seedbed to avoid uneven maturity.

Replanting of missing hills

For DWSR:

1. Follow the recommended seeding rate of 40-60kg/ha for row seeding and 60-80kg/ha for broadcast seeding.
2. Prepare the field for seeding by following the land preparation and levelling recommendations outlined in Key Check 2 (page 17).
3. Protect pre-germinated seeds from birds, rats, snails, and weeds by following the recommended pest management practices.
4. Use drumseeder or broadcast pre-germinated seeds evenly onto the field.

Sowing pre-germinated seeds using drumseeder

5. Sow extra 1kg pre-germinated seeds on the side of the field for replanting. Replant bald areas with a radius of more than 10cm within 7-10 DAS to ensure even maturity.

Nutrient Management

Key Check 5

Sufficient nutrients from tillering to early panicle initiation (EPI) and flowering

Importance. Nutrient inputs as fertilizers fill the gap between what the crop needs and what is currently present in the soil, water, and air. Sufficient nutrients from tillering to EPI and flowering ensure good growth and uniform panicle development of the crop. They also ensure attainment of the crop's yield potential.

If nutrients are insufficient during these stages, there may be slow growth, less tillers and panicles, fewer seeds, and lighter grain. Excessive nutrients will cause pest damage, lodging, and soil pollution.

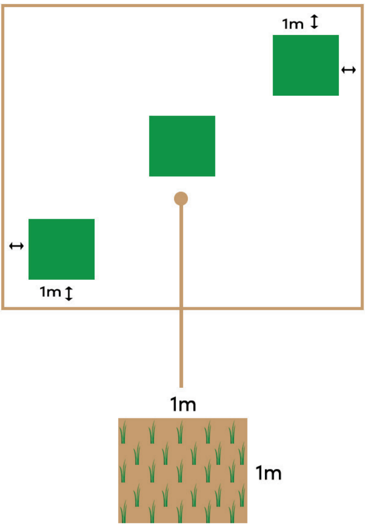
Assessment of Key Check

✓ No symptoms of nutrient deficiency or toxicity from tillering to early panicle initiation (EPI) and flowering.

✓ Achieved at least 300 panicles/m^2 (TPR) or 350 panicles/m^2 (DWSR) at dough stage.

How to assess the number of panicles at dough stage:

1. Randomly select three sampling sites (1m x 1m quadrat) at least 1m from the dike and in a diagonal line across the field.
2. Count the panicles in each quadrat and get the average number of panicles/m^2.

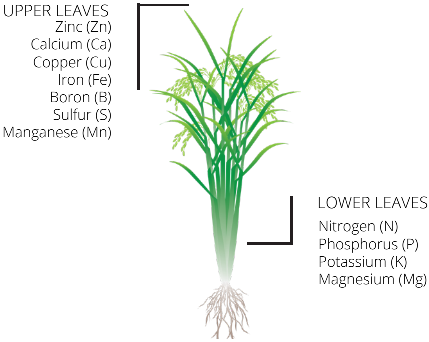


Recommendations to achieve Key Check 5

1. **Know and manage the nutrient requirements of your crop based on:**

   a. visual observation of deficiency symptoms

   <u>Tips in proper visual diagnosis of nutrient deficiency</u>



   b. results of nutrient diagnostic and decision support tools such as:

Leaf Color Chart/ Computing (LCC) App
Tools to assess the nitrogen status of the rice crop using a 4-colored "ruler" for leaf color comparison, or an ICT-based mobile application that captures digital leaf images.

Minus-One-Element Technique (MOET) kit and MOET App
A soil nutrient diagnostic technology done through a pot experiment complemented with an ICT-based application to determine the nutrients deficient in the soil and the amount of fertilizer needed to attain a certain target yield.

Nutrient-Omission-Plot Technique (NOPT)
A means to assess indigenous nutrient supply to serve as basis of fertilizer recommendation.

Rice Crop Manager Advisory Service (RCMAS)
An ICT-based platform for rapidly deploying improved nutrient and rice-farming management technologies.

c. other available information such as data obtained from extension workers or rice specialists

2. Know the right Element, Amount, and Timing of fertilizer application. Make E-A-T right.

E - Know the right nutrient ELEMENT that the plant needs. Giving the right nutrients increases cost efficiency and attainment of target yield.

A - Know the right AMOUNT of fertilizer to apply. Too much or too little is not good.

T- Know the right TIMING of fertilizer application to increase efficiency in input cost and nutrient uptake.

- **NITROGEN (N)**

  Right element. N promotes rapid growth for increased:

  • plant height, tiller number, and leaf size;
  • number of panicles per hill;

• number of spikelets per panicle;
• grain protein content; and,
• percentage of filled spikelets.

N deficiency results in stunted, yellowish plants; older leaves or whole plants are yellowish green.

(Right) N-deficient rice plant.

Excessive N during panicle initiation and flowering:

- makes the plant prone to lodging and pests;
- increases unfilled spikelets;
- is costly and may contribute to environmental pollution.

Right amount. Use results of LCC/ LCC App, or the recommendations of the RCMAS, NOPT, and MOET/ MOET App as basis in properly determining the amount of N to apply.

Right timing.

If LCC/LCC App is available:

- use LCC every 7 days from 14 DAT or 21 DAS until early flowering

• apply N if 6 or more out of 10 leaves are below 4 (TPR) or 3 (DWSR).

If LCC/LCC App is not available:

	APPLICATION		
	1st	2nd	3rd
For ≤110-day maturity	0-14 DAT or 7-10 DAS	5-7 days before panicle initiation	
For >110-day maturity	0-14DAT or 7-10 DAS	mid-tillering	5-7 days before or after panicle initiation

- **PHOSPHORUS (P)**

Right element. P functions mainly for energy storage and transfer. In rice, it promotes vigorous root development, tillering, and early flowering and ripening.

Deficiency symptoms include:

• stunted dark green plants with narrow, short, very erect leaves and greatly reduced tillering;
• thin stems and retarded development; and,
• less leaves, panicles, and grains per panicle

(Right) P-deficient rice plant.

Right amount. Use results of MOET/MOET App or the recommendations of RCMAS as basis in properly determining the amount of P to apply.

Right timing.

	APPLICATION
TPR	0-14 DAT
DWSR	7-10 DAS

- **POTASSIUM (K)**

Right element. K in rice plants:

- speeds up root growth and boosts plant vigor;
- accelerates uptake of other nutrients;
- improves tolerance of rice to adverse conditions such as pest and disease infestations, drought, lodging; and,
- increases grain size and weight, and percent filled grains

K deficiency is often not detected because its symptoms do not appear until the later growth stages, and are not as easy to recognize as those of N deficiency.

K-deficient rice plant.

K deficiency symptoms include dark green plants with yellowish brown leaf margins or dark brown necrotic spots first appearing on the tip of older leaves. Yellowing follows a "Λ" pattern and progresses downward if deficiency is not corrected.

Right amount. Use results of MOET/ MOET App or the recommendations of RCMAS as basis in properly determining the amount of K to apply.

Right timing.

	APPLICATION	
	1st	2nd
TPR	0-14 DAT	5-7 days before or after panicle initiation
DWSR	7-10 DAS	5-7 days before or after panicle initiation

- **ZINC (Zn)**

Right element. Zn promotes good seedling and overall growth of plants. It is essential for several biochemical pathways and structural processes in the rice plant.

Zn deficiency symptoms include dusty brown spots on upper leaves of stunted plants appearing 2-4 weeks after transplanting. In Zn-deficient soils, NPK fertilizers alone cannot provide good yield unless the deficiency is corrected.

Zn-deficient rice plant (leaf).

