DESIGN AND TESTING OF FAR- INFRARED PADDY DRYER

Bobby Y. Lived, Manuel Jose C. Regalado, and Alexis T. Belonio

DEPARTMENT OF AGRICULTURE
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RATIONALE

- Drying paddy during harvest season is one of the major problems in the Philippines.
- Rice harvested during wet season exhibit very high moisture content.
- Undried paddy will easily deteriorate and spoil thus reducing its quality
- A far-infrared dryer which simulate sundrying was designed and tested at REMD as alternative means of low-cost drying paddy especially during rainy period.

OBJECTIVES

General Objective:

To design and test a far-infrared paddy dryer.

Specific Objectives:

1. To design the dryer using locally available material as source of far-infrared heat; and
2. To determine the moisture content profile of paddy in the dryer at different temperature and initial moisture content.

METHODOLOGY

- Laboratory experiment
- Design Conceptualization
- Calculations and Drawing Preparation
- Fabrication
- Testing
  - Power requirement (Oscillating Tray, Suction Blower)
  - Emitter Temperature (Burner, emitter, & Chimney)
  - Moisture content (Low and Intermediate)

The Far-Infrared Dryer

RESULTS AND DISCUSSION

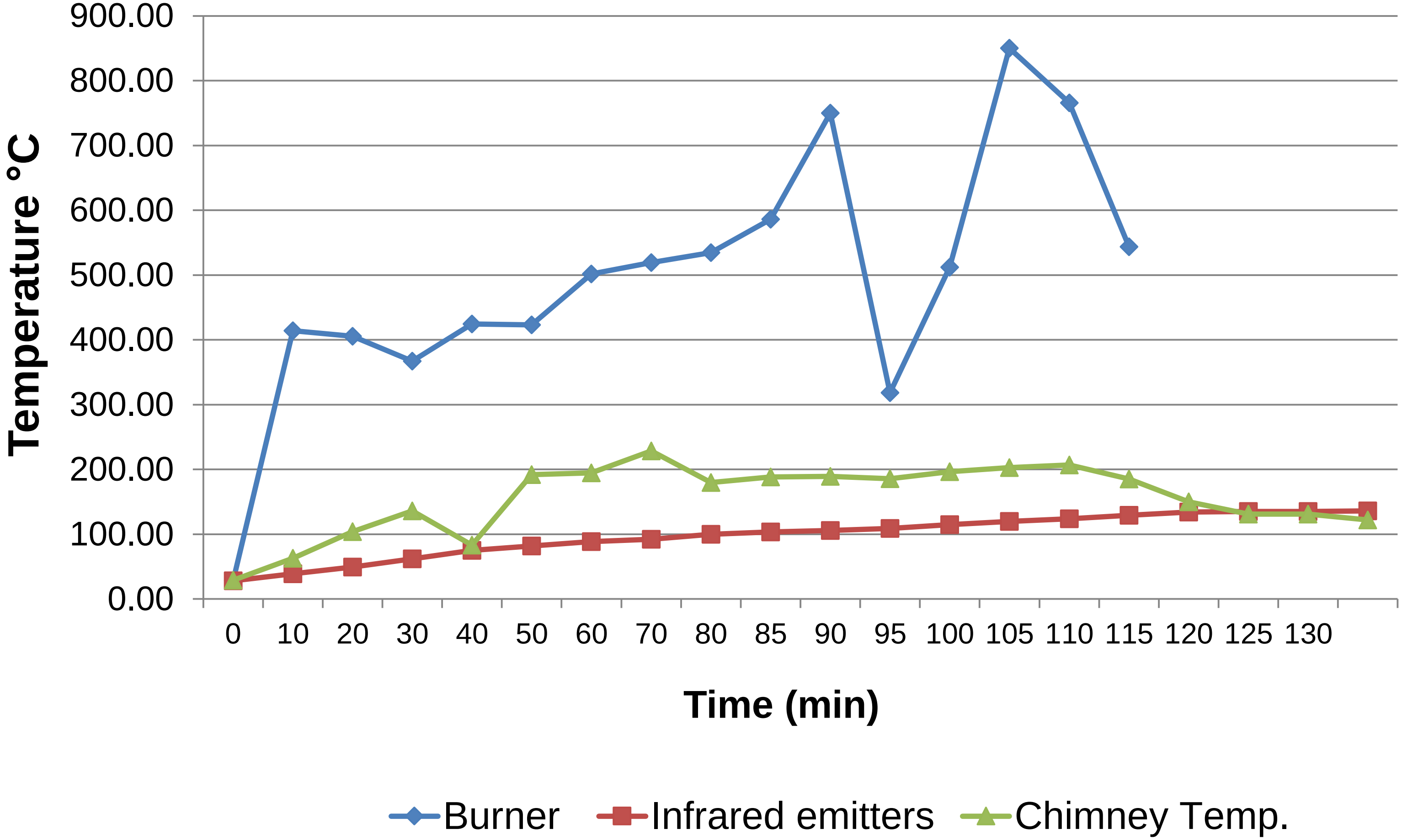
Laboratory Experiment Result

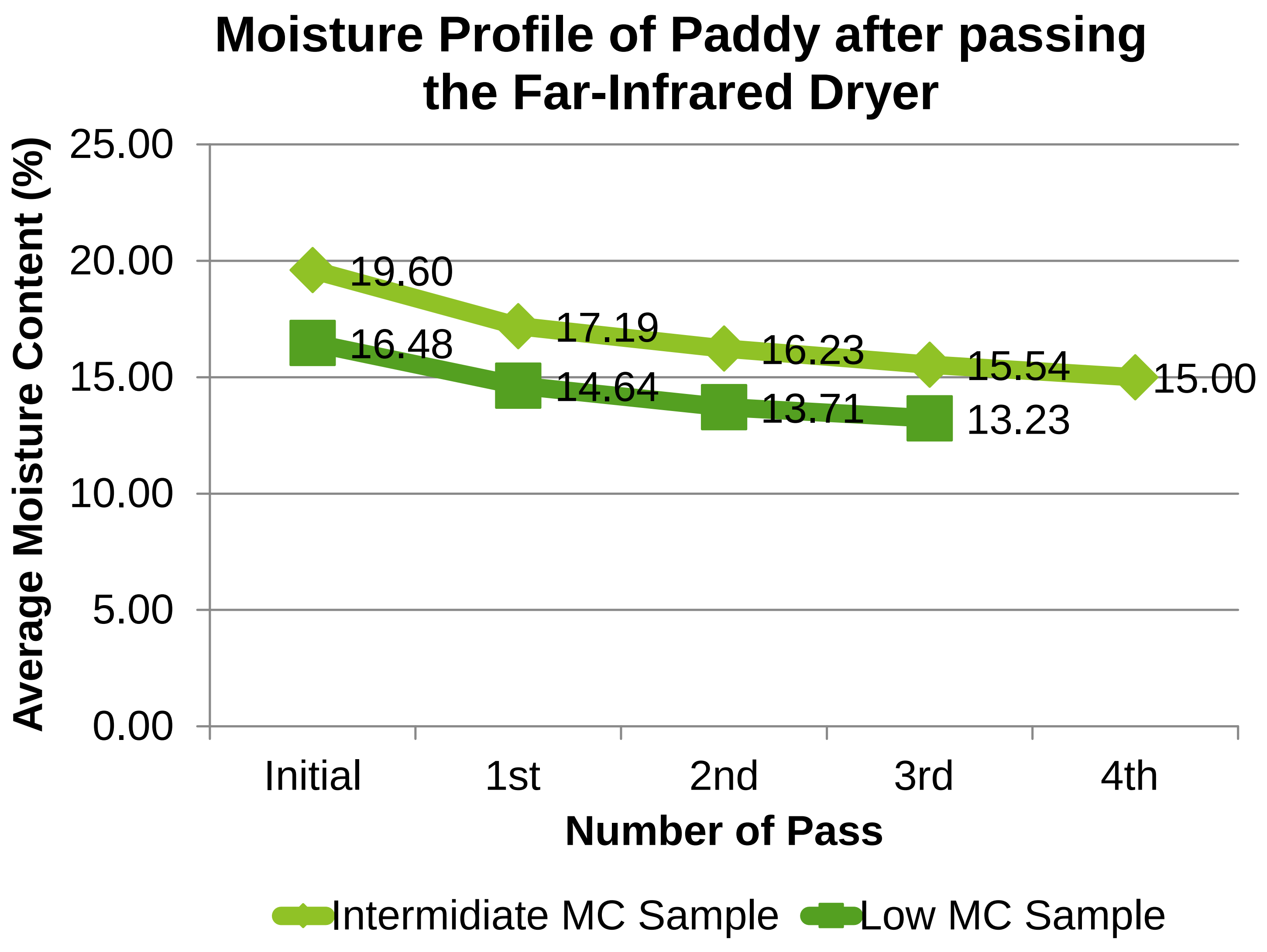
Current (A)	Final Surface Temperature (°C)		
	1C : 1L	2C : 1L	1C : 2L
0.2	49.4	58.8	67.4
0.3	61.4	72.6	77.2
0.4	90.4	85.8	90.8
0.5	113.6	109.4	108.0

Design Specifications of the Far-Infrared Dryer

Dimensions	
Length of emitter	10 m
Width Emitter	0.8 m
Thickness of the emitter	10 cm
Power Requirement	
Oscillating Tray	1.13 kw
Blower	1.2 kw
Total	2.33 kw
Specific Power Consumption	3.58 kw-hr/ton
Throughput Capacity	0.55 - 0.65 ton/hr
Heat Source (Rice Husk Gasifier)	
Diameter of Reactor	0.80 m

Temperature Profile





Moisture Profile of Paddy after passing the Far-Infrared Dryer
Average Moisture Content (%)
25.00
20.00
15.00
10.00
5.00
0.00
19.60
17.19
16.23
15.54
15.00
16.48
14.64
13.71
13.23
Initial
1st
2nd
3rd
4th
Number of Pass
Intermidiate MC Sample
Low MC Sample

Relative Humidity Readings

Samples	Ambient RH (%)	Cooler RH (%)
Intermediate MC		
1	55.00	60.50
2	52.00	54.60
3	52.50	55.70
Low MC		
1	43.70	47.43
2	45.77	49.16
3	43.53	47.10

CONCLUSIONS AND RECOMMENDATIONS

- The far infrared paddy dryer can successfully reduce the moisture content of paddy in 3 to 4 passes from the initial moisture tested until it reaches 13 to 15%.
- The temperature of the emitter affects the moisture removal of paddy in the dryer. The higher the temperature of the emitter the lesser the required number of passes.
- The dryer has a relatively low specific power of 3.58 kW-hr/ton.
- Actual evaluation need to be done to further assess the performance of the dryer as well as the milling quality of the product during harvest season.

End of Presentation

THANK YOU FOR LISTENING!!!

Paperless field data collection for quick data turnover on a nationwide scale

Ulysses Duque
Crop Protection Division
Philippine Rice Research Institute

Introduction

- The Philippine Rice Information System (PRiSM) aims to develop a monitoring and information system for rice production in the country
  - One of its objectives is to provide timely and accurate information on the rice crop to support policy making, decision making and activity planning related to food security.
    - Such information are being collected through surveys at farmer's fields, characterizing the production situations in the area and to assess the injuries caused by diseases, animal pests and weeds.

- For Crop Health component, we are using the following forms;
    1. Fertilizers and Pesticides – information are collected throughout the season. Data collectors asked the farmers on the farm management strategies they did on their farms within the season.

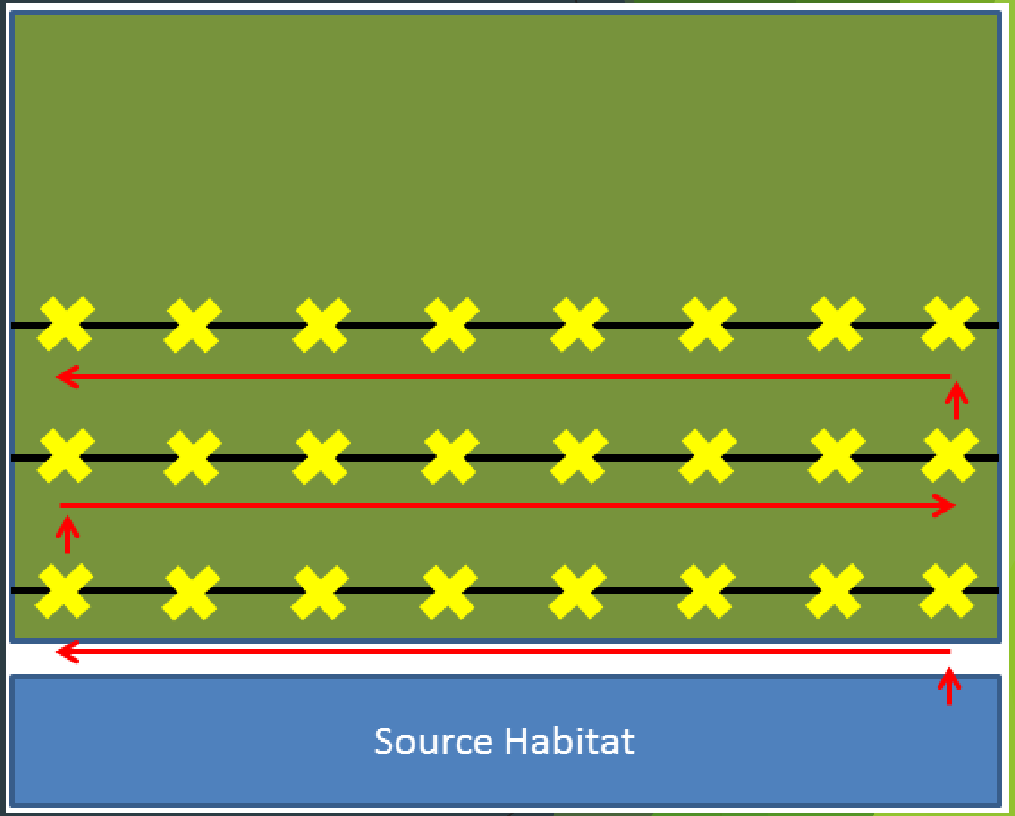
2. Crop and Injuries – this for is used at booting and dough stages. At booting injuries on the leaves and tiller are collected. At dough stage, similar injuries are assessed with the addition of injuries on panicles These are all assessed at 10 hills in each monitoring field. Systemic injuries are also assessed at five 1x1m quadrant. Aside from these, weed occurrence above and below canopy, most dominant weed type and species are assessed in three 1x1m quadrant.

bird, rice bug, rice grain bug, stem borer and black bug (dead heart), dirty panicle, false smut and neck blast diseases

leaf folder, leaf miner, thrips, whorl maggots, other defoliatios, bacterial leaf blight, bacterial leaf streak, brown spot, leaf blast, narrow brown spot, and red stripe

dead heart caused by stem borer and black bug, bakanae, sheath blight, sheath rot, stem rot

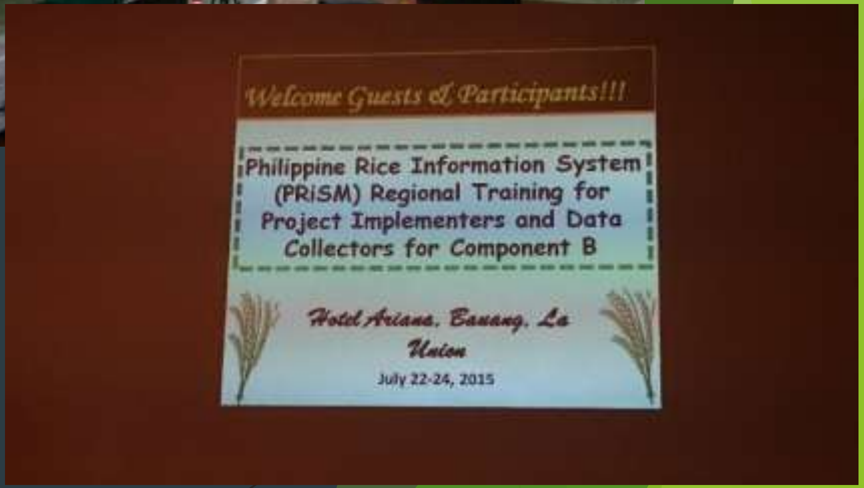
- Rat Injuries – it is assessed at maturity of the crop to be able to relate the damage with the yield loss.



- Crop Cut – yield of each monitoring field is also assessed on 3 2x2.5m (5sqm) quadrant. Samples are manually threshed, weigh, and determine the moisture content

How do we do it?

1. PRiSM developed a standard assessment protocol for each injury
2. We conducted series of training national level and then on regional level at least twice a year
3. Regular monitoring of the project field activities by the facilitators and experts



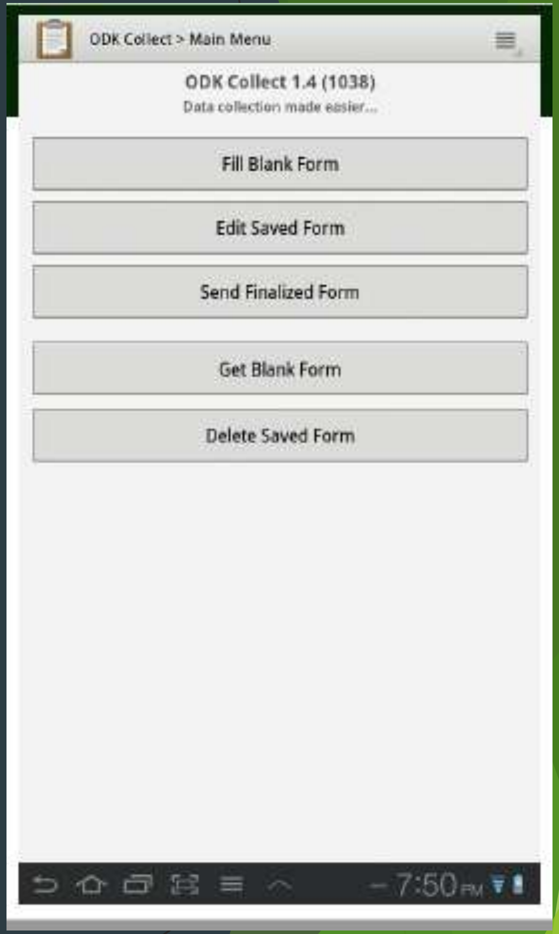
How PRiSM Collects information?