Right amount and timing. Use results of MOET/ MOET App or the recommendations of RCMAS as basis in properly determining the amount and timing of Zn application.

If MOET/MOET App or RCMAS are not available, choose only one among the following amelioration techniques:

	AMELIORATION TECHNIQUES	AMOUNT	TIMING
TPR	Seedling dip	2% ZnO solution	dip for 15-30min
	Seedbed	apply 0.5kg $ZnSO_4$ per 400m^2 seedbed or 40kg seeds if deficiency is mild; 2kg if severe	seedbed at 7-10 DAS
	Broadcast	25kg $ZnSO_4$/ha	10-14 DAT
	Foliar spraying	follow product recommendation	14 DAT
DWSR	Seed Zn soaking	1kg $ZnSO_4$ per 40kg seeds	soak seeds in $ZnSO_4$ solution during the last change in soaking water before incubation

- **SULFUR (S)**

Right element. S in rice plants:

- promotes uniform growth and maturity;
- speeds up chlorophyll production, protein synthesis, and plant function and structure; and

- reduces yield if deficiency occurs at vegetative stage

Symptoms of S deficiency include yellowing of young leaves, less tillers, fewer and shorter panicles, reduced number of spikelets per panicle, and delayed maturity.

(Left) S-deficient rice plant.

Right amount. Use results of MOET/MOET App or the recommendations of RCMAS as basis in properly determining the amount of S to apply. The amount of S in 14-14-14-12S (12%S) as recommended to treat P and K deficiencies is adequate to correct usual S deficiency.

Right timing.

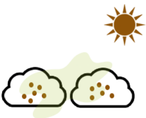
	APPLICATION
TPR	0-14 DAT
DWSR	7-10 DAS

Box 3. TIPS FOR EFFICIENT USE OF FERTILIZERS

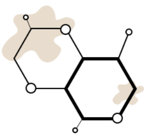
- Incorporate granular inorganic fertilizer into the soil for better absorption of nutrients and to avoid nutrient leaching and N volatilization.

- Apply only 30% of the total N requirement during the first application.

- Apply topdress (granular-inorganic) fertilizer at low water depth (2-5cm) to reduce N volatilization, and nutrient run-off.



- Apply granular inorganic fertilizer during the cooler time of the day (particularly after 3:00PM) to avoid N losses.



- Maximize indigenous nutrient supply by incorporating rice straw from the previous cropping and allowing it to decompose in the soil. Using rice straw and other organic fertilizers that are own produced or available for free in combination with inorganic fertilizer can lower fertilizer cost.

Water Management

Key Check 6

Avoided stress caused by drought or excessive water that could affect the growth and yield of the crop

Importance. The right volume of water promotes better nutrient uptake, good plant vigor, better snail and weed management, uniform growth and maturity, and more efficient farm operations.

Insufficient water causes drought stress that results in low fertilizer efficiency, and low yield and low grain quality. Excessive water results in higher irrigation cost (if using pump), nutrient imbalance, low yield, and more greenhouse gas emissions.

Assessment of Key Check

- ✓ No symptoms of water stress due to drought from seedling through the dough grain stages.
- ✓ No symptoms of water stress due to excessive irrigation water during the vegetative phase.

Symptoms of water stress during the vegetative phase:

Drought stress (deep soil-cracking for more than three days):

- leaf-rolling and leaf tip-drying
- stunted growth
- reduced tillering (<10 tillers per hill)

Excessive water stress (>5cm water depth for seven days or more):

- reduced tillering (<10 tillers per hill)
- smaller leaf area
- roots are dark-colored instead of reddish brown or lighter

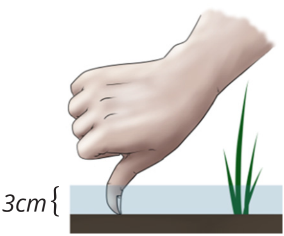
Symptoms of water stress due to drought during the panicle initiation to grain-filling stages:

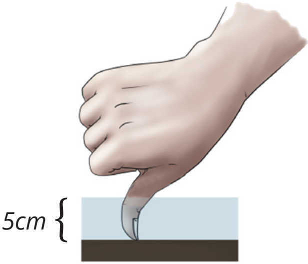
- leaf-rolling and leaf tip-drying
- many unfilled spikelets
- reduced panicle exsertion

Recommendations to achieve Key Check 6

1. **Achieve 3-5cm water level every irrigation time from early tillering until 1-2 weeks before harvest, except during the flowering stage when 5-7cm water level should be maintained.**

If DWSR, suspend irrigation for 0-14 DAS, unless severe drought symptoms appear.

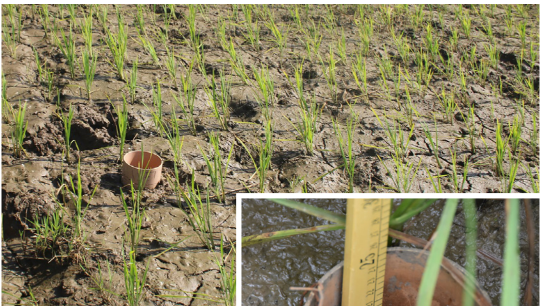




2. Drain water or stop irrigation:

- one week before expected date of harvest for medium-textured soil or during DS
- two weeks before expected date of harvest for fine-textured soil or during WS.

3. If water is scarce, practice controlled irrigation. During crop growth, practice the Alternate Wetting and Drying (AWD) technology aided by an observation well.



Observation well

Pest Management

Key Check 7

No significant yield loss due to pests

Importance. Knowing how the rice crop interacts with biotic factors and the agroecosystem, and correctly identifying pests and applying ecologically sound management strategies can help prevent significant yield loss. They can also promote high-quality grains.

Assessment of Key Check

✓ No significant yield loss due to damages caused by insect pests, diseases, weeds, rats, snails, and birds. Such loss occurs when one or more pests inflict damage.

Check Tables 1-3 (pp. 48-49) for pest damage levels; Annexes 1-2 (p. 71) for insect pest and disease identification; and Annexes 3a-3c (pp. 72-73) for practical assessment of pest damages.

Table 1. Insect pest level associated with significant yield loss (for 120-day-maturing variety).

Growth stage	Stem borer (SB)	Rice black bug (RBB)	Brown planthopper (BPH) / White-backed planthopper (WBPH)	Rice bug (RB)
Nursery/ Seedbed	≥5 egg masses/ m^2	negligible	negligible	negligible
Early tillering	≥30% deadheart	≥10 nymphs or adults/ hill; ≥20% deadheart/ bugburn	≥25 all stages of insects/hill	negligible
Mid to max tillering/ Early panicle initiation (EPI)	≥1 egg mass/m^2	≥20 nymphs or adults/ hill; ≥ 30% deadheart/ bugburn	≥50 all stages of insects/hill	negligible
Flowering	≥20% whitehead	≥20 nymphs or adults/ hill; ≥20 whitehead	≥50 all stages of insects/hill	negligible
Milk	≥20% whitehead	≥20 nymphs or adults/ hill; ≥20 whitehead	≥100 all stages of insects/hill	≥5 nymphs and adults/ m^2
Grain-filling	≥20% whitehead	≥20 nymphs or adults/ hill; ≥20 whitehead	≥100 all stages of insects/hill	≥10 nymphs and adults/ m^2
Maturity	≥20% whitehead	≥20% whitehead	≥100 all stages of insects/hill	tolerable

Insect pests are monitored in the early morning (5:00-7:00AM) or late afternoon (5:00PM). Other pests are usually monitored in the late afternoon.

Table 2. Disease level associated with significant yield loss (for 120-day- maturing variety).

<table>
<tr><th>Growth stage</th><th>Rice blast (leaf, neck, panicle)</th><th>Sheath blight (ShB)</th><th>Bacterial leaf blight (BLB)</th><th>Rice tungro disease (RTD)</th><th>Brown Spot (BS)</th></tr>
<tr><td>Nursery/ Seedbed</td><td rowspan="2">≥20% of seedbed with leaf blast</td><td rowspan="2">none to negligible</td><td rowspan="2">negligible</td><td>none</td><td>None</td></tr>
<tr><td>Early tillering</td><td>≥20% of field with RTD</td><td>>30% of the field infected with BS</td></tr>
<tr><td>Mid to max tillering/ EPI</td><td>≥30% of field with leaf blast</td><td rowspan="3">≥40% of field with ShB</td><td>≥30% of field with BLB</td><td>≥40% of field with RTD</td><td>>50% of the field infected with BS seen on the leaves</td></tr>
<tr><td>Flowering</td><td>≥10% of field with neck blast</td><td>≥30% of field with BLB on flag leaf</td><td rowspan="4">tolerable</td><td>>50% of the field infected with BS seen on the flag leaves</td></tr>
<tr><td>Milk</td><td rowspan="3">≥10% of field with panicle blast</td><td rowspan="3">≥30% of field with BLB and with undeveloped spikelets</td><td>>50% of the field infected with BS seen on the flag leaves and spikelets</td></tr>
<tr><td>Grain-filling</td><td rowspan="2">≥40% of field with ShB and ≥10% unfilled grains</td><td rowspan="2">>75% of the field infected with BS and 10% unfilled grains</td></tr>
<tr><td>Maturity</td></tr>
</table>

Table 3. Weed, rat, snail, and bird infestation level associated with significant yield loss.

	Weeds	Rats	Snails	Birds
Significant yield loss	≥5% of the area has weed cover at 0-40 DAS (DWSR), or >10% at 15-40 DAT (TPR)	≥5% of the area has damaged tillers from maximum tillering to maturity	≥10% of the area has missing or snail-damaged hills at 14 DAT or DAS	≥5% of the area has damaged panicles

Recommendations to achieve Key Check 7

1. **Use varieties that are resistant to pests prevalent in the locality.** This is the first line of defense against pests and is compatible with the biological control method.

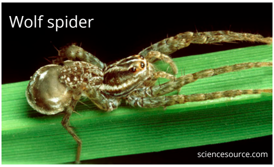
   Change or rotate varieties every 2-4 croppings.

2. **Practice synchronous planting after a 30-day rest period** (see Key Check 3, pp 21-22).

3. **Conduct regular field-monitoring from the early stage of crop growth onwards to identify potential pests at their initial stage of development.** Preventive disease management options can be applied before it spreads and reaches intolerable levels. For insect pests, preventive management options such as use of resistant varieties and synchronous planting are preferred. Insecticide application is a corrective measure to be used as a last resort when all cultural, biological, and physical control measures fail.

4. **Let the many beneficial organisms thrive in the rice ecosystem.** Such organisms regulate pest populations. The indiscriminate use of pesticides reduces biodiversity and disrupts the natural balance of insect pests and beneficial organisms. Conserving these organisms is economical and permanent.

For example, long-horned grasshoppers feed on the egg masses of stemborers while spiders feed on the nymphs and adults of leaf and planthoppers.



Common beneficial organisms in the rice field

Table 4. Management options for common rice pests

Pest/ disease	Management options
Insect pests and diseases	Do not spray against defoliators within 30 DAT or 40 DAS. Diagnose diseases correctly, and practice field sanitation and synchronous planting after a rest period.
Weeds	• Control weeds within 0-45 DAT/DAS. • Use high-quality seeds. • Practice field sanitation. • Practice proper land preparation and water management. • Do manual and mechanical weeding. • Use herbicides as the last option.
Rats	Practice timely, integrated, and sustained community-wide control. Fill rat burrows with soil and water. Practice sanitation.
Invasive Apple Snails also known as golden apple snails (GAS)	• Keep field saturated up to 25 DAS or up to 15 DAT. • Construct small canals and place attractants to facilitate snail collection. • Place wire/ bamboo screen at water in/outlets to regulate snail entry.
Birds	Scaring them away is the most practical approach to managing birds.

Harvest Management

Key Check 8

Harvested the crop at the right time

Importance. Timely reaping and threshing ensures high-quality rice that leads to high market value and consumer acceptance.

Harvesting too early results in immature grains with <1 to 1.5% harvest losses, and leads to low milling recovery of as low as 53%. Harvesting too late leads to grain-shattering with ≥ 3% (if manual) harvest losses. This results in low head rice recovery as low as 32% (manual) or 38% (mechanized).

Assessment of Key Check

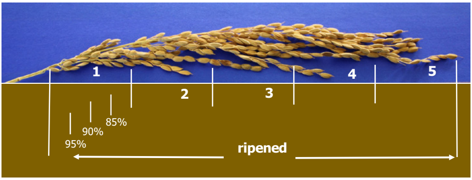
✓ *Palay* is harvested when most of the grains are golden yellow:
- 85-90% if manual harvesting
- 90-95% if using combine harvester

✓ *Palay* is threshed not later than one day after manual harvest during WS or two days during DS.

Recommendations to achieve Key Check 8

1. **Drain field 1-2 weeks before the expected date of harvesting:**
    - to attain uniform maturity and ripening
    - to prevent wetting of the grains during harvesting
    - for easy operation in the field

2. **Harvest at the right maturity, when 85-90% (manual) or 90-95% (if using combine harvester) of the grains are golden yellow.**



3. **Harvest at the right grain moisture content (MC).**
    - Use grain moisture meter when available.

18-21% (typical MC for DS)

20-25% (typical MC for WS)

4. **After manual harvesting, thresh *palay* not later than one (WS) or two (DS) days.**
    - Avoid piling the harvested crop in the field for more than a day to prevent heat build-up which leads to grain discoloration and low-quality milled rice.
    - Avoid threshing dripping-wet palay using a mechanical thresher to prevent losses from poor grain-cleaning and separation.
    - Observe the recommended threshing drum speed (800rpm for most engine-driven threshers) to prevent grain damage. Faster speed may increase capacity but will also incur more blower and separation losses.

Postharvest Management

Key Check 9

Dried, cleaned, and stored grains properly

Importance. Proper drying, cleaning, and storing maintains grain quality, and helps control postharvest losses. These also maintain the quality of *palay* suitable for milling and allow long storage.

Producing high-quality rice helps meet customers' requirement and acceptance in the market. It also achieves greater overall market value.

Assessment of Key Check

- ✓ Uniformly dried grains within 12-24 hours after harvest/threshing.
- ✓ Attained premium quality of grains.
- ✓ Properly stored cleaned grains at 12-14% MC.

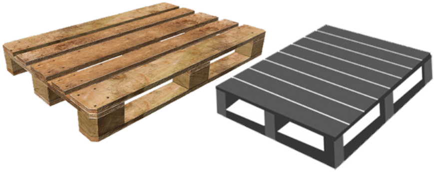
Recommendations to achieve Key Check 9

1. **Dry the palay uniformly within 12-24 hours after harvest/threshing.**
   - Use mechanical dryers at temperature not exceeding 50-70°C for 5-8 hours.
   - When drying dripping-wet *palay*, operate the dryer with unheated air during the first 1-2 hours of drying or until 18% MC (skin dry).
   - Reduce drying air temperature to 40-45°C during the last 2 hours of drying or when MC is about 15%. Dry grains to 12-14% MC.
   - When no mechanical dryer is available, sun-dry on clean concreted pavement. Stir the grains at least once every 30min for uniform drying. Avoid getting the dried *palay* drenched with rain.