- Instead of pen and paper, PRiSM uses an Android-based smart phone installed with Open Data Kit Collect (ODK-collect) that is specifically programed for PRiSM.

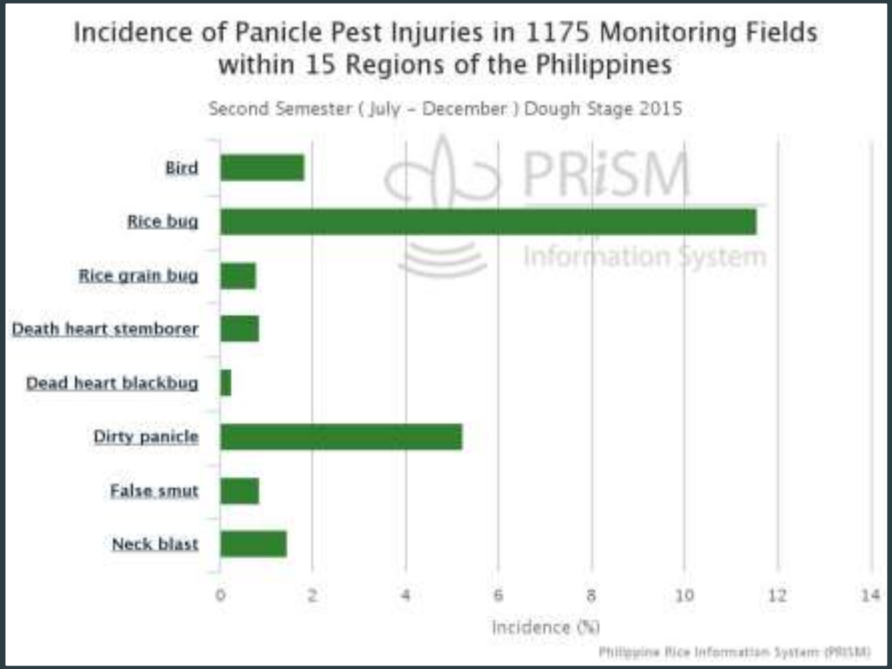
What is ODK Collect?

Open Data Kit (https://opendatakit.org/) is a free and open-source set of tools which help organizations author, field, and manage mobile data collection solutions. ODK provides an out-of-the-box solution for users to:

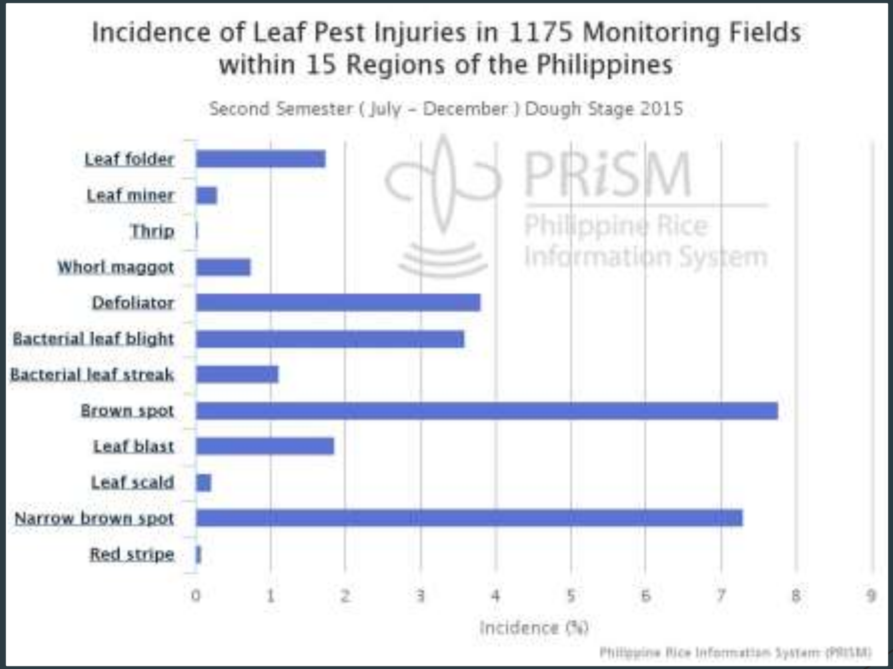
- **Build** a data collection form or survey (XLSForm is recommended for larger forms);
- **Collect** the data on a mobile device and send it to a server; and
- **Aggregate** the collected data on a server and extract it in useful formats.



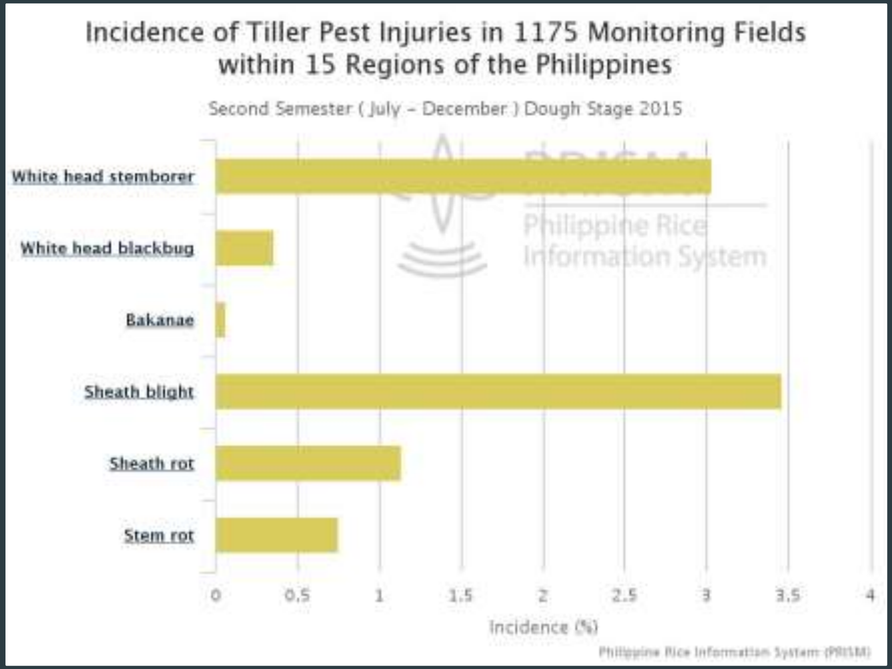
Our Outputs

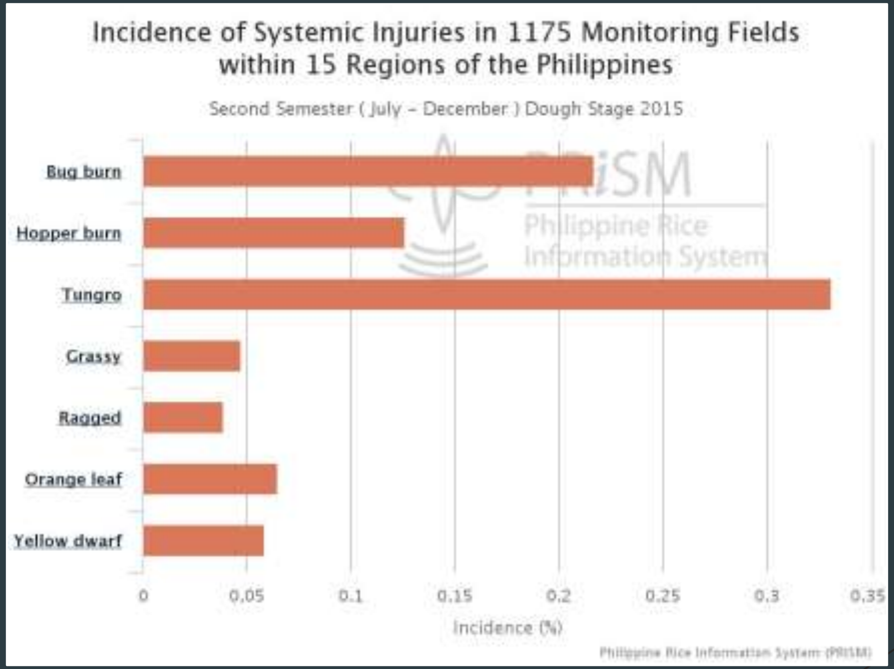


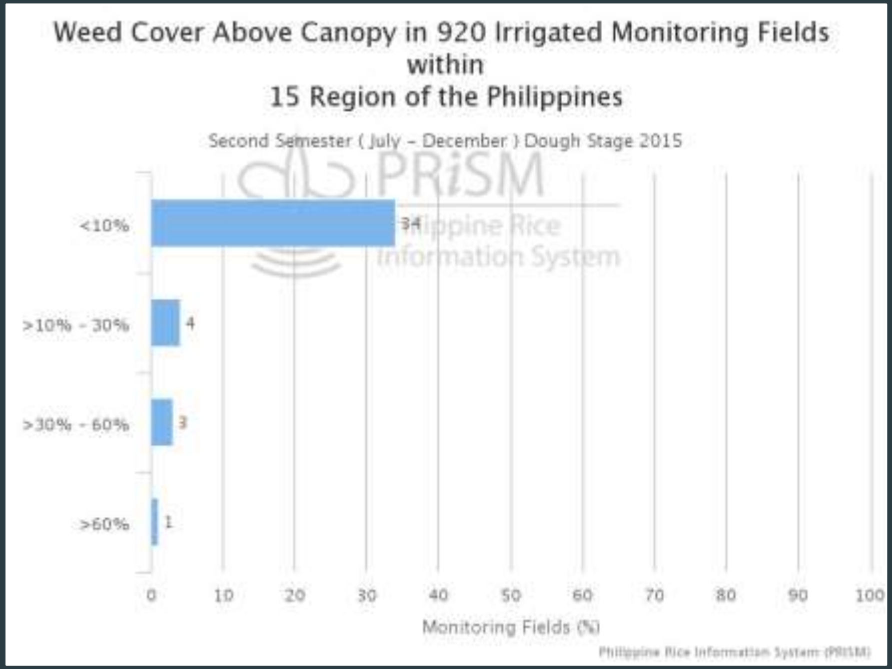
Incidence of Panicle Pest Injuries in 1175 Monitoring Fields within 15 Regions of the Philippines
Second Semester (July – December) Dough Stage 2015
PRiSM
Information System
Bird
Rice bug
Rice grain bug
Death heart stemborer
Dead heart blackbug
Dirty panicle
False smut
Neck blast
0
2
4
6
8
10
12
14
Incidence (%)
Philippine Rice Information System (PRISM)



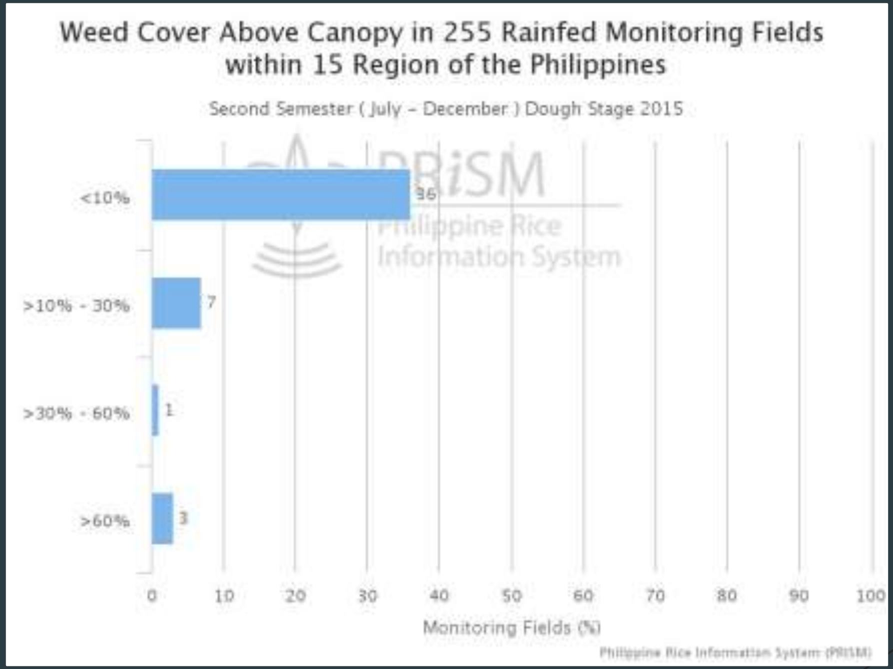
Incidence of Leaf Pest Injuries in 1175 Monitoring Fields within 15 Regions of the Philippines
Second Semester (July – December) Dough Stage 2015
PRiSM
Philippine Rice Information System
Leaf folder
Leaf miner
Thrip
Whorl maggot
Defoliator
Bacterial leaf blight
Bacterial leaf streak
Brown spot
Leaf blast
Leaf scald
Narrow brown spot
Red stripe
0
1
2
3
4
5
6
7
8
9
Incidence (%)
Philippine Rice Information System (PRISM)


Incidence of Tiller Pest Injuries in 1175 Monitoring Fields within 15 Regions of the Philippines
Second Semester (July – December) Dough Stage 2015
White head stemborer
White head blackbug
Bakanae
Sheath blight
Sheath rot
Stem rot
0
0.5
1
1.5
2
2.5
3
3.5
4
Incidence (%)
Philippine Rice Information System (PRISM)

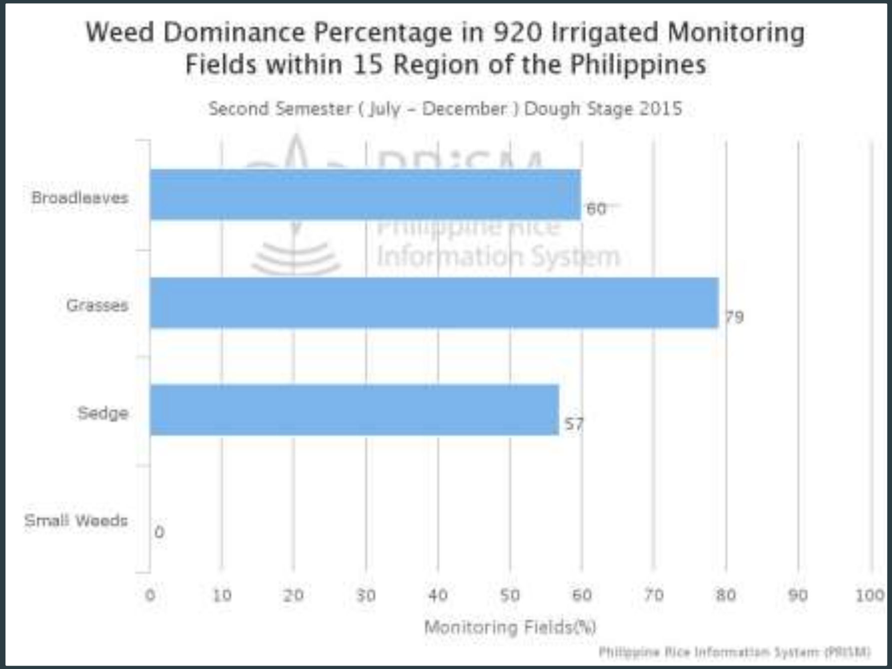

Incidence of Systemic Injuries in 1175 Monitoring Fields within 15 Regions of the Philippines
Second Semester (July – December) Dough Stage 2015
Bug burn
Hopper burn
Tungro
Grassy
Ragged
Orange leaf
Yellow dwarf
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Incidence (%)
Philippine Rice Information System (PRISM)

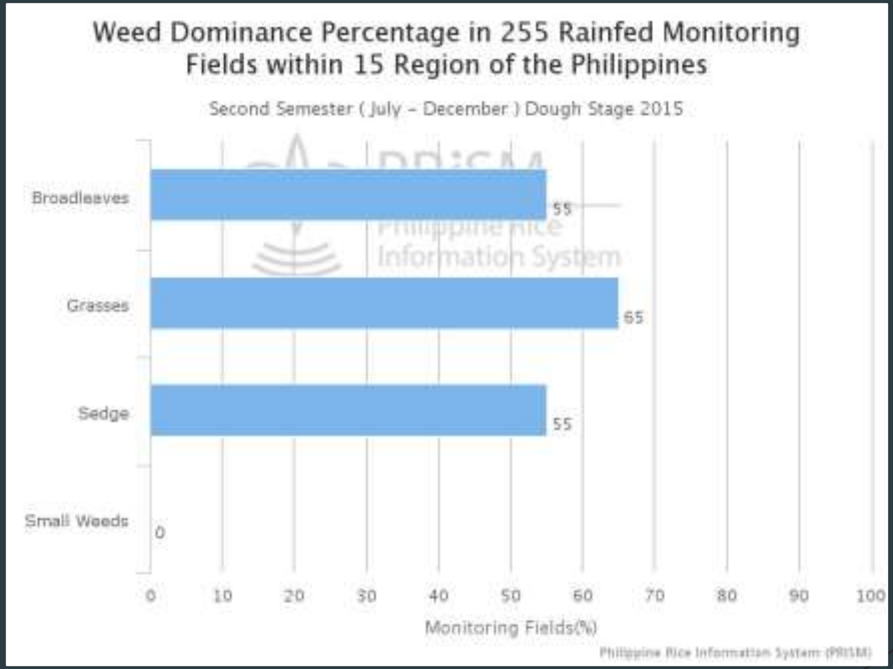


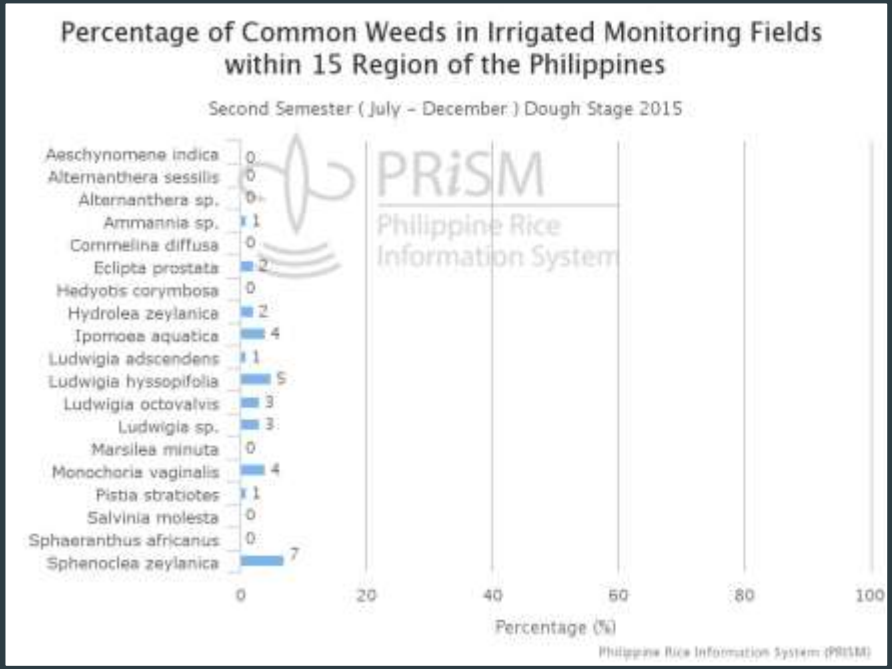
Weed Cover Above Canopy in 920 Irrigated Monitoring Fields within
15 Region of the Philippines
Second Semester (July – December) Dough Stage 2015
<10%
>10% - 30%
>30% - 60%
>60%
34
4
3
1
0
10
20
30
40
50
60
70
80
90
100
Monitoring Fields (%)
Philippine Rice Information System (PRISM)