Advantages and disadvantages of sun-drying and mechanical drying

Drying technique	Advantages	Disadvantages
Sun-drying	• low maintenance cost • thorough and complete drying • energy-efficient • kills fungi and other storage pests	• weather-dependent • requires more labor • uncontrollable heating • prone to contamination
Mechanical drying	• not weather-dependent • requires less labor • controlled drying air temperature • easier operation • kills fungi and other storage pests	• higher drying cost • uneven drying (conventional flatbed) • less energy-efficient

2. **Place dried grains on top of pallets to protect them from dampness while awaiting grain-cleaning.**



- Use clean containers or sacks with plastic lining.
- Ensure that correct label is placed inside and outside the sack.
- Store dried grains before cleaning for not longer than three days.

3. **Clean grains 2-3 days after drying.**
   - Remove impurities such as chaff or unfilled grains and straw, which have high MC that causes hot spots inside the sack.

   If using a grain cleaner, regulate its speed to minimize losses. Before using the grain cleaner, ensure that it is clean and free from any grain left from previous operation.

4. **If not sold immediately, keep grains in a storage area that is waterproof, with proper aeration, and free from pests such as rats, birds, and insects.**

   - Never store clean, dried grains together with agricultural chemicals, fertilizers, or cement in the same storage area.
   - Check for heating by lifting the top bag and feeling the bag below.
   - Inspect the stacks at least once a week to detect pest infestation, physical damage, or staining caused by water which indicates re-wetting.
   - Keep the storage area clean and tidy inside and outside, and ensure periodic aeration to:
     a. prevent re-entry of moisture in stored grains
     b. protect grains from insects, rodents, and birds
     c. facilitate loading and unloading
     d. maximize the use of space
     e. ease product maintenance and management

5. **Do not drag rice sacks when transporting to prevent damages. Use sack barrows if available.**

6. Prepare the stack layout plan before the sacks arrive.

- Do not mix varieties in one stack or pile. Do not mix old and new stocks in the pile.
- The pile should be built up to the edge of the pallet. Bonded piles are more stable.
- Provide air spaces in every pile for ventilation.
- Piles should not be so high that pallets at the bottom are crushed or split. Up to 6-7 bags per pile is acceptable. Height of stacks should not exceed the height of the walls.
- Maintain one-meter space between piles, walls, and roof frames.

Summary of Key Checks and Assessment, Monitoring, Analysis, and Improvement

1. VARIETY AND SEED SELECTION

Key Check 1. Used high-quality seeds of a recommended variety

Assessment of Key Check. The seeds of a recommended variety are certified by the BPI-NSQCS. The variety must suit the environment, address a prevailing local field problem, or has performed well in at least two seasons of adaptability trials.

2. LAND PREPARATION

Key Check 2. Well-leveled field

Assessment of Key Check. There should be no high and low soil spots after final leveling. No portion has deeper than 5cm water and no mound of soil must be seen above the 5cm water surface.

3. CROP ESTABLISHMENT

Key Check 3. Practiced synchronous planting after a rest period

Assessment of Key Check. The field must have rested for at least 30 days after harvest before the next cropping season begins. Farmers should have planted 14 days before or 14 days after the regular planting schedule in the irrigation service area or applicable vicinity.

Key Check 4. Sufficient number of healthy seedlings

Assessment of Key Check

- *For Transplanted Rice (TPR).* Followed the recommended seeding rate of 20-40kg/ha inbred rice seeds; ensured hill density of at least 25 hills/m^2 if manually transplanted, or at least 21 hills/m^2 if mechanically transplanted. There should be at least one healthy seedling per hill.

- *For Direct Wet-Seeded Rice (DWSR):* Followed the recommended seeding rate of 40-60kg/ha for row seeding and 60-80kg/ha for broadcast seeding; ensured plant density of at least 150 plants/m^2 if row seeding, or at least 225 plants/m^2 at 60kg/ha seeding rate, or at least 300 plants/m^2 at 80kg/ha seeding rate if broadcast seeding. Plants in each quadrat have no pest damage and are uniform in leaf color and plant height.

4. NUTRIENT MANAGEMENT

Key Check 5. Sufficient nutrients from tillering to early panicle initiation (EPI) and flowering

Assessment of Key Check. There should be no symptoms of nutrient deficiency or toxicity from tillering to EPI and flowering. At least 300 panicles/m^2 (TPR) or 350 panicles/m^2 (DWSR) at dough stage must be attained.

5. WATER MANAGEMENT

Key Check 6. Avoided stress caused by drought or excessive water that could affect the growth and yield of the crop

Assessment of Key Check. There should neither be symptoms of water stress due to drought from seedling through the dough grain stages, nor symptoms of stress due to excessive water during the vegetative phase.

6. PEST MANAGEMENT

Key Check 7. No significant yield loss due to pests

Assessment of Key Check. There should be no significant yield loss due to damages caused by insect pests, diseases, weeds, rats, snails, and birds. Such loss occurs when one or more pests inflict damage.

7. HARVEST MANAGEMENT

Key Check 8. Harvested the crop at the right time

Assessment of Key Check. *Palay* must be harvested when most of the grains are golden yellow (85-90% if manual or 90-95% if mechanical harvesting), and threshed not later than one (WS) or two (DS) days after manual harvesting.

8. POSTHARVEST MANAGEMENT

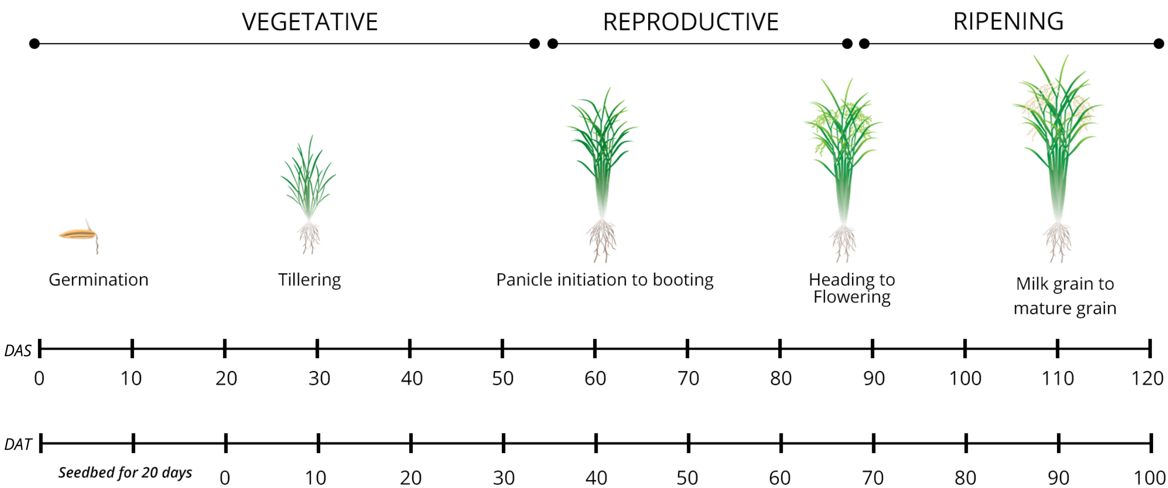
Key Check 9. Dried, cleaned, and stored grains properly

Assessment of Key Check. Grains should be dried uniformly within 12-24 hours after harvest/threshing, premium purity must be attained, and grains must be properly cleaned and stored at 12-14% MC.