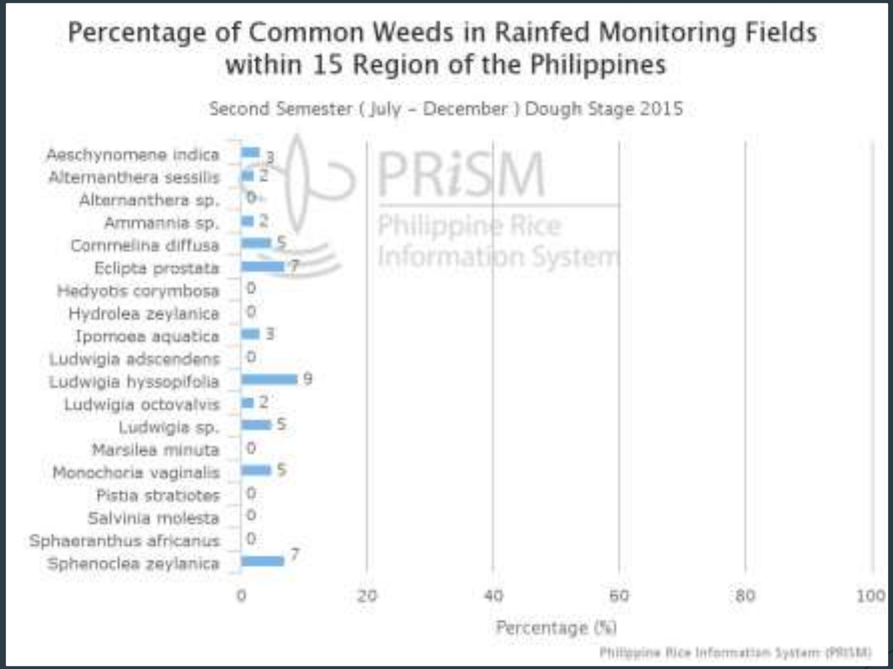


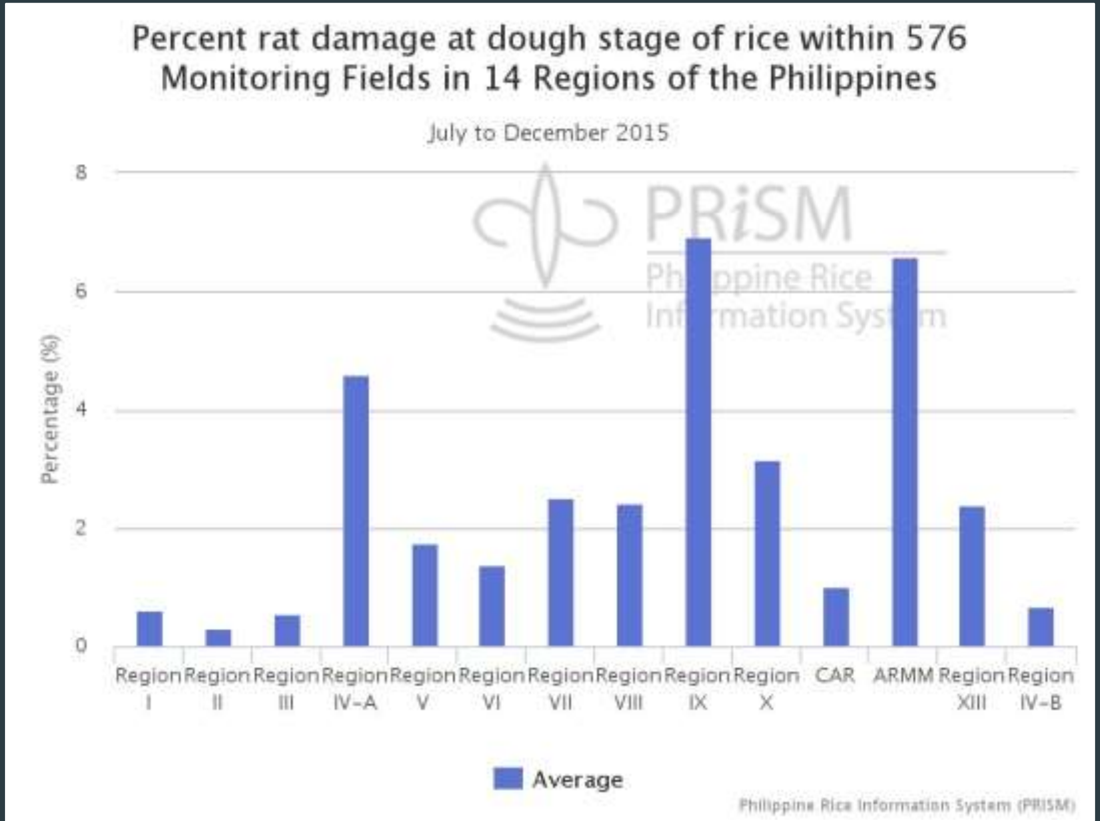
Weed Cover Above Canopy in 255 Rainfed Monitoring Fields
within 15 Region of the Philippines
Second Semester (July – December) Dough Stage 2015
<10%
>10% - 30%
>30% - 60%
>60%
36
7
1
3
0
10
20
30
40
50
60
70
80
90
100
Monitoring Fields (%)
Philippine Rice Information System (PRISM)


Weed Dominance Percentage in 920 Irrigated Monitoring Fields within 15 Region of the Philippines
Second Semester (July - December) Dough Stage 2015
Broadleaves
60
Grasses
79
Sedge
57
Small Weeds
0
0 10 20 30 40 50 60 70 80 90 100
Monitoring Fields(%)
Philippine Rice Information System (PRISM)


Weed Dominance Percentage in 255 Rainfed Monitoring Fields within 15 Region of the Philippines
Second Semester (July - December) Dough Stage 2015
Broadleaves
55
Grasses
65
Sedge
55
Small Weeds
0
0 10 20 30 40 50 60 70 80 90 100
Monitoring Fields(%)
Philippine Rice Information System (PRISM)


Percentage of Common Weeds in Irrigated Monitoring Fields within 15 Region of the Philippines
Second Semester (July - December) Dough Stage 2015
Aeschynomene indica 0
Alternanthera sessilis 0
Alternanthera sp. 0
Ammannia sp. 1
Commelina diffusa 0
Eclipta prostata 2
Hedyotis corymbosa 0
Hydrolea zeylanica 2
Ipomoea aquatica 4
Ludwigia adscendens 1
Ludwigia hyssopifolia 5
Ludwigia octovalvis 3
Ludwigia sp. 3
Marsilea minuta 0
Monochoria vaginalis 4
Pistia stratiotes 1
Salvinia molesta 0
Sphaeranthus africanus 0
Sphenoclea zeylanica 7
0 20 40 60 80 100
Percentage (%)
PRiSM Philippine Rice Information System
Philippine Rice Information System (PRISM)

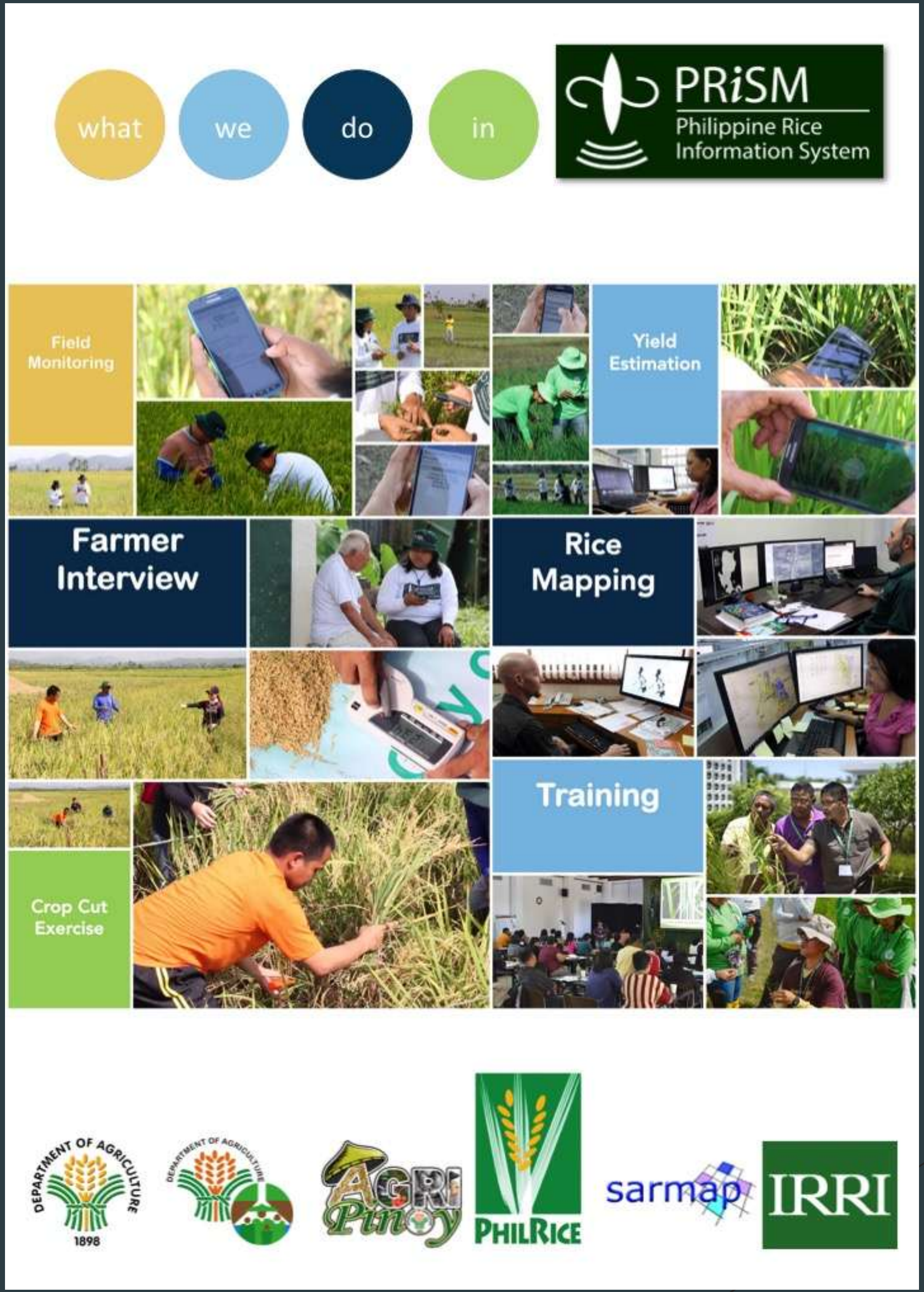

Percentage of Common Weeds in Rainfed Monitoring Fields within 15 Region of the Philippines
Second Semester (July - December) Dough Stage 2015
Aeschynomene indica 3
Alternanthera sessilis 2
Alternanthera sp. 0
Ammannia sp. 2
Commelina diffusa 5
Eclipta prostata 7
Hedyotis corymbosa 0
Hydrolea zeylanica 0
Ipomoea aquatica 3
Ludwigia adscendens 0
Ludwigia hyssopifolia 9
Ludwigia octovalvis 2
Ludwigia sp. 5
Marsilea minuta 0
Monochoria vaginalis 5
Pistia stratiotes 0
Salvinia molesta 0
Sphaeranthus africanus 0
Sphenoclea zeylanica 7
0 20 40 60 80 100
Percentage (%)
PRiSM Philippine Rice Information System
Philippine Rice Information System (PRISM)



Percent rat damage at dough stage of rice within 576 Monitoring Fields in 14 Regions of the Philippines
July to December 2015
Percentage (%)
8
6
4
2
0
Region I
Region II
Region III
Region IV-A
Region V
Region VI
Region VII
Region VIII
Region IX
Region X
CAR
ARMM
Region XIII
Region IV-B
Average
Philippine Rice Information System (PRISM)

With these….

- Timely information especially of rice pests are available on nationwide scale
- That this method of data collection can ease data management


what we do in
PRiSM
Philippine Rice Information System
Field Monitoring
Yield Estimation
Farmer Interview
Rice Mapping
Training
Crop Cut Exercise
DEPARTMENT OF AGRICULTURE
1898
AGRI Pinoy
PHILRICE
sarmap
IRRI

The authors....


Thank You

Rodent Damage in the Philippines: PRiSM National Survey Results

Leonardo V. Marquez, Ulysses G. Duque, and
Edwin C. Martin (PhilRice CES)

Introduction

- Rodents are a chronic rice pest inflicting an average of 5-60% crop damage (Joshi et al., 2000)
- Crop loss due to rodents often exceeds to the combined losses of all other pests (Quick, 1990)
- An effective quantitative method to determine crop losses due to rodent is essential in formulating working rodent management system

Introduction

- A national damage survey for losses of growing rice to rodents in the Philippines was conducted by the Rodent Research Center in 1968 to 1971 in 16 major rice producing provinces
- After more than four decades, national survey of major rice pest injuries were regularly monitored by the Philippine Rice Information System (PR*i*SM) team