MONITORING, ANALYSIS, AND IMPROVEMENT IN CROP MANAGEMENT

1. Observe, measure, and record crop growth and management performance.
2. Compare and interpret results to identify problem areas.
3. Take action to correct management problems next season.

BOX 4. CROP MANAGEMENT AREA, DEVELOPMENT STAGE, AND KEY CHECKS IN THE PALAYCHECK SYSTEM



Box 4. (continuation)

CROP MANAGEMENT AREA	CROP GROWTH STAGES							KEY CHECK
	Pre-crop (seeds)	Seedling	Tillering to stem elongation	Panicle initiation to booting; heading	Flowering to dough grain	Mature grain	After harvest (grains)	
Seed and variety selection	*							✓ Used high-quality seeds of a recommended variety
Land preparation	*							✓ Well-leveled field
Crop establishment	*	*						✓ Practiced synchronous planting after a rest period
	*		*					✓ Sufficient number of healthy seedlings
Nutrient management			*	*	*			✓ Sufficient nutrients from tillering to EPI and flowering
Water management		*	*	*	*			✓ Avoided stress caused by drought or excessive water that could affect the growth and yield of the crop
Pest management		*	*	*	*	*		✓ No significant yield loss due to pests
Harvest management						*		✓ Harvested the crop at the right time
Postharvest management							*	✓ Dried, cleaned and stored grains properly

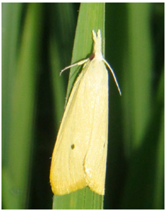
***Check assessment**

Note: *Manage, measure, record, and discuss at the shaded crop development stages*

ANNEXES

Annex 1. Major insect pests in the rice field.

White stem borer



Yellow stem borer

Rice black bug

Brown planthoppers

Rice bug

Annex 2. Common diseases in the rice field.

Blast

Sheath blight

Bacterial leaf blight

Tungro

Brown spot

Annex 3a. Schematic Guide for Monitoring Key Rice Pests from Planting to Harvest (Differentiated from nutrient deficiency, e.g. Zinc - refer to Annexes 5-14, pp 75-79).

Days After Transplanting (DAT)	Refer to Annexes for photos
14-28 DAT	Yellow dead young leaves at center of tillers damaged by stem borer larvae [see deadheart (Annex 4, p. 74)]
14-40 DAT	Yellow young leaves and rusted or black dots on the lower surface of leaves (see Annex 5, p. 75)
21-45 DAT	Stunted plant with greenish to yellow top leaves. The viral disease is transmitted by green leafhoppers. Note: N deficiency and rice tungro disease (RTD) symptoms are similar; plants are shorter. However, N-deficient leaves of the entire plant are yellowish green, and leaf tips are chlorotic or brownish. (see Annex 6, p. 75)
	Greenish diamond-shaped lesions with yellow margin on the leaf surface. Later, lesions are fused and turn dark brown. (see Annex 7, p. 76)
	Note: Blast lesions might be confused with those caused by brown spot (BS) disease. Lesions of BS are solid, dark brown. Both diseases may occur at similar growth stages. BS is common in K-deficient soils. (see Annex 8, p. 76)
35-70 DAT	Dead tillers, lower leaves, or entire plant with burnt-like appearance. Surviving plants produce panicles with empty spikelets. (see Annex 9, p. 77)
45-90 DAT	Yellow spots along leaf margins; later they enlarge, fuse, and turn brown, and run lengthwise toward the base of the leaf (see Annex 10, p. 77)
70-90 DAT	Brown to dark brown lesions at the base of flag leaf and panicle with unfilled spikelets (see Annex 11a, p. 78)
	Note: Panicle infected with neck blast has unfilled or half-filled spikelets and straw-colored. However, whitehead caused by stemborer has completely empty spikelets and panicle appears white (see Annex 11b, p. 78)
75-100 DAT	Unfilled or half-filled spikelets; but filled seeds with damage have chalky grains. Damage is due to insect-feeding during the milking stage (see Annex 12, p. 78)

Note: To obtain the corresponding days after sowing (DAS), add the age (days) of seedlings at transplanting. For example, 14 to 28 DAT equals 35-49 DAS if the age of seedlings during transplanting is 21 days.

Annex 3b. To measure the scope of damage caused by nutrient deficiency, insect pests, and diseases in the field, visually subdivide a parcel into 4 parts, assess percent damage in each part, and get the average.

For example:

45%	35%
30%	40%

% damage per parcel = (45+35+30+40) / 4
= 37.5%

Annex 3c. Schematic Guide for Assessing Major Rice Pests from Planting to Harvest (to estimate percent damage to crop per farm parcel or *pinitak*, refer to Annex 4b).

Days After Transplanting (DAT)	Refer to Annexes 1 and 2 for photos of rice pests and diseases
14-28 DAT	Visually subdivide each parcel into 4 parts, assess the percentage of pest damage to crop in each part, and get the average
	Follow above procedure for assessing damage due to whitehead
21-45 DAT	Follow above procedure for assessing rice tungro incidence but record the corresponding growth stages
	Follow the above procedure for assessing damage due to rice blast

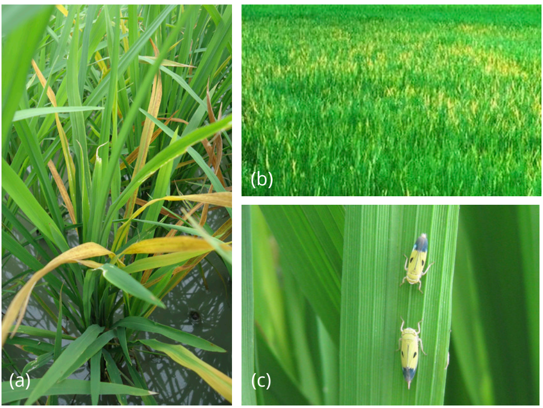
35-70 DAT	Follow above procedure for assessing bug burn damage
45-90 DAT	Follow the above procedure but note on the bacterial leaf blight lesion length on flag leaves
70-90 DAT	Follow the above procedure for assessing damage due to collar blast
75-100 DAT	Follow the above procedure for assessing rice bug damage

Note: To obtain the corresponding days after sowing (DAS), add the age (days) of seedlings at transplanting. For example, 14 to 28 DAT equals 35-49 DAS if the age of seedlings during transplanting is 21 days.

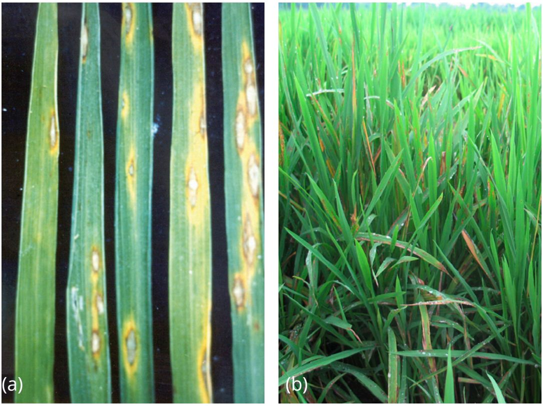
Annex 4. Yellow to dark yellow young leaves at the center of tillers caused by feeding of stemborer larvae inside the stem of rice plant (a) and the white heads (b).

Annex 5. Zinc deficiency in the field shown by rusted and dead seedlings (a) and pale yellow leaves with brown/black-dotted lower leaves (b).

Annex 6. Plants infected with rice tungro disease show yellow top leaves (a); infected field has uneven growth (b); green leafhopper, the tungro virus vector (c).



Annex 7. Diamond greenish blast lesion with yellow margin (a); infected field showing yellow and dark brown plants (b).



Annex 8. Infected plants are stunted with yellow leaves (a) and brown spots or dark brown solid lesions (b).

Annex 9. Bug burn (a) caused by feeding black bugs at the base of the plants (b).

Annex 10. Brown lesions of bacterial leaf blight (BLB) along leaf margins fuse into bands running lengthwise toward the base of the leaf (a); and severely BLB-infected field (b).

Annex 11. Droopy panicles with half-filled spikelets caused by node/neck blast (a); and whitehead due to stemborer larval infestation resulting in completely empty spikelets (b).

Annex 12. Damaged panicle with unfilled spikelets and chalky grains (a) caused by rice bug feeding (b).

Annex 13. Field with whitehead caused by stemborer damage

Annex 14. Zinc-deficient field

Annex 15. Field infected with rice tungro disease

Annex 16. Field infected with rice blast

Annex 17. Rice black bug infestation in the field

Annex 18. Rice plant infected with neck blast

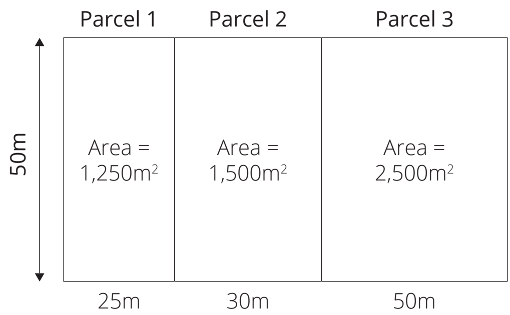
Photo from: www.lsuagcenter.com

Annex 19. Measurement of grain yield from a farm parcel or *pinitak*

1. Parcel yield will be obtained from the fields of farmer-partners (FPs) and farmer-cooperators (FCs). The site coordinator and/ or agricultural technologist should supervise the measurement, harvesting, threshing, collecting and recording of data.
2. If there are many missing hills due to pests (e.g. rats) and diseases in each parcel, estimate the area of missing hills in percent and record.
3. The following should be considered:
   a. Before harvesting/ reaping, measure the area (length and width in meters) of each parcel. Sample areas for 3 parcels are shown below.

      Note: A farmer may have one or more parcels.

      For example:



   b. After threshing, count and record the number of sacks of threshed palay per parcel. From each parcel, randomly select five bags. Get the weight (kg) of the grains from each bag and obtain the percent moisture content (MC) of sample grains using a grain moisture meter. Follow the instructions in using the Meter.

c. Sample data for Parcel 1:

   (1) Parcel 1 area = 1,250m^2

   (2) Total number of sacks or bags of palay harvested from Parcel 1=13

   (3) Average weight of one sack (average of five sacks randomly sampled) = 51.80kg/sack

   (4) Estimated total fresh grain weight from Parcel 1 = 13 sacks x 51.8kg/sack = 673.4kg

   (5) Average %MC (average grain MC from 5 sacks randomly sampled) = 22.3%

d. Calculate the grain yield from fresh weight of grain sample from Parcel 1 and adjust to 14%MC using the formula below. Follow the same procedure for Parcels 2 and 3. Tabulate data and get average of yields of Parcels 1 to 3.

Grain yield at 14% MC (kg/ha)	= Fresh grain weight (kg) / Parcel 1 area (m^2) x 10,000 m^2/ha x (100-%MC) / 86 = 673.4kg / 1, 250m^2 x 10,000m^2/ha x (100 - 22.3%) / 86 = 5,387.2kg/ha x 0.9035 = 4,867.34kg/ha or 4.9t/ha

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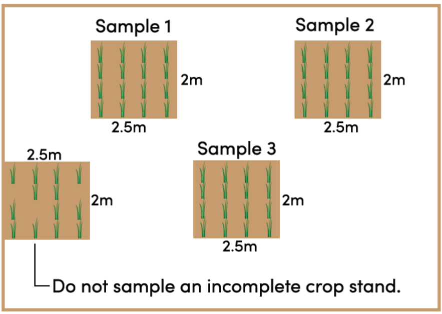
Table 5. Sample grain yield data of three parcels from each farmer-partner or farmer-cooperator.

Parcel no.	Area (m^2)	% Area with Missing hills (if many)	Fresh weight of grain samples per parcel (kg/m^2)	% Moisture Content (MC)	Grain Yield adjusted to 14% MC	
					kg/ha	t/ha = (kg/ha)/ 1,000
1	1,250		673.4	22.3	**4,867.3**	**4.9**
2	1,250		900.1	19.0	**5,651.8**	**5.7**
3	1,250		1,600.1	20.0	**5,953.5**	**6.0**
				Average	5,490.9	5.5

Annex 20. Measurement of "crop-cut" grain yield from a selected parcel or *pinitak*

1. If a farmer-partner (FP) or farmer-cooperator (FC) has two or more parcels, select a representative parcel. From the selected parcel, randomly measure three $5m^2$ harvest areas (see figure below). Select areas with good crop stand, without missing hills, not damaged by pests and diseases, and without nutrient deficiency symptoms.



2. Harvest/reap all plants from each sample area measuring $5m^2$ (=2mx2.5m). Thresh, clean, dry, weigh, and obtain the grain %MC using a grain moisture meter. Drying samples may be done in the oven at 70°C for 49 hours, or sun-drying for 2-3 days. Follow instructions in using the meter.

3. Sample data for crop-cut sample 1 from a representative farm parcel:

   (a) Crop-cut sample 1 area = $5m^2$

   (b) Grain weight for sample 1 = 2.03kg

   (c) Grain moisture content = 14.1%

   Calculate the grain yield from grain weight of crop-cut sample 1 and adjust to 14% MC using the formula below. Follow the same procedure for crop-cut samples 2 and 3. Tabulate and get the average yields of crop-cut samples 1 to 3.

Grain yield at 14% MC (kg/ha)
= Grain weight (kg) / Crop-cut Sample 1 area (m^2) x 10,000m^2/ha x (100 - %MC) / 86
= 2.03kg / $5m^2$ x 10,000m^2/ha x (100 - 14.1%) / 86
= 4,060kg/ha x 0.9988
= 4,055.13kg/ha or 4.1t/ha

Table 6. Sample grain yield data from 3 crop-cut samples obtained from a representative farm parcel.

Sample no.	Grain weight (kg) / $5m^2$	Moisture content (%)	Grain Yield	
			kg/ha	t/ha = (kg/ha)/ 1,000
1	2.03	14.1	4,055.1	4.1
2	2.35	13.9	4,700.0	4.7
3	2.28	13.7	4,560.0	4.6
			Average	**4.5**

Annex 21. Measurement of yield components from 4-hill samples adjacent to crop-cut area.

Note: Do this only if resources (manpower, time, and payment) are adequate.

1. Select three representative 4-hill (2x2 hills) samples adjacent to the "crop-cut" area or 5m^2 harvest area. At 20x20cm distance between hills, 4 hills will occupy an area of 0.16m^2.
2. For each representative sample, count the panicles from each hill and total them for four hills.
3. Thresh the grains from all hills sampled.
4. Separate and count the filled and unfilled spikelets.
5. From the filled spikelets, separate the 1,000 grains and dry in the oven at 70^{o}C for 49 hours.
6. After drying the grains and weight has stabilized, record and label the weight as the 1,000-grain weight.

Yield components:

- Panicle number/m^2 = (Panicle number for 4 hills at 20cm x 20 cm between hills) / 0.16m^2
- Number of spikelets / panicle = (Total no. of filled and unfilled spikelets / panicle)

- % Filled spikelets = (no. of filled spikelets / panicle) / (no. of filled + unfilled spikelets) x 100
- 1,000-grain weight (g)
- Follow the same procedure for the other two 4-hill samples. Tabulate the data and get the average.