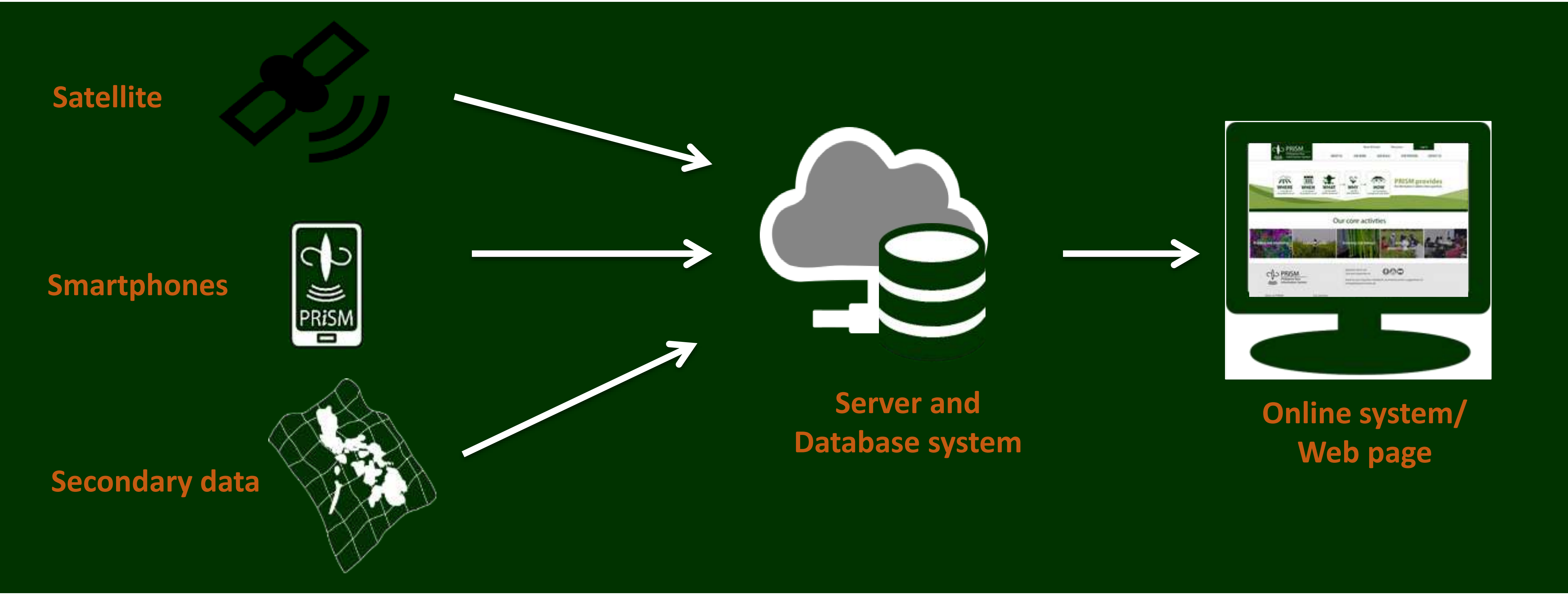
Introduction

The Philippine Rice Information system or PR*i*SM

Provides information to address questions on

Introduction

The Philippine Rice Information system or PR*i*SM

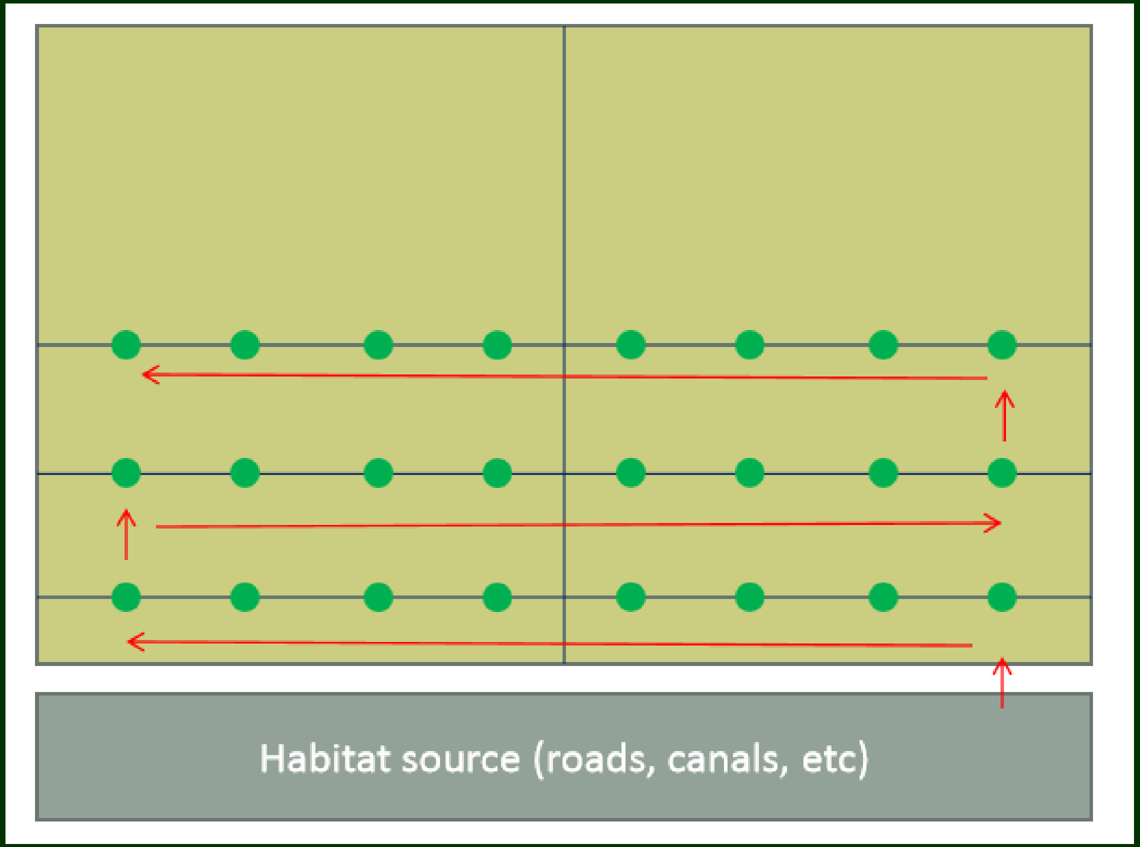


PRiSM
Philippine Rice
Information System

Methodology

Monitoring and Stratum for rodent damage of PR*i*SM

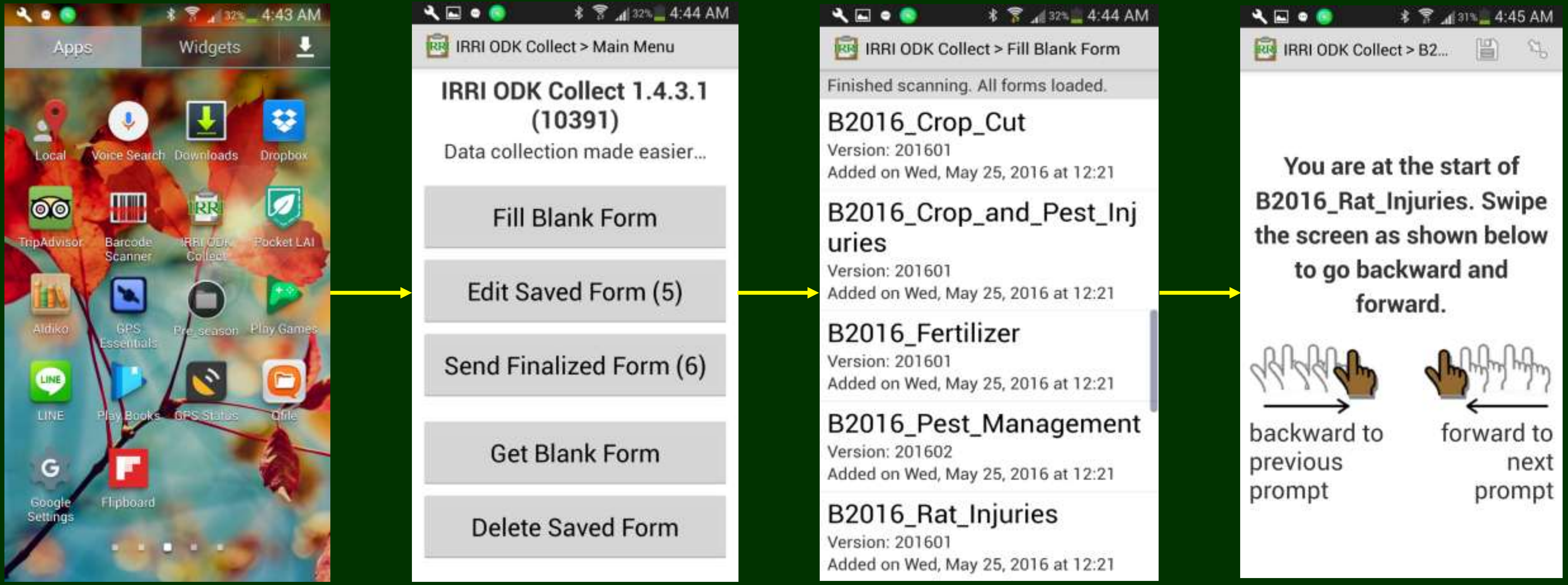
1 sampling point = 20 or more tillers



Methodology

- Data recording and sending was done using smartphone with open data kit (ODK) app
- Open Data Kit (ODK) is a free and open-source set of tools which help organizations author, field, and manage mobile data collection
- ODK's core developers are researchers at the University of Washington

Methodology



Methodology

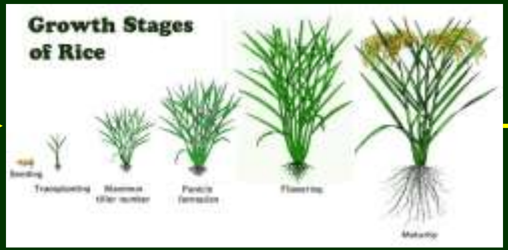
GPS location

today

Monitoring field ID

Harvest

Data collector



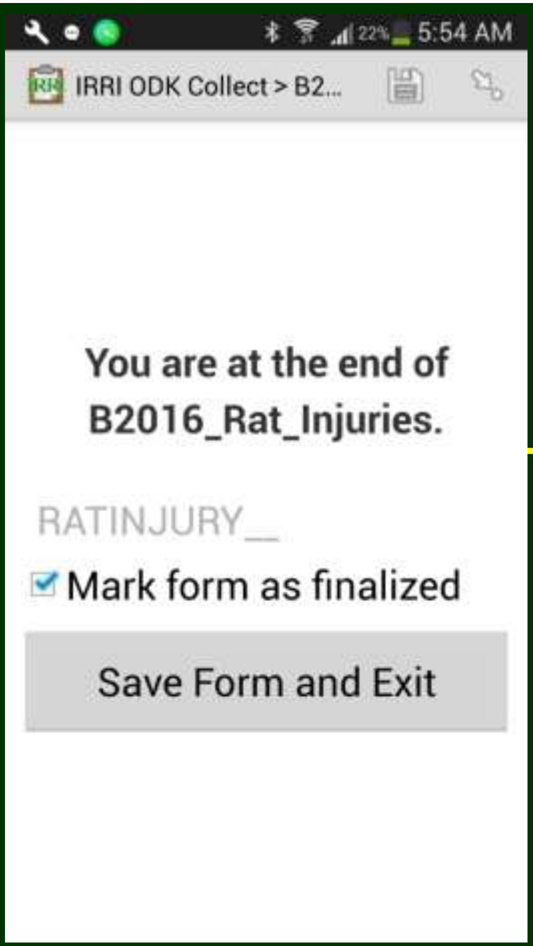
select

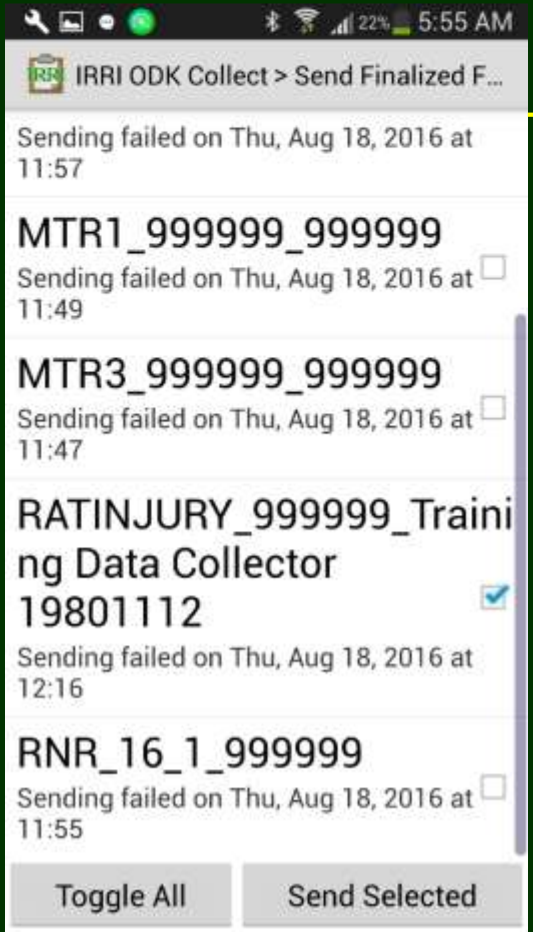
COUNT…

Methodology

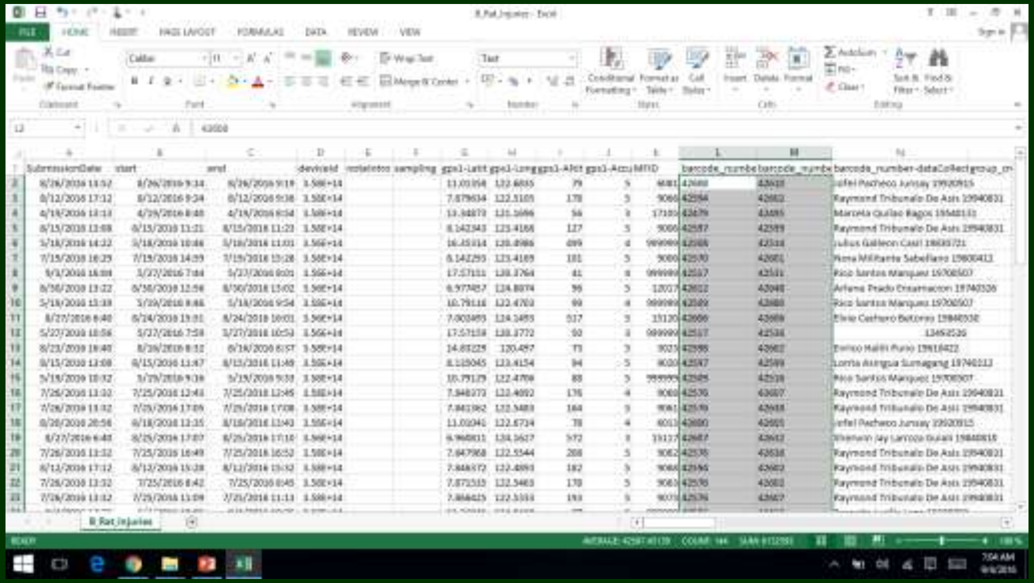
- Add general remarks (optional) or description of scene surrounding of the monitoring field
- Take interesting photo of the monitoring field (optional)

Methodology





Data were received by the aggregator



Methodology

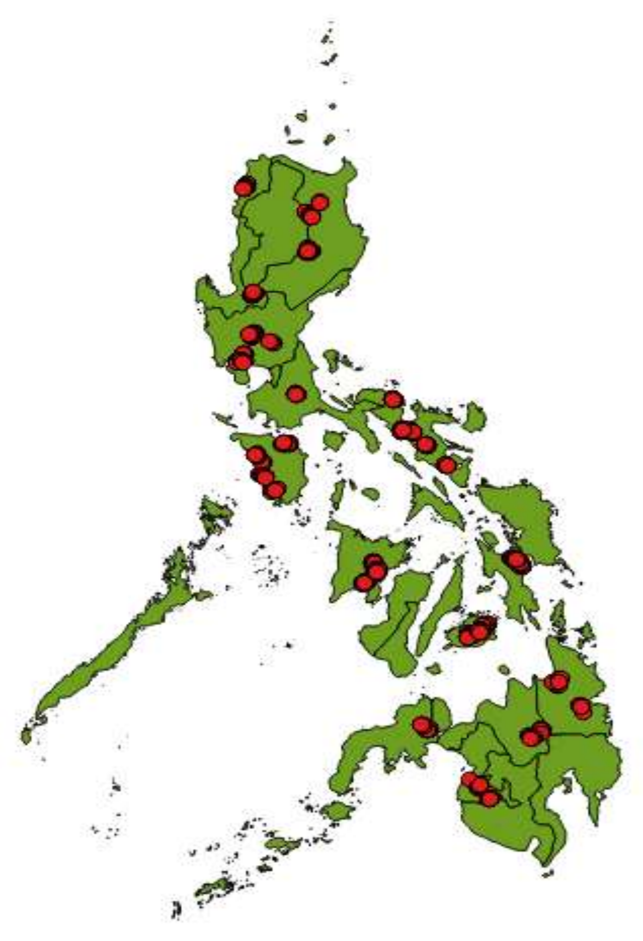
- Data were analysed using the formula:

$$\% \text{ damage} = \frac{\text{damaged tillers}}{\text{total number of tillers}} \times 100$$

Results

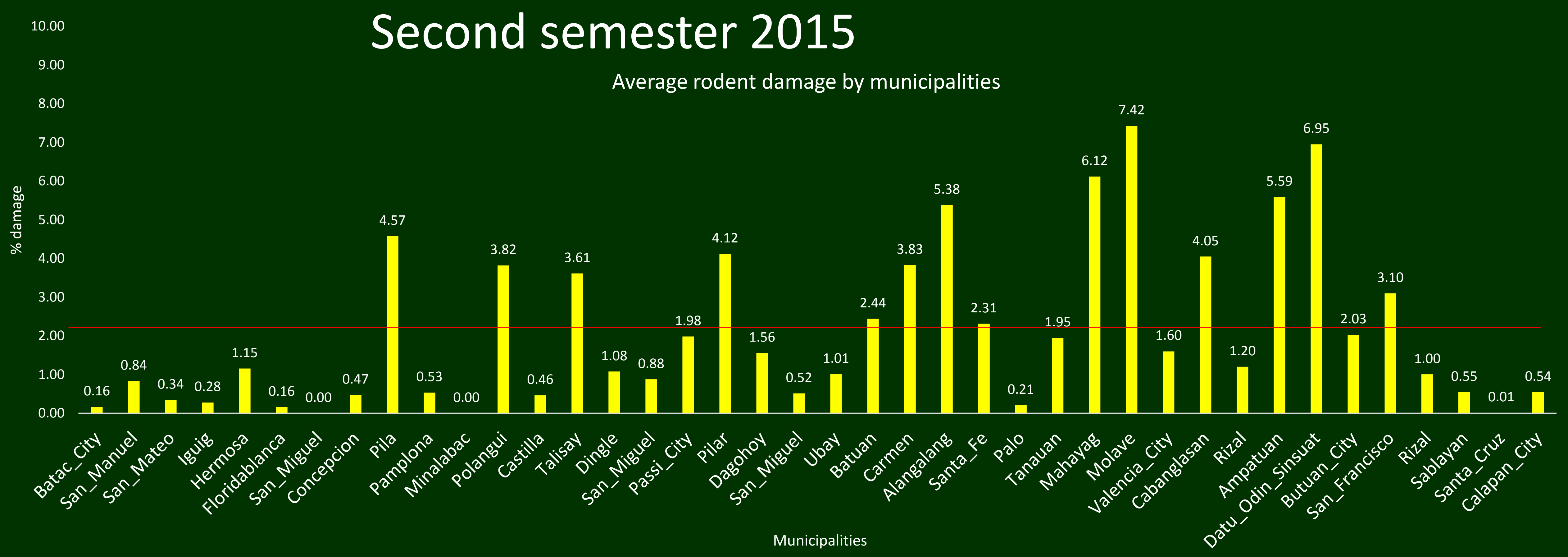
Second semester 2015

- **576** fields in 24 provinces were surveyed
- **2.11%** was the average national rodent damage
- **0.00 to 35.67%** range of rodent damage
- **62.08%** chance of rodent damage incidence



PRiSM
Philippine Rice Information System

Results

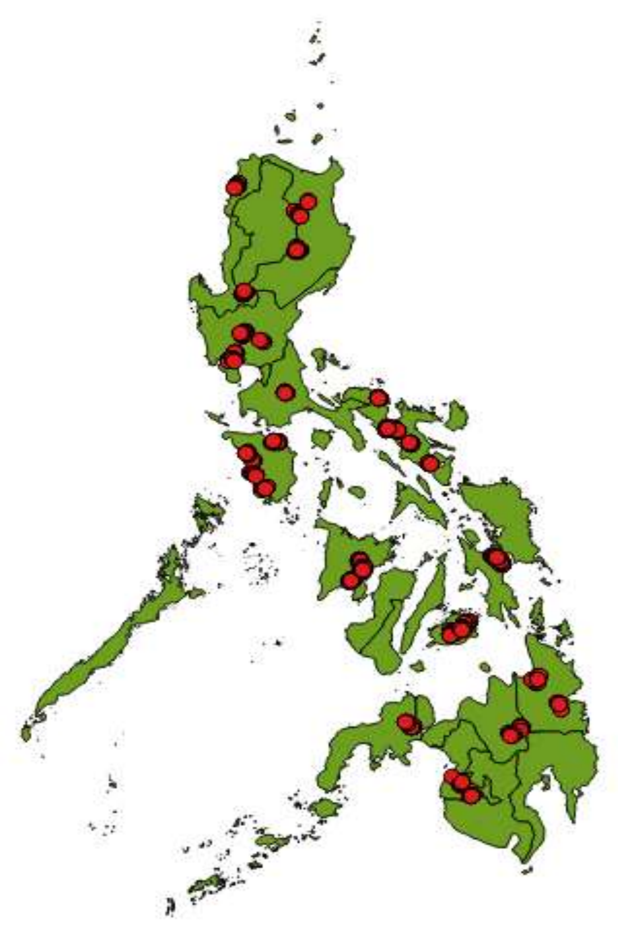


PRiSM
Philippine Rice
Information System

Results

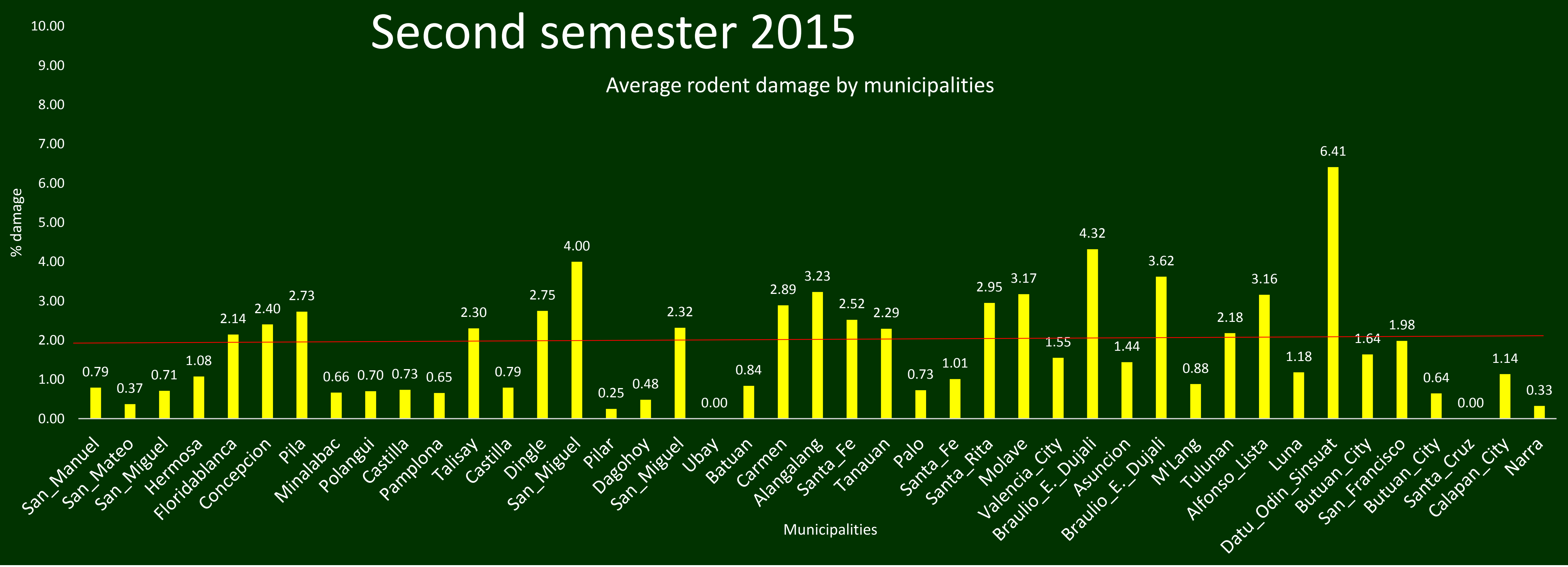
first semester 2016

- **548** fields in 24 provinces were surveyed
- **1.96%** was the average national rodent damage
- **0.00 to 22.28%** range of rodent damage
- **35.03%** chance of rodent damage incidence



PRiSM
Philippine Rice
Information System

Results



PRiSM
Philippine Rice
Information System

For more information:

PRiSM Philippine Rice Information System

PRiSM

END

http://philippinericeinfo.ph

Development of Capillary Irrigation (*Capillarigation*) System for Rice-based Crops

Maximizing the Use of Water by Small-holder Farmers During Extreme Drought Conditions

Ricardo F. Orge & Derose A. Sawey
PhilRice -CES

29th National Rice R&D Conference
September 7-8, 2016
PhilRice, Maligaya, Munoz SC, Nueva Ecija

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Introduction

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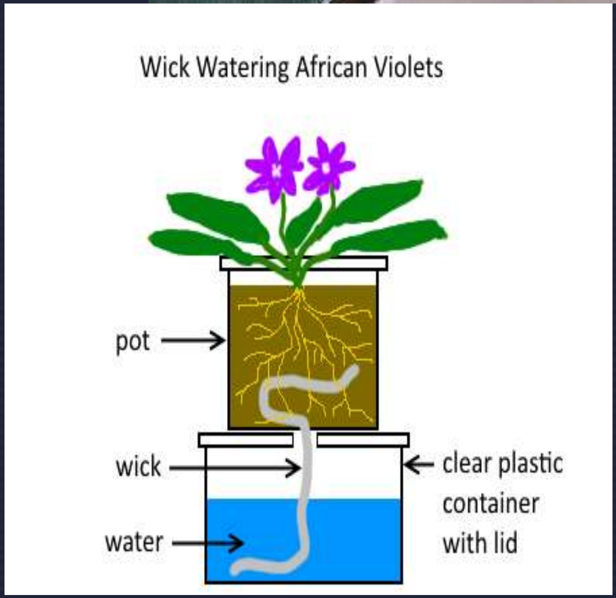
- How water is applied to plants needs to be seriously considered especially now that water is becoming scarce
- Extreme event like El Niño comes every 2 to 7 years
- The Philippines, together with other Southeast Asian Countries, will experience a "high" degree of water shortage in the year 2040 (World Resources Institute)
- There is an increasing need for efficient and affordable method of irrigating crops

Use of capillary wicks

Proven to efficiently work on nurseries, labor-efficient and can substantially reduce water usage (Nalliah, & Sri Ranjan, 2010)

No advancements done yet for field crop production (Million et al., 2007)



Objective

To develop a low cost irrigation system for rice-based crops making use of capillary wicks as media for dispensing water to plants

Materials & Methods

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Development criteria

Target users:

- small-holder rice-based farmers

Target outcomes:

- low cost technology
  - ✓ Local, low cost/recycled materials
- capacity enhancement of farmers
  - ✓ Low skill fabrication, operation, & maintenance

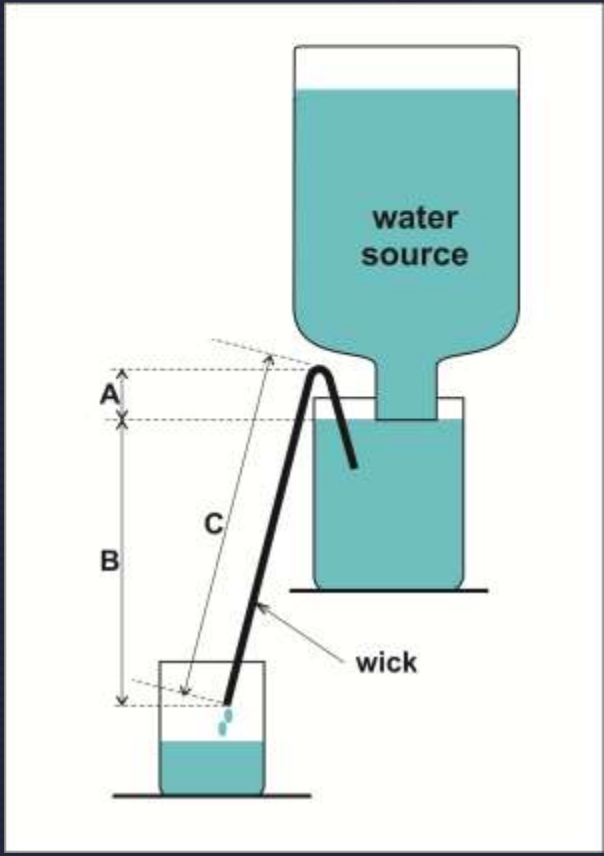
Benchmark: drip irrigation system

- capillary wicks instead of drippers

Materials & Methods

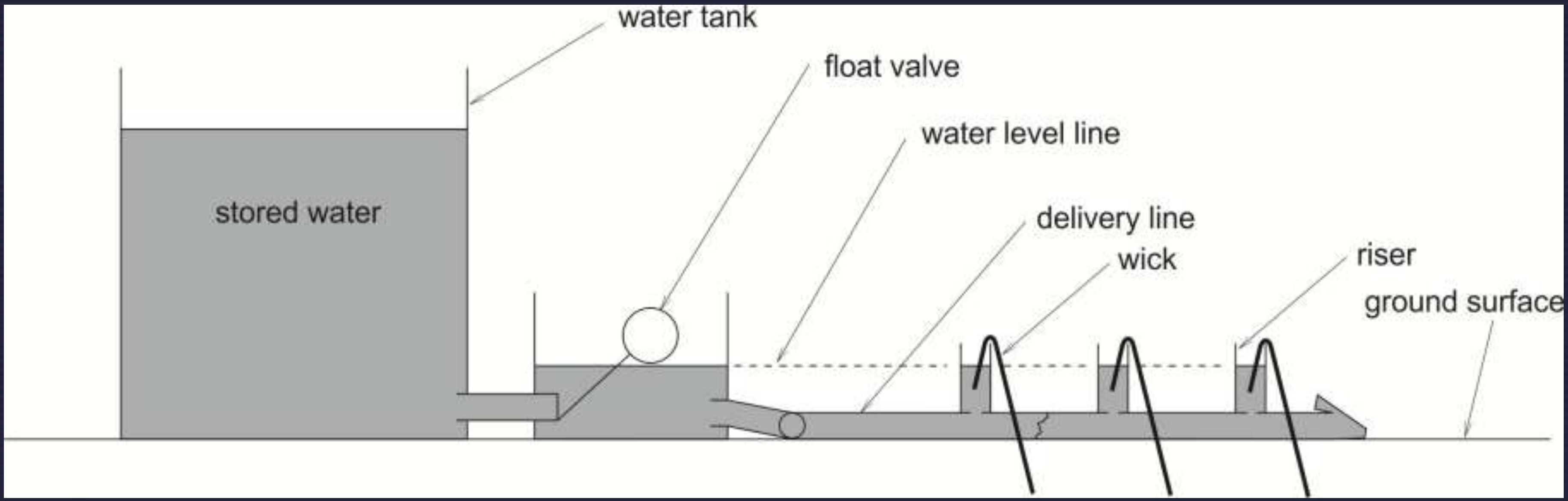
Activities

1. Establishment of design data
   a. Suitable wick material
   b. Factors affecting wicking flow rate
2. Design of system components
3. Field Performance test



Results

System's basic components



Results

Flow rate of the wicks (cotton yarn) under actual field conditions

Wick location	Average WFR, mL h^{-1}				
	Day 1	Day 7	Day 14	Day 21	Mean
Upstream	16.7	53.7	38.0	40.7	37.2a
Tail end	26.3	47.7	44.0	40.3	39.6a
Mean	21.5b	50.7a	41.0a	41.5a	

Results

Capillarigation field setup


Results

Capillarigation as compared to drip irrigation system

PARAMETER	CAPILLARIGATION	DRIP
Emitter discharge (mL h^{-1})	30-50	800 – 3000
Operating pressure (cm water)	10-15	>100
Water filtration system	Highly needed	Not so important
Sub-surface application	yes	no
Application	continuous	intermittent

Results

Yield, weed density, and water use efficiency as affected by two irrigation methods

Performance Parameter	Trial 1 (Green Pepper)		Trial 2 (Tomato)	
	Capillarigation	Control	*Capillarigation*	Control
Yield per Plant, g	51.7	63.1	399.0	306.0
Weed density, g m^{-2}	47.2	111.7	--	--
Water use efficiency, g L^{-1}	1.8	1.2	5.5	2.5

Challenges

- mold accumulation in wicks
- cost reduction

Prospects

- Vertical farming
- Integration of nutrients (fertigation)
- Aquaponics

Concluding Remarks

- **Use of capillary wicks as replacement for dripper (following a drip irrigation setup) is technically feasible**

- **Initial results of field trials show that the *capillarigation* system works for the rice-based crops tested.**

- **More field tests need to be done in wider areas to verify the results and test its suitability under various field and crop conditions**

Pathogenicity Analysis of Philippine Isolates of Rice Blast Fungus (*Pyricularia oryzae* Cavara) Using the International Blast Designation System

JT Niones[1], JP Rillon[1], LM Perez[1], MER Fabreag[2] and Y Fukuta[3]

[1]PhilRice Central Experiment Station, Maligaya, Science City of Munoz, Nueva Ecija, Philippines

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Rice Blast

Leaf Blast

- Seedling to tillering stage
- Diamond-shaped lesions with gray or white center
- Leaf blast can kill young plants



Photos credit to the PRISM project

Photo credit to SESantiago

NSIC Rc216 infected with leaf blast (seedbed) Cuyapo, Nueva Ecija. WS2016.

NSIC Rc298 infected with leaf blast (transplanted), Babatnon, Leyte. WS2016 Photo credit to UGDuque

Node Blast

- Node of the stem turns blackish and breaks easily

Collar Blast

- Infection at the intersection of leaf blade and sheath results in “ collar rot”
- Entire leaf blade dries up when the base of the flag leaf is infected

Neck/panicle Blast

- Caused incomplete grain filling and poor milling quality
- Early occurrence of neck rot causes premature death of entire panicle, leaving it white and destroyed.

Photos credit to the PRISM project

Varieties that succumb to rice blast disease

Variety name	Date approved as variety	Blast resistance reaction *	Year reported**
NSIC Rc222	2009	intermediate	WS 2016
NSIC Rc122	2003	resistant	2005
NSIC Rc112	2002	Intermediate	2005
PSB Rc82	2000	resistant	2002
PSB Rc14	1992	intermediate	2005
IR64	1985	resistant	2003

- Blast field resistance reaction when released as variety

** Report of susceptible blast reaction

- ❑ Breakdown of resistance only few years after varietal release.
- ❑ Occurrence or dominance of new pathogenic races

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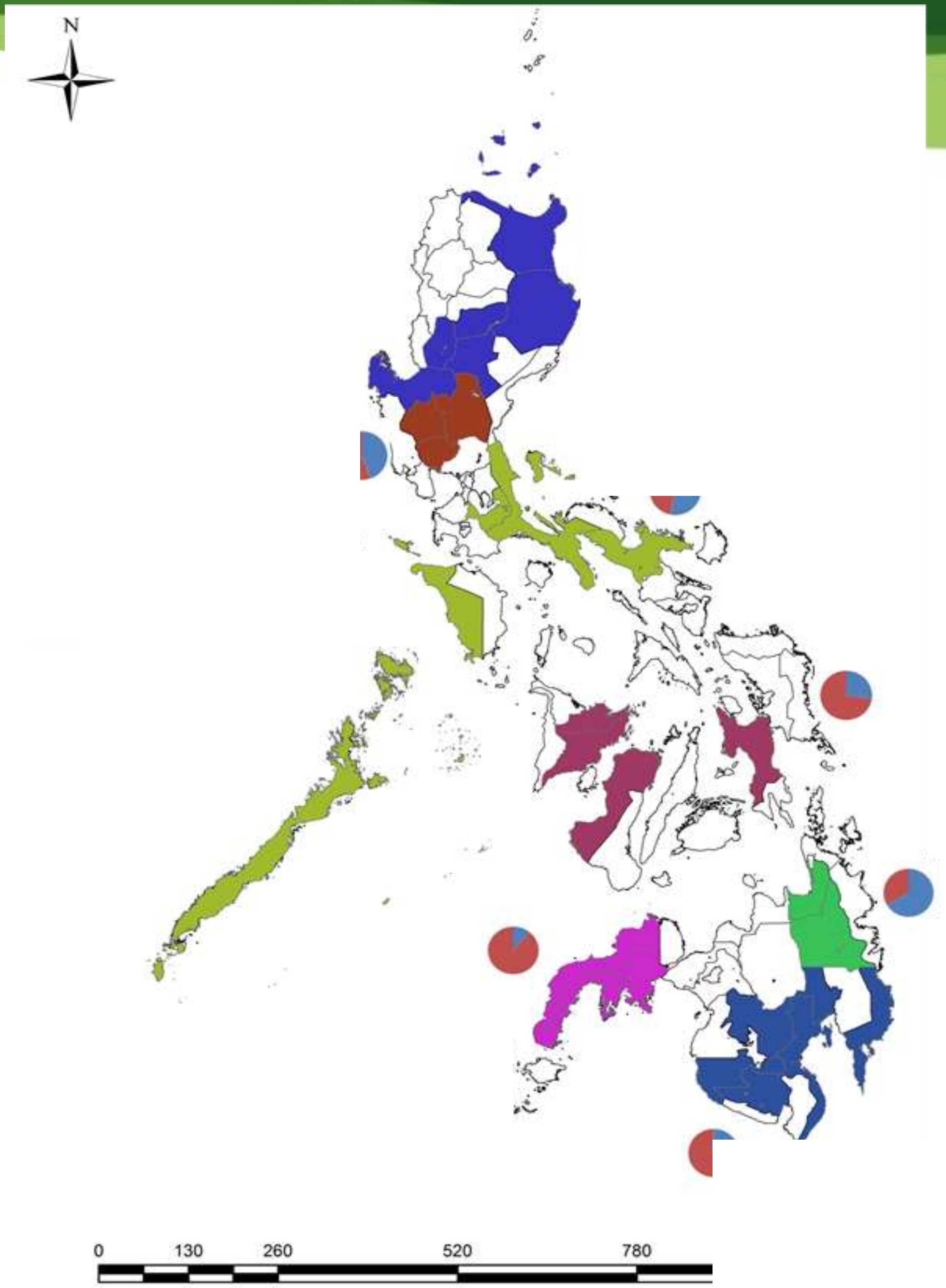
Materials and Method

- 213 rice blast isolates

Luzon: 7 regions, 14 provinces
N: 141
IL: 94 Rainfed: 14
Cool-elevated: 28 Upland: 5

Visayas: 2 regions, 4 provinces
N: 11
IL: 3 Rainfed: 8
Cool-elevated: 0 Upland: 0

Mindanao: 4 regions, 11 provinces
N= 61
IL: 56 Rainfed: 3
Cool-elevated: 0 Upland: 2



Differential rice varieties

- 25 LTH monogenic lines
  - 23 Target resistance genes

Susceptible control: LTH, US-2

Monogenic lines (IRBL)	sh-S LTH b-B a-A T-K59 -	i-F5 3-CP4 5-M	ks-S km-Ts k-Ka - 1-CL kp-K60 - Kh-K3 7-M	9-W z-Fu - z5-CA - zt-T	ta2-Pi ta-K1 19-A ta2-Re ta-CP1 20-IR24 12-M - -
Resistance gene	*Pish* + *Pib* *Pia* *Pit* -	*Pii* *Pi3* *Pi5(t)*	*Pik-s* *Pik-m* *Pik* - *Pi1* *Pik-p* - *Pik-h* *Pi7(t)*	*Pi9(t)* *Piz* - *Piz-5* - *Piz-t*	*Pita-2* *Pita* *Pi19* *Pita-2* *Pita* *Pi20(t)* *Pi12(t)* - -