Table 7. Sample yield components from 4 hills (0.16m²) / sample.

Sample no.	No. of panicles/m²	No. of spikelets/ panicle	% Filled spikelets	1,000-grain weight (g)
1	500	122	76.1	22.8
2	506	88	81.8	23.9
3	575	101	81.9	25.0
Average	**527**	**104**	**79.9**	**23.9**

Note: Yield components can be used to partly explain grain yield differences due to treatments or from farm parcels.

Grain yield (kg/ha) = Panicle number/m² x spikelet number/panicle x %filled spikelets x 1000-grain weight (g) x 10^{-2}
= Spikelet number/m² x %filled spikelets x 1000-grain weight (g) x 10^{-2}

Notes:

- *Percent filled spikelets should be in decimal form.*
- *Compare the yield calculated from yield components (obtained from plant hills sampled adjacent the crop-cut area) to yield obtained from a 5m² "crop-cut" sample or yield from a farm parcel.*

APPENDICES

MONITORING FORM 1

Year:
Season: (DS/WS)
Farm area (ha):

FARMING ACTIVITY	DATE	EXPENSES (P)
1) Seed Quality a) Variety: ____________ b) Amount (kg): _______		
2) Land Preparation a) Plowing b) Harrowing c) Land leveling		
3-4) Crop Establishment a) Direct wet seeding b) Pulling of seedlings c) Transplanting d) Replanting of missing hills		
5) Fertilizer Application (type and amount) a) First: ___________________________ b) Second: __________________________ c) Third: __________________________ d) Fourth: __________________________		
6) Irrigation a) NIA/ CIS b) Water pump (crude oil)		
7) Pest Management (chemical type and volume) a)____________________________________ b)____________________________________ c)____________________________________ d)____________________________________ e)____________________________________		
8) Harvesting a) Reaping b) Threshing c) Hauling d) Percentage share		
9) Postharvest a) Drying b) Cleaning c) Storing d) Transportation		
TOTAL COST		
HARVEST		
Paddy rice (no. of cavans)		
Weight per cavan (kg)		
Market price of paddy rice (P/kg)		
TOTAL INCOME (P)		
NET INCOME (P)		

MONITORING FORM 2

Planting Season (DS or WS): _____ Date: ____________

Crop management area/ Key Check	Key Check followed	Observations	Changes in the current crop management practices
	✓or x		
Seed Quality 1. Used high-quality seeds of a recommended variety			
Land Preparation 2. Well-leveled field			
Crop Establishment 3. Practiced synchronous planting after a rest period 4. Sufficient number of healthy seedlings			
Nutrient Management 5. Sufficient nutrients from tillering to EPI and flowering stages			
Water Management 6. Avoided stress caused by drought or excessive water that could affect the growth and yield of the crop			
Pest Management 7. No significant yield loss due to pests			
Harvest Management 8. Harvested the crop at the right time			
Postharvest Management 9. Dried, cleaned, and stored grains properly			

AGRONOMIC CHARACTERISTICS OF INBRED RICE VARIETIES FOR TRANSPLANTED IRRIGATED LOWLAND

Variety	Local name	Ave. Yield (t/ha)	Max.Yield (t/ha)	Maturity (DAS)	Height (cm)	Number of productive tillers per hill
PSB Rc 2	Nahalin	5.1	7.1	123	99	15
PSB Rc 4	Molawin	4.6	6.1	104	81	17
PSB Rc 6	Carranglan	5.2	6.8	112	84	14
PSB Rc 8	Talavera	5.0	7.1	108	82	13
PSB Rc 10	Pagsanjan	4.8	7.5	106	77	16
PSB Rc 18	Ala	5.1	8.1	123	102	15
PSB Rc 20	Chico	4.9	7.1	111	86	16
PSB Rc 22	Liliw	5.0	7.2	129	96	15
PSB Rc 28	Agno	5.0	7.6	111	93	16
PSB Rc 30	Agus	5.0	8.0	118	88	16
PSB Rc 32	Jaro	5.2	8.8	112	94	16

AGRONOMIC CHARACTERISTICS ... TRANSPLANTED (Continuation)

Variety	Local name	Ave. Yield (t/ha)	Max.Yield (t/ha)	Maturity (DAS)	Height (cm)	Number of productive tillers per hill
PSB Rc 34	Burdagol	4.8	10.3	124	101	16
PSB Rc 52	Gandara	5.3	5.3	115	86	16
PSB Rc 54	Abra	5.0	6.6	113	91	15
PSB Rc 56	Dapitan	5.3	7.5	114	88	17
PSB Rc 58	Mayapa	4.9	7.3	124	93	14
PSB Rc 64	Kabacan	5.0	8.9	124	96	14
PSB Rc 66	Agusan	5.2	10.2	123	90	17
PSB Rc 74	Aklan	5.2	8.3	114	92	15
PSB Rc 78	Pampanga	5.0	9.5	111	94	15
PSB Rc 80	Pasig	5.0	8.7	112	92	14

AGRONOMIC CHARACTERISTICS ... TRANSPLANTED (Continuation)

Variety	Local name	Ave. Yield (t/ha)	Max.Yield (t/ha)	Maturity (DAS)	Height (cm)	Number of productive tillers per hill
PSB Rc 82	Peñaranda	5.4	12.0	110	100	15
IR69726-29-1-2-2-2	Matatag 2	4.4	7.6	116	105	13
NSIC Rc 110	Tubigan 1	4.8	6.6	113	91	14
NSIC Rc 112	Tubigan 2	4.6	7.3	111	92	14

AGRONOMIC CHARACTERISTICS OF INBRED RICE VARIETIES FOR TRANSPLANTED/ DIRECT WET-SEEDED IRRIGATED LOWLAND

Variety	Local name	Establishment method	Ave. Yield (t/ha)	Max. Yield (t/ha)	Maturity (DAS)	Height (cm)	Number of productive tillers (TPR - per hill; DWSR - per m^2)
NSIC Rc 118	Matatag 3	TPR	4.6	6.7	107	95	14
NSIC Rc 120	Matatag 6	TPR	4.8	6.6	109	91	15
NSIC Rc 122	Angelica	TPR	4.7	8.9	121	106	14
NSIC Rc 128	Mabango 1 (A)	TPR	5.5	6.2	118	99	14
NSIC Rc 130	Tubigan 3	TPR/ DWSR	4.9/4.8	7.6/ 7.9	108/ 104	89/ 87	14/ 226
NSIC Rc 134	Tubigan 4	TPR/ DWSR	5.4/ 5.4	9.8/ 9.7	107/ 103	90/ 87	14/ 236
NSIC Rc 138	Tubigan 5	TPR/ DWSR	5.4/ 5.5	8.0/ 8.7	111/ 106	94/ 92	15/ 292
NSIC Rc 140	Tubigan 6	TPR/ DWSR	5.7/ 5.5	8.7/ 6.7	110/ 104	94/ 92	14/ 291
NSIC Rc 142	Tubigan 7	TPR/ DWSR	5.6/ 5.6	7.8/ 9.2	112/ 105	88/ 85	14/ 285

AGRONOMIC CHARACTERISTICS... TRANSPLANTED/ DIRECT WET-SEEDED (Continuation)