New designation system for blast races based on the reaction of monogenic line with LTH background (Hayashi and Fukuta, 2009)

			Chr.9	Chr.11			Chr.6		Chr.12		
Group	**I**		**II**	**III**			**IV**		**V**		
Locus	**-**		***Pii***	***Pik***			***Piz***		***Pita***		
Target resistance gene	*Pish*	+	*Pii*	*Pik-s*	*Pik-m*	*Pik*	*Pi9(t)*	*Piz*	*Pita-2*	*Pita*	*Pi19*
	Pib	*Pia*	*Pi3*	-	*Pi1*	*Pik-p*	-	*Piz-5*	*Pita-2*	*Pita*	*Pi20(t)*
	Pit	-	*Pi5(t)*	-	*Pik-h*	*Pi7(t)*	-	*Piz-t*	*Pi12(t)*	-	-
Monogenic lines (IRBL)	sh-S	LTH	i-F5	ks-S	km-Ts	k-Ka	9-W	z-Fu	ta2-Pi	ta-K1	19-A
	b-B	a-A	3-CP4	-	1-CL	kp-K60	-	z5-CA	ta2-Re	ta-CP1	20-IR24
	T-K59	-	5-M	-	Kh-K3	7-M	-	zt-T	12-M	-	-
Code	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	-	2	2	-	2	2	2	2
	4	-	4	-	4	4	-	4	4	-	-
Ex. Blast isolates virulent to all genes	S	S	S	S	S	S	S	S	S	S	S
	S	S	S	-	S	S	-	S	S	S	S
	S	-	S	-	S	S	-	S	S	-	-
	7	**3**	**7**	**1**	**7**	**7**	**1**	**7**	**7**	**3**	**3**

Race number **virulent** to ALL differential varieties: **U73-i7-k177-z17-ta733**

			Chr.9	Chr.11			Chr.6		Chr.12		
Group	**I**		**II**	**III**			**IV**		**V**		
Locus	**-**		***Pii***	***Pik***			***Piz***		***Pita***		
Target resistance gene	*Pish*	+	*Pii*	*Pik-s*	*Pik-m*	*Pik*	*Pi9(t)*	*Piz*	*Pita-2*	*Pita*	*Pi19*
	Pib	*Pia*	*Pi3*	-	*Pi1*	*Pik-p*	-	*Piz-5*	*Pita-2*	*Pita*	*Pi20(t)*
	Pit	-	*Pi5(t)*	-	*Pik-h*	*Pi7(t)*	-	*Piz-t*	*Pi12(t)*	-	-
Monogenic lines (IRBL)	sh-S	LTH	i-F5	ks-S	km-Ts	k-Ka	9-W	z-Fu	ta2-Pi	ta-K1	19-A
	b-B	a-A	3-CP4	-	1-CL	kp-K60	-	z5-CA	ta2-Re	ta-CP1	20-IR24
	T-K59	-	5-M	-	Kh-K3	7-M	-	zt-T	12-M	-	-
Code	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	-	2	2	-	2	2	2	2
	4	-	4	-	4	4	-	4	4	-	-
Ex. Blast isolates virulent to all genes	S	S	S	S	S	S	S	S	S	S	S
	S	S	S	-	S	S	-	S	S	S	S
	S	-	S	-	S	S	-	S	S	-	-
	7	**3**	**7**	**1**	**7**	**7**	**1**	**7**	**7**	**3**	**3**

Race number **avirulent** to ALL differential varieties: **U00-i0-k000-z00-ta000**

Results

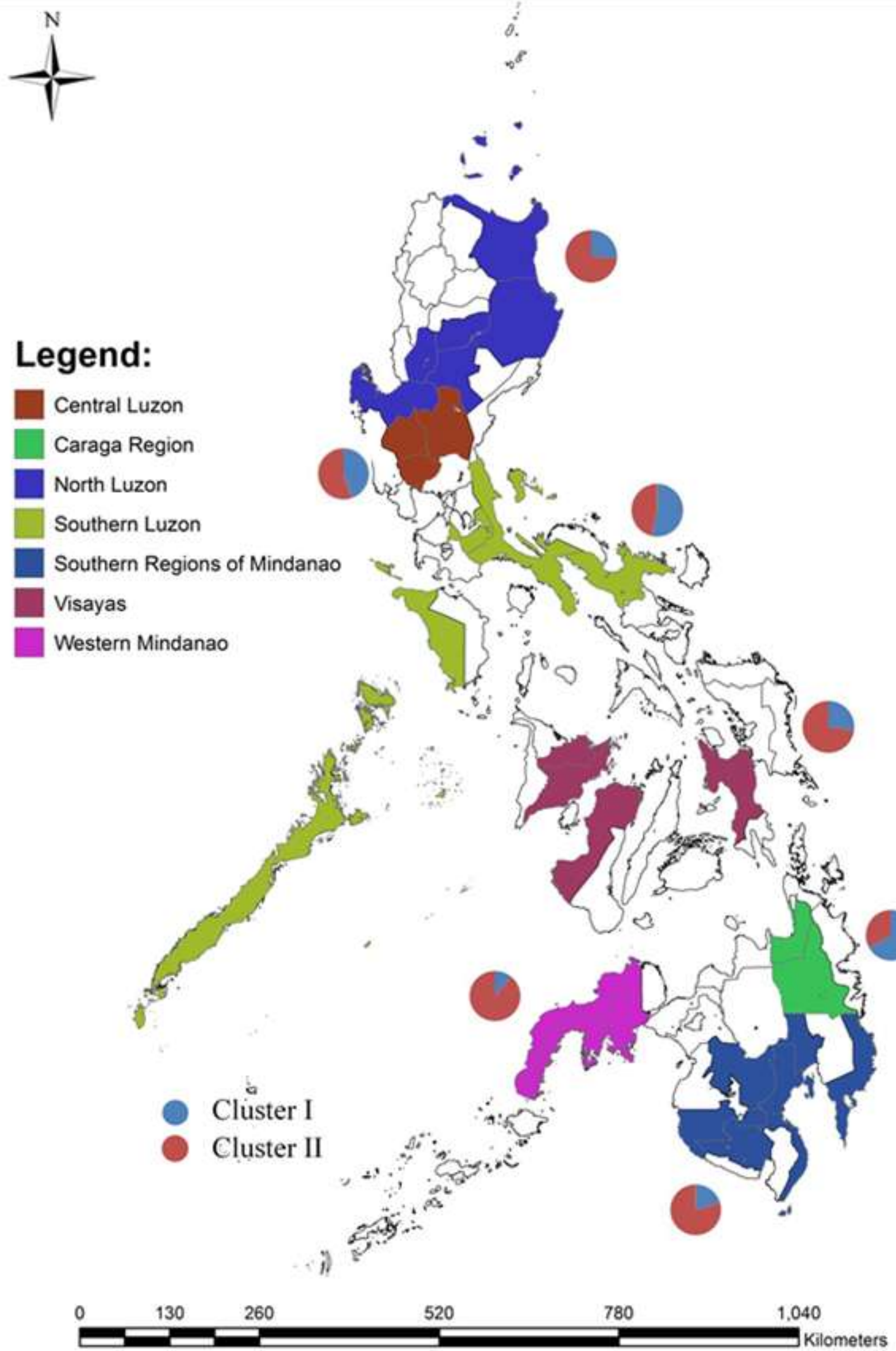
Blast races in the Philippines based on new international blast designation system

Designation	No. of blast isolates	(%)
U63-i0-k175-z00-ta700	13	6
U63-i0-k100-z04-ta431	7	3
U63-i0-k100-z04-ta421	4	2
U00-i0-k000-z00-ta000	3	1
U01-i0-k100-z00-ta401	3	1
U21-i0-k175-z00-ta500	3	1
U23-i0-k175-z00-ta702	3	1
U23-i0-k175-z10-ta700	3	1
U20-i0-k100-z00-ta400	2	1
U23-i0-k135-z00-ta500	2	1
U63-i0-k100-z04-ta401	2	1
U63-i0-k100-z05-ta431	2	1
Other pathotypes (with only one isolate each)	**163**	-
TOTAL isolates	213	-

- 213 isolates are categorized into 175 races

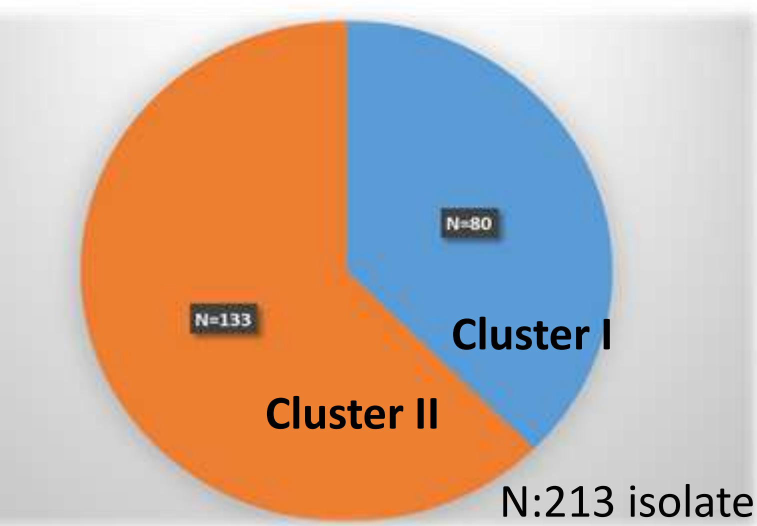
Distribution (Cluster I and II) of rice blast isolates

- South and Central Luzon: same number of isolates belonging to Cluster I and II
- Northern Luzon: mainly belonged to Cluster II
- Visayas: mainly belonged to Cluster II

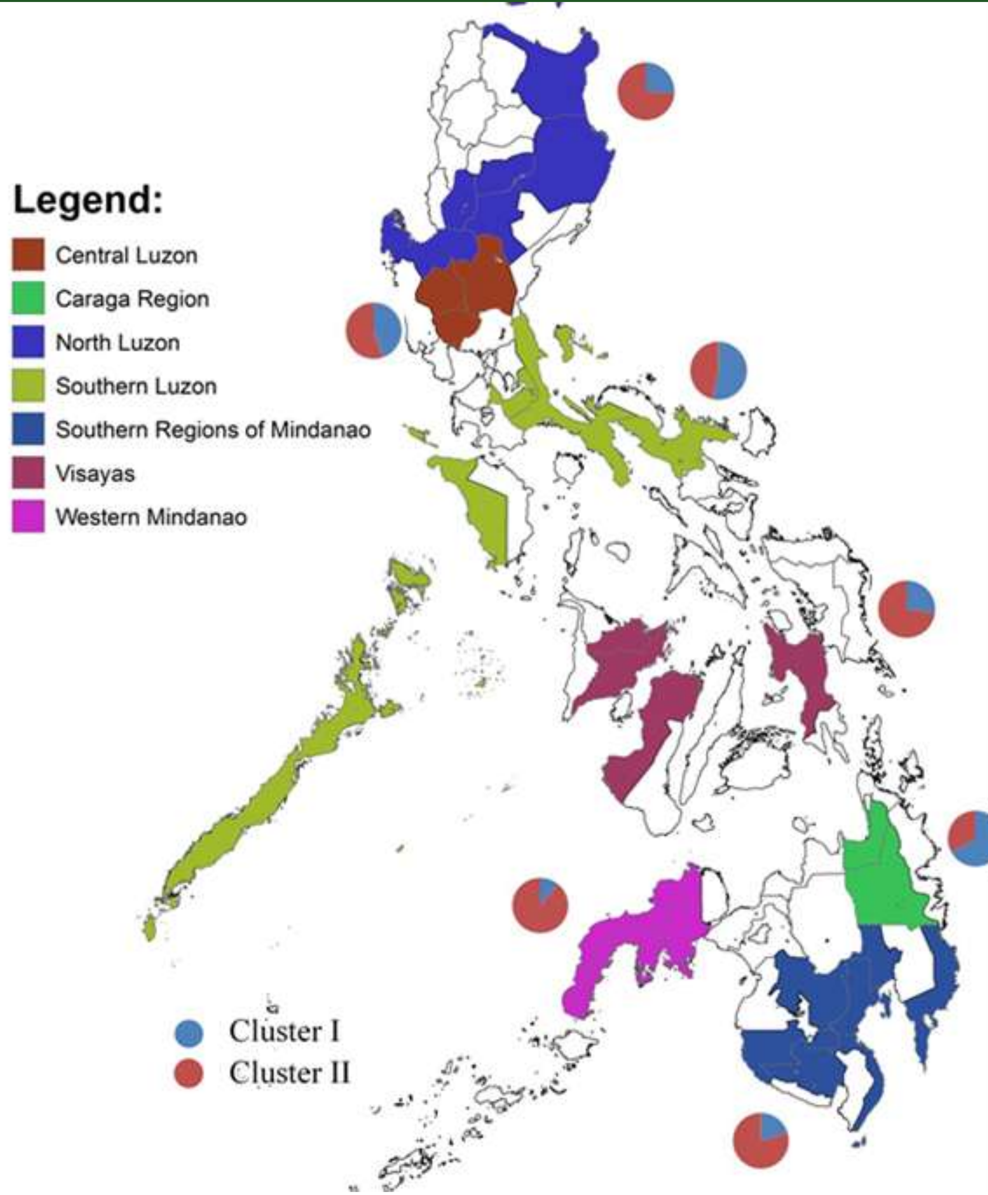


- Western and Southern Mindanao: mainly categorized into Cluster II

- Caraga region : mainly belonged to Cluster I



N:213 isolates



Number of blast isolates categorized as Cluster I or Cluster II.

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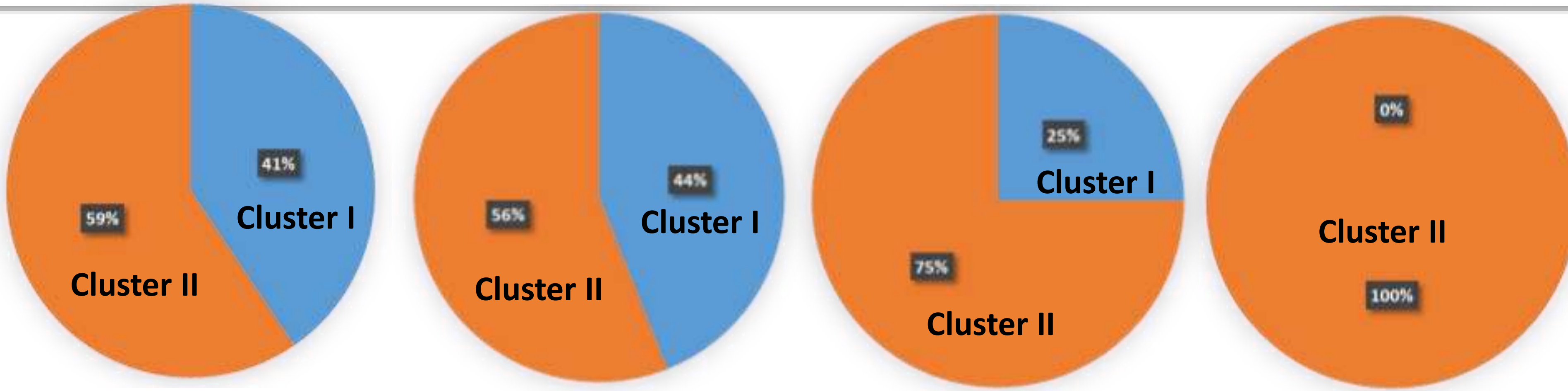
Distributions of blast isolates classified into pathogenicity group in each ecosystem



Irrigated N=153 | **Rainfed lowland** N=25 | **Cool-elevated** N=28 | **Upland** N=7

- ❑ Isolates belonging to Cluster I and II were distributed in irrigated and rainfed lowland
- ❑ Majority of isolates from Cool-elevated areas belonged to Cluster II.
- ❑ All of the isolates from Upland belonged to Cluster II

Dominant Pathogenic races common in both Cluster I and II

Reaction type	Virulent to	Avirulent to
U63	*Pib, Pit, Pia*	*Pish*
U23	*Pib, Pia*	*Pish, Pit*
i0	-	*Pii, Pi3, Pi5(t)*
z00	-	*Pi9(t) Piz Piz-5 Piz-t*

- ❑ Isolates that are virulent to ***Pib, Pit, Pia*** genes can be found in both Cluster I and II
- ❑ Isolates that are avirulent to ***Pish, Pit,Pii, Pi3, Pi5, Pi9, Piz, Piz-5*** and ***Piz-t*** genes are present in Cluster I and II

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Pathogenic races that differentiates between Cluster I and II

Reaction type	Virulent to	Avirulent to	Remarks
k175	*Pik-s*, ***Pik-m Pi1, Pik-h Pik, Pi7***	*Pik-p*	**only in Cluster I**
ta 700	***Pita-2***, *Pi12*	***Pita***, ***Pi19***, *Pi20*	**mainly in Cluster I**
k100	*Pik-s*	***Pik-m , Pik , Pi1*** *Pik-p* , ***Pik-h , Pi7****(t)*	**only in Cluster II**
ta431	*Pi12*, ***Pita***, *Pi19*	*Pita-2, Pi20*	**mainly in Cluster II**

- Isolates **avirulent** to ***Pik-m, Pik, Pi1, Pik-h and Pi7*** and ***Pita-2*** genes and virulent to ***Pita*** and ***Pi19*** genes can only be found in **Cluster II**

- Isolates **virulent** to ***Pik-m, Pik, Pi1, Pik-h and Pi7*** and ***Pita-2*** and avirulent to ***Pita*** and ***Pi20*** can only be found in **Cluster I**

Summary and Conclusion

❖ ***Pib, Pit and Pia*** genes are **not effective** against Philippine blast isolates

❖ ***Pish, Pit, Pii, Pi3, Pi5, Pi9, Piz, Piz-5*** and ***Piz-t*** are **effective genes** against Philippine blast isolates

*** **Broad-spectrum resistance genes**

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Differentiation of Philippine blast isolates

- Blast isolates in Cluster I and Cluster II differentiated on their reactions to DVs carrying genes in the ***Pik*** and ***Pita*** chromosome regions

- In areas where isolates mainly characterized as **Cluster I**: ***Pik-m, Pik, Pi1, Pik-h , Pi7*** and ***Pita-2*** genes are **not effective** ; on the other hand ***Pita*** and ***Pi20*** are **effective genes**

- In areas where isolates mainly characterized as **Cluster II**: ***Pita*** and ***Pi19*** genes are **not effective** ; while ***Pik-m, Pik, Pi1, Pik-h, Pi7*** and ***Pita-2*** are **effective genes**

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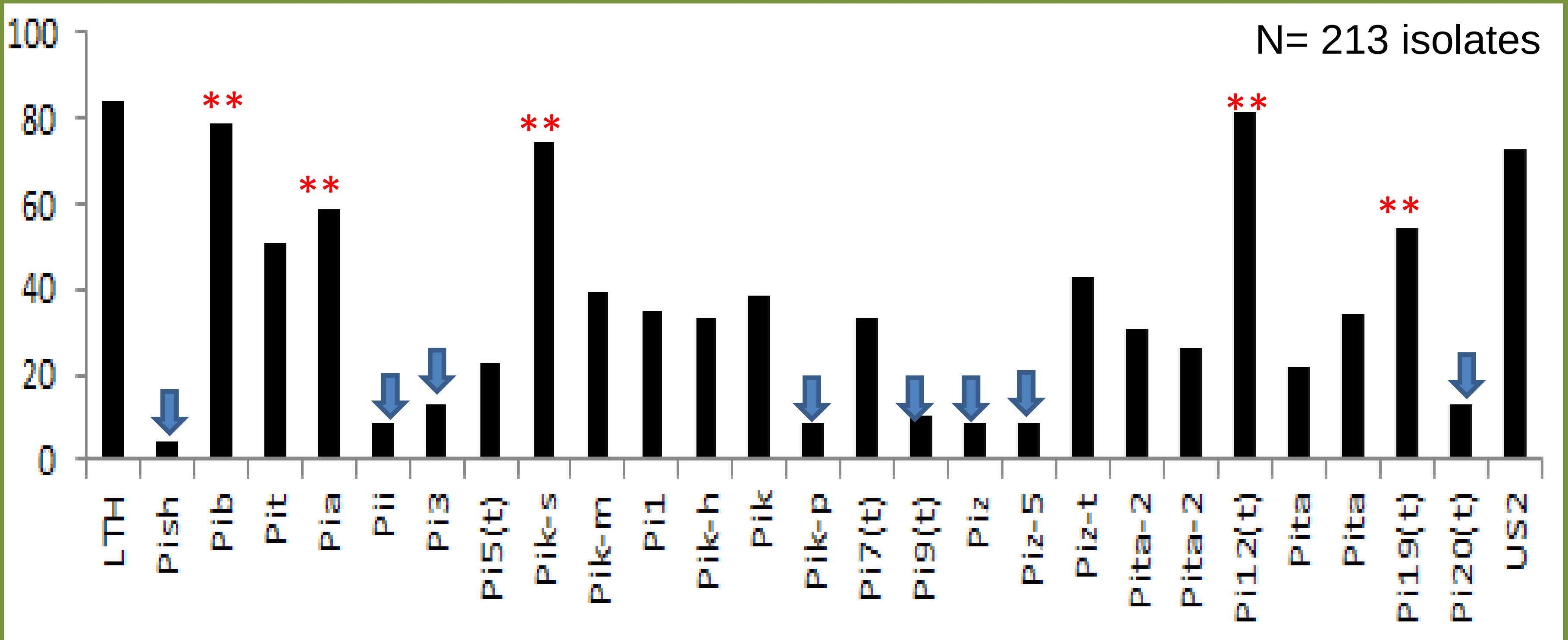
End of presentation

Frequency of virulent blast isolates against blast resistance genes



- ❑ High frequencies (>60%) of occurrences of blast isolates virulent to DVs harboring ***Pib, Pia, Pik-s,Pi12(t), and Pi19*.**

- ❑ Low frequencies (<20%) of blast isolates virulent to ***Pish, Pii, Pi3, Pik-p, Pi9(t), Piz, Piz-5 and Pi20(t).***

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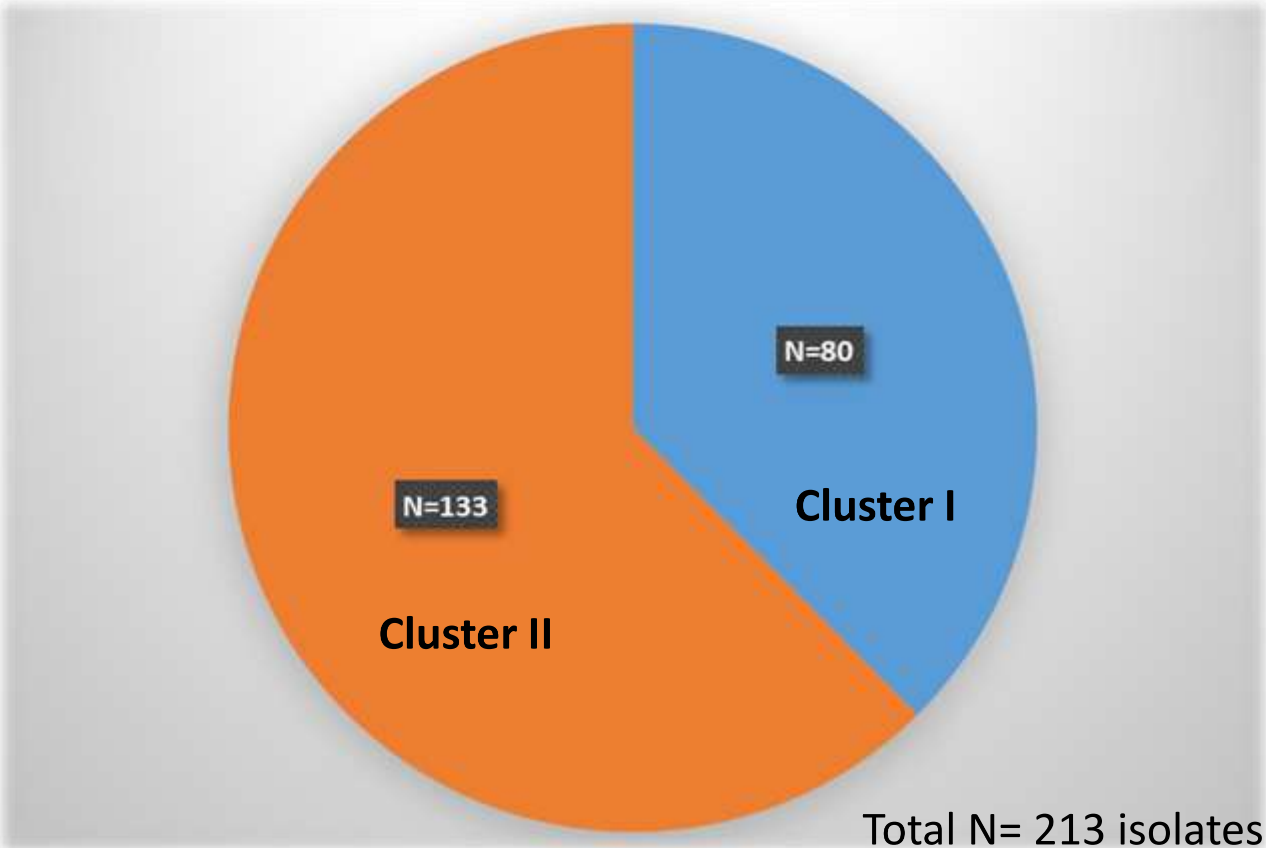
Variety name	Date approved as variety	Blast resistance reaction *	Year reported /areas affected
NSIC Rc216	2009	susceptible	2016,WS (Cuyapo, N. Ecija
NSIC Rc222	**2009**	**intermediate**	**2016,WS** (Munoz, N. Ecija
NSIC Rc298	2012	susceptible	2014, 2016,WS (Carmen, Bohol; Babatnon, Leyte
NSIC Rc128	2004	susceptible	2010 (Sta. Rosa, N. Ecija)
NSIC Rc122	**2003**	**resistant**	**2005** (areas in Mindanao)
NSIC Rc112	**2002**	**intermediate**	**2005** (in most parts of Visayas-Iloilo,Bohol, Aklan and Capiz)
PSB Rc82	**2000**	**resistant**	**2005**
PSB Rc14	**1992**	**intermediate**	**2005**
IR64		**resistant**	**2005 (Lasam, Cagayan**



Number of blast isolates categorized as Cluster I or Cluster II.

Concept of host plant resistance

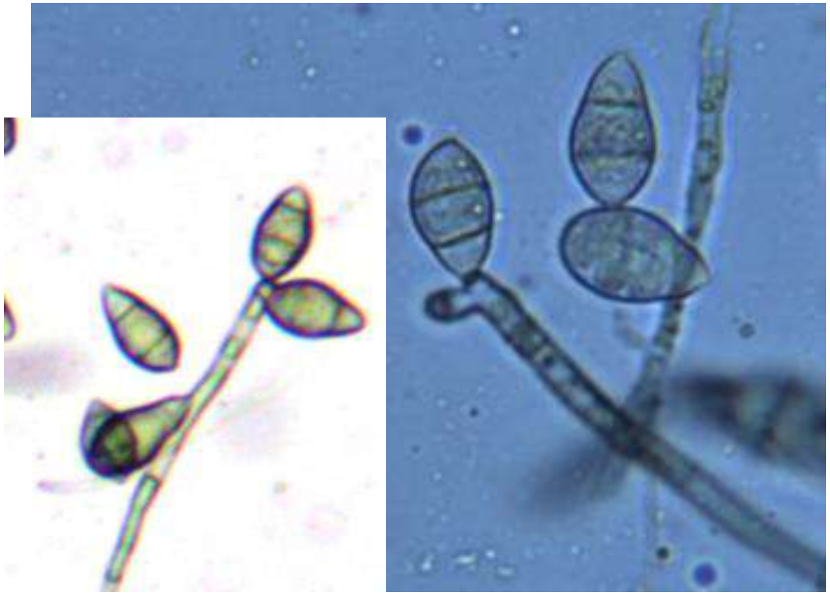
" Gene- for gene" theory

every resistance gene (R gene) in the host corresponds to an avirulence gene (Avr gene) in the pathogen

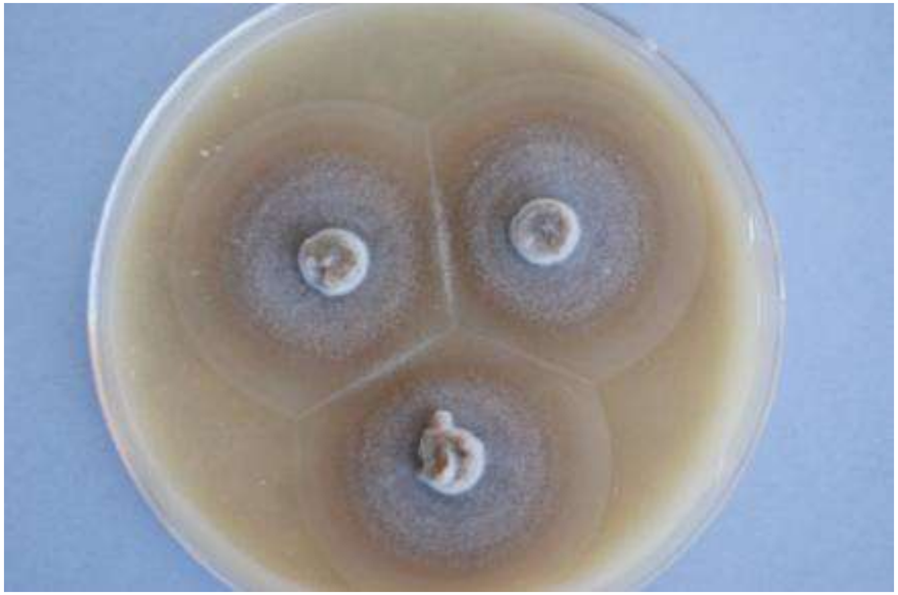
Plant (rice cultivar)	**Pathogen** (isolate)	**Disease reaction**
resistant	avirulent	Incompatible (-)
susceptible	virulent	compatible (+)

Rice blast causal organism

- Perfect stage: *Magnaporthe oryzae*
- Imperfect stage (anamorph): *Pyricularia oryzae*



fungal spores



Mycelial colony growth in PDA

Effects of Water Management and Fertilizer N Levels on Rice Yield and Incidence of Pests and Diseases in Rainfed Rice Ecosystem

Anielyn Y. Alibuyog, Sonia V. Pojas, Eleanor S. Avellanoza, and Septie Val P. Aquino

29th National Rice R&D Conference

Introduction

- **Water stress** is considered to be the main factor contributing to the decline of yield
- Looming water crisis, challenging sustainability in rice production system, necessitates the **development of suitable crop management**
- Amount and timing of **rainfall is the main constraint** to rice productivity, followed by **low soil fertility**
- Small nutrient reserves in soils are exacerbated by the effects of a **changing water regime** on nutrient forms and their availability in the soil

Area planted (ha) and volume of production (t) in WS2015 in Region I

Ecosystem/ Province	Area Planted (ha)	Volume of Production (t)	Yield (t/ha)
Rainfed			
Ilocos Norte	11,220	45,692	4.07
Ilocos Sur	20,197	83,555	4.14
La Union	14,262	60,664	4.25
Pangasinan	80,839	294,794	3.65
Total	**126,518**	**484,705**	**3.83**
Irrigated			
Ilocos Norte	40,975	200,176	4.89
Ilocos Sur	22,630	103,137	4.56
La Union	16,115	76,676	4.76
Pangasinan	103,820	443,619	4.27
Total	**183,540**	**823,608**	**4.49**

Source: PSA, 2016

Related Literature

Author (Year Published)	Findings
Ghosh et al. (2012)	Aerobic rice grown in water stress experienced **9.2 to 24.2 % yield penalty.** **21% increase in root biomass** in irrigated crop which resulted in **increased nutrient uptake** and **greater N use efficiency**
Upadhyaya et al. (2007)	Crops growing with water stress form reactive oxygen species (ROS) within roots that **threatens plants normal function**
Cheng et al. (2006)	Formation of ROS, concentration of major biochemical compounds hydrogen peroxides, total soluble protein (TSP), and proline in roots were greatly affected by water stress resulting in reduced **grain yield**

Related Literature

Author (Year Published)	Findings
Doberman et al. (1998)	**Nitrogen supply commonly limits grain yield** in irrigated rice systems. The demand of the rice plant for other macronutrients mainly depends on the N supply.
Pramanick et al. (1995)	**high rates of nitrogen fertilizers favors the incidence of many pests** such as green leafhoppers, yellow stemborer, leaf folder and ear head bug
Subbaih and Morachan (1974)	high level of nitrogen increases leaf folder infestation
Raju et al. (1996)	Potassium at enhanced doses induced **resistance to rice leafhopper**

Objectives

- To determine the effect of water management and fertilizer N levels on the yield, nitrogen-use efficiency and incidence of pests and diseases of PSB Rc82 in rainfed ecosystem
- To find any associations of water management and N levels on yield, nitrogen-use efficiency, pest incidences and injuries
- To identify the optimum water management and N level for rainfed areas in Ilocos Norte

Methodology

Location: PhilRice Batac (2014 WS)
MMSU-CRL (2015 WS)

Treatments:

Water Management (3 treatments)
Fertilizer N Levels (6 treatments)

Experimental Design:	Strip Plot, 3 replications
Variety:	PSB Rc82
Seedling Establishment:	Wetbed method
Days of seedlings:	21-25 day old
No. of seedlings/hill:	2-3
Plot dimension:	3m x 5m

Methodology

Water Management (Vertical Factor)

Treatment Code	Description	How it was done
W1	Without supplemental irrigation	Purely dependent on rainfall; application of fertilizer treatments depend only on the availability of rain water
W2	With supplemental irrigation during fertilizer application if needed	Supplemental irrigation was done only when there was no rainfall during the scheduled fertilizer application; topdressing was done at tillering and at booting stage
W3	With supplemental irrigation if rainfall is insufficient during critical stages on the crop	Supplemental irrigation was done as needed; enough soil moisture was maintained

Methodology

Fertilizer N Rate (Horizontal Factor)

Code	N Fertilizer Level	Total kg NPK/ha Applied	kg N per Application	Time of Application
N1	None			
N2	60 kg N/ha; 2x application	60-30-30	30 30	After transplanting Tillering
N3	90 kg N /ha; 2x application	90-30-30	30 60	After transplanting Tillering
N4	90 kg N /ha; 3x application	90-30-30	30 30 30	After transplanting Tillering Booting
N5	120 kg N /ha; 3x application	120-30-30	40 40 40	After transplanting Tillering Booting
N6*	150 kg N/ha; 3x application	150-30-30	30 60 60	After transplanting Tillering Booting

*Additional treatment in 2015WS

Supplemental Irrigation

Table 1. Schedule of supplemental irrigation for W3 treatment plots during the two-year experiment.

2014 WS			2015 WS		
Date	DAT	Growth Stage	**Date**	DAT	Growth Stage
Sep 08	41	PI	Oct 08	47	PI
Sep 30	63	Flowering	Oct 12	50	PI
Oct 05	68	Grain filling	Oct 16	53	Flowering
Oct 10	73	Grain filling	Oct 27	64	Grain filling
-	-	-	Nov 03	71	Grain filling

Data Gathering

Soil Chemical and Physical Properties

Before crop establishment and after harvesting the crop, soil samples were collected for the analysis of

- pH
- organic matter (OM)
- nitrogen (N)
- phosphorus (P)
- potassium (K)

Agromet data

The ff data were gathered from the PAG-ASA weather station at MMSU:

- Min, max, and average daily temp
- Daily rainfall
- Wind speed
- Relative humidity

Methodology

Water depth monitoring

- ✓ 9 piezometers were installed (1 for each block)
- ✓ 1.5 m long; installed below ground to 125 cm soil depth, with 25 cm top segment protruding above the soil

Soil Moisture

- ✓ At critical stages, during drought occurrence, soil MC was determined gravimetrically, by sampling soils at 30 cm below the soil surface

Methodology

Agronomic and Physiological

- ✓ Plant height
- ✓ No. of tillers/hill
- ✓ Days to maturity
- ✓ Yield and yield components
- ✓ Leaf area index (LAI)
- ✓ Harvest Index (HI)
- ✓ Nitrogen-use efficiency (NUE)

Pest Assessment

- ✓ Weeds
- ✓ Leaf injuries damaged by insects and diseases following the Standard Evaluation System (SES) for Rice

Statistical Analysis

Statistical Analysis

- All agronomic and physiological data measured in the experiment were subjected to analysis of variance (ANOVA) using the STAR software.