Variety	Local name	Establishment method	Ave. Yield (t/ha)	Max. Yield (t/ha)	Maturity (DAS)	Height (cm)	Number of productive tillers (TPR - per hill; DWSR - per m^2)
NSIC Rc 144	Tubigan 8	TPR/ DWSR	5.3/ 5.5	7.9/ 8.6	107/ 103	94/ 93	14/ 231
NSIC Rc 146	(PJ7)	TPR/ DWSR	4.6/ 4.7	6.9/ 7	110/ 104	101/ 99	14/ 105
NSIC Rc 148	Mabango 2	TPR	4.6	6.0	111	91	14
NSIC Rc 150	Tubigan 9	TPR/ DWSR	5.9/ 5.9	8.5/ 7.2	109/ 102	96/ 92	14/ 303
NSIC Rc 152	Tubigan 10	TPR/ DWSR	6.0/ 5.8	8.7/ 8.0	109/ 102	97/ 95	15/ 345
NSIC Rc 154	Tubigan 11	TPR	5.9	8.1	110	95	14
NSIC Rc 156	Tubigan 12	TPR/ DWSR	5.7/ 5.6	8.5/9.5	111/ 104	92/ 88	14/ 346
NSIC Rc 158	Tubigan 13	TPR	6.0	8.1	113	94	15
NSIC Rc 160	Tubigan 14	TPR/ DWSR	6.4/ 5.6	7.3/ 8.2	122/ 107	-/ 96	- / 314
NSIC Rc 170	MS 11	TPR	4.5	6.7	112	90	16

AGRONOMIC CHARACTERISTICS... TRANSPLANTED/ DIRECT WET-SEEDED (Continuation)

Variety	Local name	Establishment method	Ave. Yield (t/ha)	Max. Yield (t/ha)	Maturity (DAS)	Height (cm)	Number of productive tillers (TPR - per hill; DWSR - per m²)
NSIC Rc 172	MS 13	TPR	4.6	5.9	112	78	16
NSIC Rc 212	Tubigan 15	TPR/ DWSR	6.0/ 5.6	10/ 7.4	115/ 111	109/ 104	15/ 294
NSIC Rc 214	Tubigan 16	TPR/ DWSR	6.0/ 5.5	10.2/ 9.2	116/ 110	106/ 103	15/ 290
NSIC Rc 216	Tubigan 17	TPR/ DWSR	6.0/ 5.7	9.7/ 9.3	112/ 104	96/ 92	14/ 285
NSIC Rc 218 SR	Mabango 3	TPR	3.8	8.0	120	106	14
NSIC Rc 220 SR	Japonica 1	TPR	2.8	5.8	109	89	13
NSIC Rc 222	Tubigan 18	TPR/ DWSR	6.1/ 5.7	10/ 7.9	114/ 106	101/ 98	14 / 278
NSIC 2010 Rc 224	Tubigan 19	TPR	5.8	9.1	111	104	14
NSIC 2010 Rc 226	Tubigan 20	TPR/ DWSR	6.2/ 5.4	9.8/ 8.5	112/ 104	102/ 102	14/ 295
NSIC 2011 Rc 238	Tubigan 21	TPR	6.4	10.6	110	104	15

AGRONOMIC CHARACTERISTICS... TRANSPLANTED/ DIRECT WET-SEEDED (Continuation)

Variety	Local name	Establishment method	Ave. Yield	Max. Yield	Maturity	Height	Number of productive tillers (TPR - per hill; DWSR - per m^2)
			(t/ha)	(t/ha)	(DAS)	(cm)	
NSIC 2011 Rc 240	Tubigan 22	TPR/ DWSR	6.4/ 5.8	10.6/ 7.6	115/ 108	107/ 104	12/ 259
NSIC 2012 Rc 298	Tubigan 23	TPR/ DWSR	5.6/ 5.3	9.9/ 8.2	116/ 104	-/ 93	- / 273
NSIC 2012 Rc 300	Tubigan 24	TPR/ DWSR	5.7/ 5.3	10.4/ 9	115/ 105	98/ 96	15/ 269
NSIC 2012 Rc 302	Tubigan 25	TPR/ DWSR	5.7/ 5.1	10.4/ 9.5	115/ 106	100/ 96	15/ 266
NSIC 2013 Rc 308	Tubigan 26	TPR/DWSR	5.8	10.9	111	99	15
		DWSR	5.5	8.0	105	94	294
NSIC 2014 Rc 352	Tubigan 27	TPR	5.1	10.7	111	104	14
NSIC 2014 Rc 354	Tubigan 28	TPR	5.4	9.0	112	95	14
NSIC 2014 Rc 356	Tubigan 29	TPR	5.0	9.0	116	105	14

AGRONOMIC CHARACTERISTICS… TRANSPLANTED/ DIRECT WET-SEEDED (Continuation)

Variety	Local name	Establishment method	Ave. Yield	Max. Yield	Maturity	Height	Number of productive tillers (TPR - per hill; DWSR - per m^2)
			(t/ha)	(t/ha)	(DAS)	(cm)	
NSIC 2014 Rc 358	Tubigan 30	TPR	5.4	9.1	114	98	14
NSIC 2014 Rc 360	Tubigan 31	TPR	5.2	8.2	118	103	14
NSIC 2015 Rc 394	Tubigan 32	TPR/ DWSR	5.3/ 5.2	9.1/ 10.0	112/ 106	-/ 94	-/ 375
NSIC 2015 Rc 396	Tubigan 33	TPR/ DWSR	4.9/ 5.1	9.1/ 10.3	114/ 106	-/ 93	-/ 358
NSIC 2015 Rc 398	Tubigan 34	TPR/ DWSR	5.5/ 5.3	9.4/ 11.3	113/ 106	-/ 98	-/ 375
NSIC 2015 Rc 400	Tubigan 35	TPR/ DWSR	5.8/ 5.4	9.5/ 12.6	120/ 113	105/ 100	15/ 387
NSIC 2015 Rc 402	Tubigan 36	TPR/ DWSR	5.5/ 5.5	10.0/ 14.0	114/ 107	-/ 95	-/ 395
NSIC 2016 Rc 436	Tubigan 37	TPR/ DWSR	5.7/ 5.4	10.0/ 10.2	107/ 101	93/ 92	14/ 301
NSIC 2016 Rc 438	Tubigan 38	TPR/ DWSR	5.4/ 5.4	10.3/ 9.6	106/ 102	95/ 92	13/ 306

AGRONOMIC CHARACTERISTICS... TRANSPLANTED/ DIRECT WET-SEEDED (Continuation)

Variety	Local name	Establishment method	Ave. Yield	Max. Yield	Maturity	Height	Number of productive tillers (TPR - per hill; DWSR - per m²)
			(t/ha)	(t/ha)	(DAS)	(cm)	
NSIC 2016 Rc 440	Tubigan 39	TPR/ DWSR	5.5/ 5.3	10.8/ 9.0	109/ 102	95/ 91	14/ 320
NSIC 2016 Rc 442	Tubigan 40	TPR/ DWSR	6.1/ 5.5	10.8/ 10.7	113/ 105	103/ 109	14/ 320
NSIC 2018 Rc 506	Tubigan 41	TPR/ DWSR	5.9/ 5.8	10.0/ 8.7	111/ 104	99/ 96	13/ 277
NSIC 2018 Rc 508	Tubigan 42	TPR/ DWSR	6.0/ 5.8	10.4/ 10.8	110/ 105	97/ 94	14/ 293
NSIC 2018 Rc 510	Tubigan 43	TPR	5.7/ 5.4	10.3/ 9.8	110/ 104	105/ 106	13/ 275
NSIC 2018 Rc 512	Tubigan 44	TPR/ DWSR	5.6/ 5.6	10.2/ 10.1	113/ 105	92/ 93	13/ 275
NSIC 2018 Rc 514	Tubigan 45	TPR/ DWSR	6.0/ 5.3	9.9/ 10.9	112/ 103	95/ 92	13/ 273

NOTE:

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