- The treatment means were compared using Least Significant Difference (LSD) and Honest Significant Difference (HSD).

RESULTS

Results

Soil Chemical and Physical Properties

Soil Property	2014 WS	2015 WS
Location	PhilRice Batac	MMSU CRL
Texture	medium	heavy
pH	6.93	7.0
OM content, %	1.26	1.69
N, %	0.063	0.085
P, ppm	9.72	6.54
K, ppm	369.93	418.86

Agro-meteorological Data

Drought stress was more severe at the **mid-reproductive to grain filling stages** than at the vegetative phase of the rice plants.

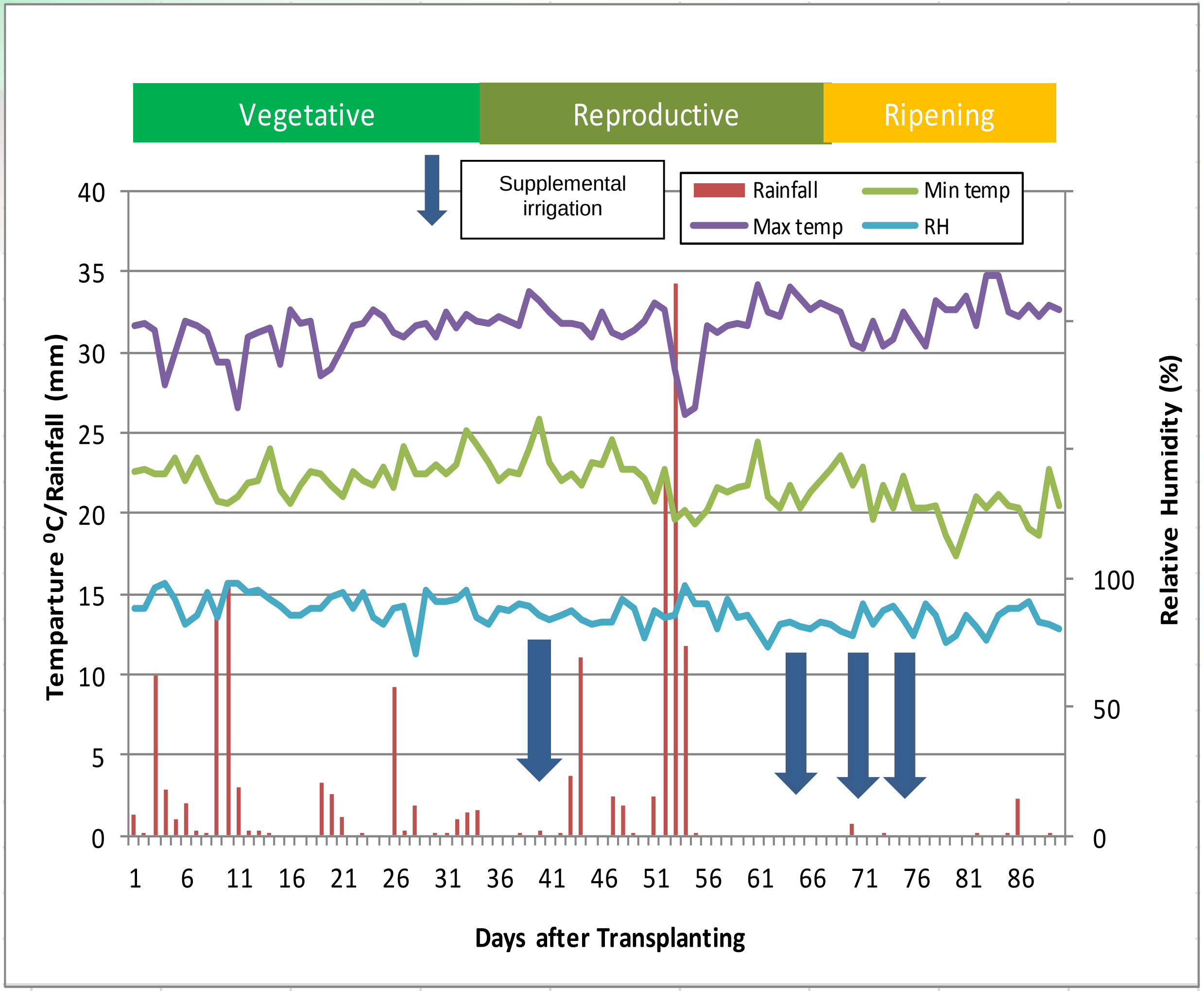


Fig.1. Rainfall distribution (mm), minimum and maximum temperature (ºC) and relative humidity (%) during the conduct of the field experiment. July to October 2014.

Water Depth,cmbgs

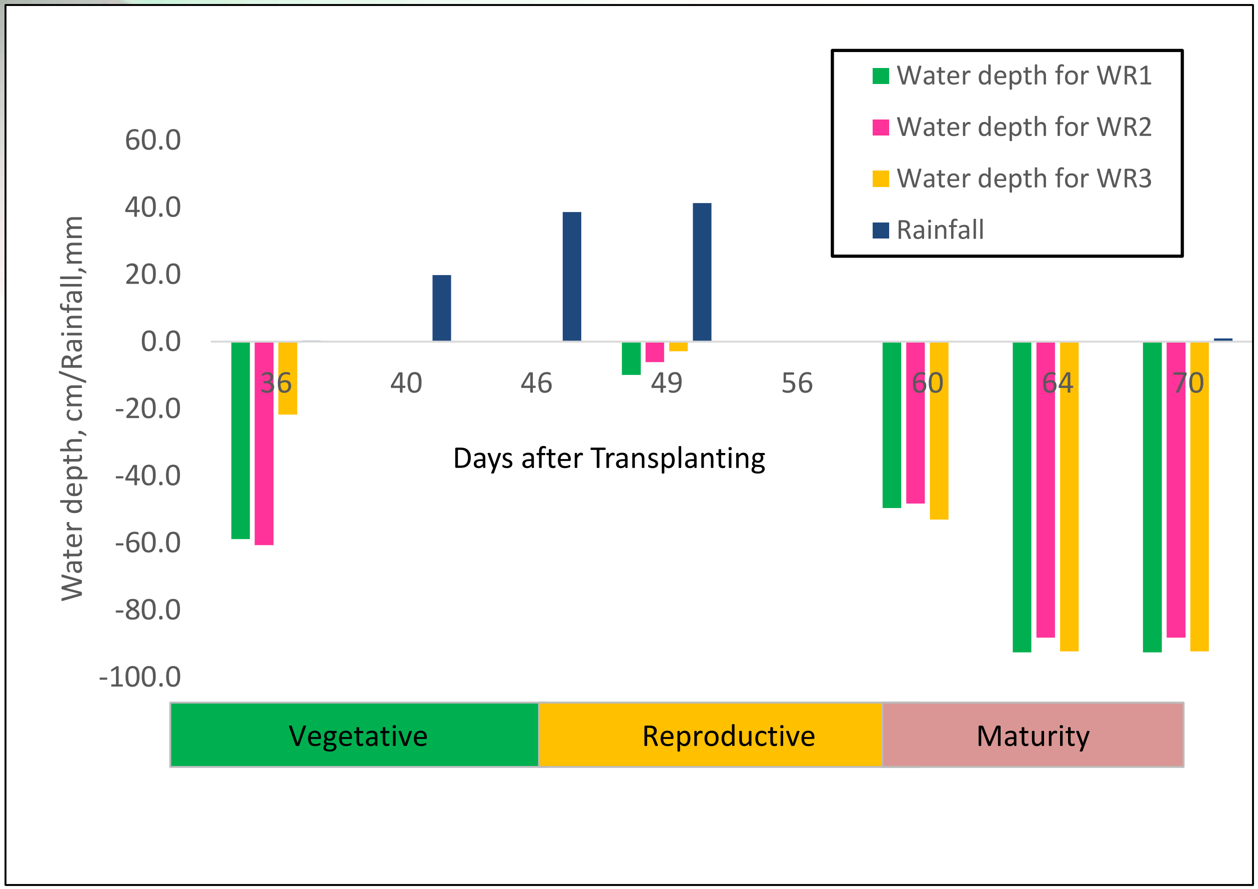


Fig. 2. Rainfall (mm) and water depth (cmbgs) during the conduct of the field experiment. PhilRice Batac. 2014 WS.

Agro-meteorological Data

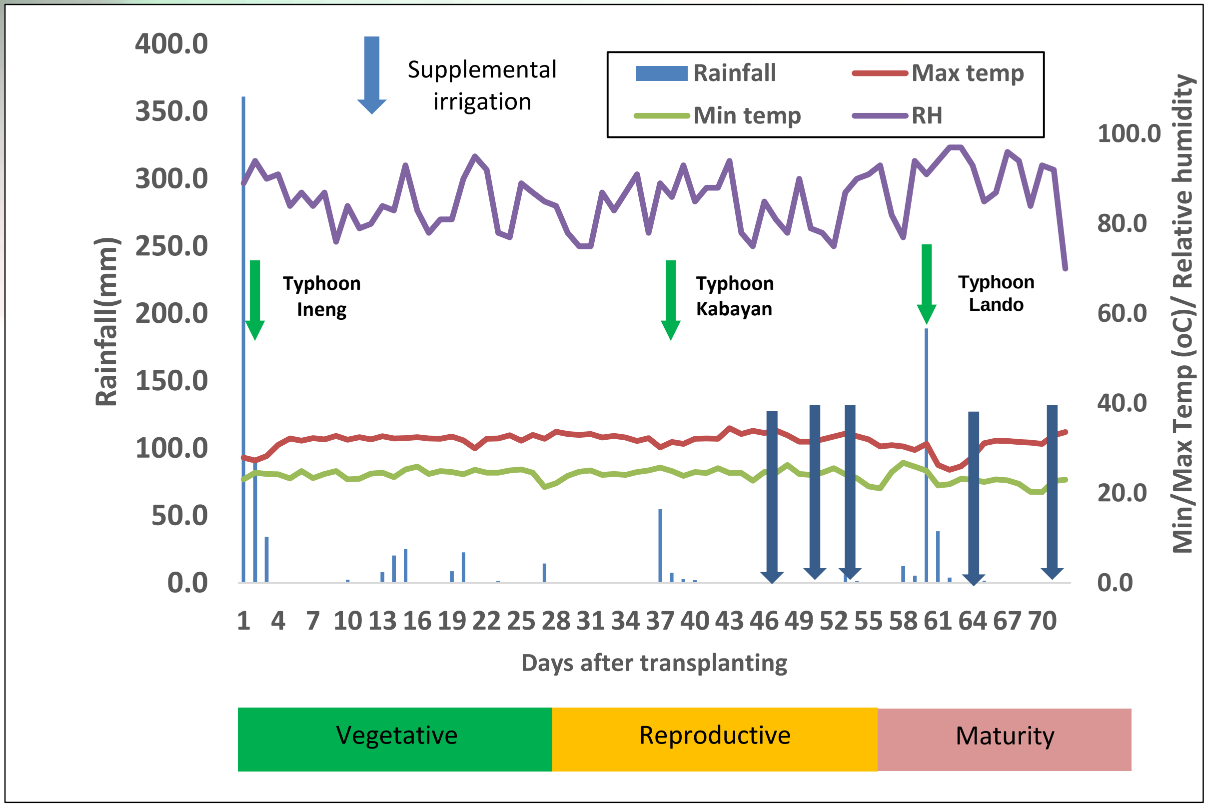


Fig. 3. Rainfall distribution (mm), minimum and maximum temperature (°C) and relative humidity (%) during the conduct of the field experiment. August to October 2015.

Water Depth, cmbgs

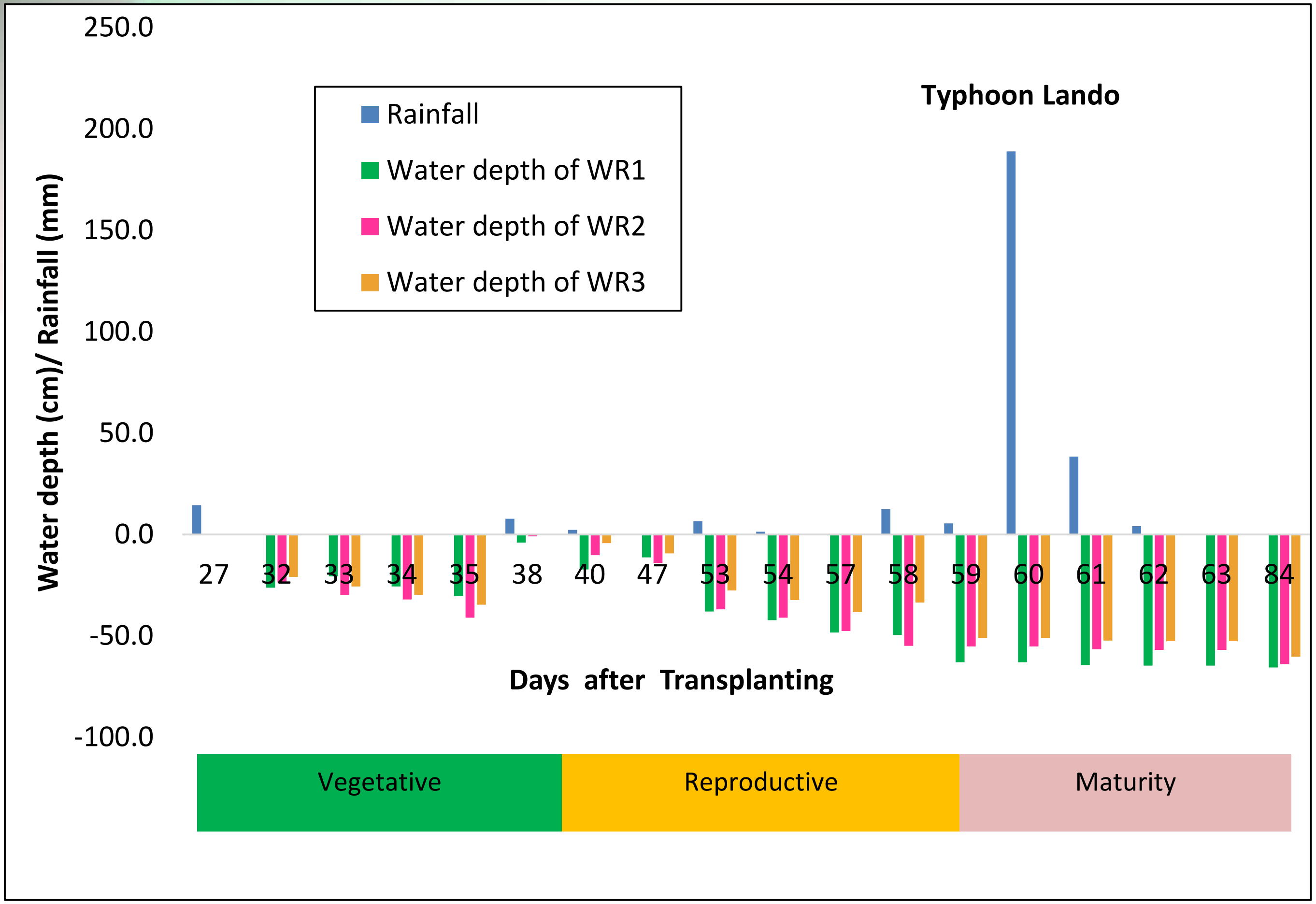


Fig. 4. Rainfall (mm) and water depth (cmbgs) during the conduct of the field experiment. PhilRice Batac. 2015 WS.

Grain Yield (2014 WS)

Table 2. Yield of PSB Rc82 as affected by water management and nitrogen levels. PhilRice Batac. 2014 WS.

Treatment	Yield (kg/ha)			Mean
	W1	W2	W3	
N1	886	1,411	1,320	**1,206**[d]
N2	1,616	1,664	2,325	**1,868**[c]
N3	1,971	2,235	2,645	**2,283**[b]
N4	1,870	1,895	2,902	**2,222**[b]
N5	2,405	2,529	**3,251**	**2,728**[a]
Mean	**1,749**	**1,947**	**2,488**	**2,062**

	Significance	CV (%)
Water Management	ns	39.64
N Levels	**	13.16
W x N Levels	ns	14.33

Grain Yield (2015 WS)

Table 3. Yield of PSB Rc82 as affected by water management and nitrogen levels. PhilRice Batac. 2015 WS.

Treatment	Yield (kg/ha)			
	W1	W2	W3	Mean
N1	2,311	2,223	3,033	**2,522** c
N2	2,918	2,614	3,597	**3,043** bc
N3	3,313	3,192	3,776	**3,427** abc
N4	3,780	3,458	**4,794**	**4,011** ab
N5	**4,893**	3,614	4,781	**4,429** a
N6	4,232	3,622	4,274	**4,043** ab
Mean	**3,575**	**3,120**	**4,043**	**3,579**

	Significance	CV(%)
Water Management	ns	14.05
N Levels	**	10.87
W x N Levels	ns	7.08

Leaf Area Index

Table 4. Leaf area index of PSB Rc82 as affected by water management and nitrogen levels. PhilRice Batac. 2014 WS.

Treatment	Leaf Area Index			
	W1	**W2**	**W3**	**Mean**
N1	1.82	1.65	1.70	**1.72** c
N2	2.25	2.18	2.22	**2.22** b
N3	2.32	2.17	2.45	**2.31** b
N4	2.33	2.58	2.40	**2.44** b
N5	3.02	3.33	2.84	**3.06** a
Mean	**2.35**	**2.38**	**2.32**	

	Significance	CV (%)
Water Management	ns	13.71
N Levels	**	14.22
W x N Levels	ns	12.88

Leaf Area Index

Table 4. Leaf area index of PSB Rc82 as affected by water management and N levels. PhilRice Batac. WS2015.

Treatment	Leaf Area Index			
	W1	W2	W3	Mean
N1	1.91	1.71	1.85	**1.82** b
N2	2.02	2.22	2.53	**2.26** ab
N3	2.75	2.46	2.44	**2.55** a
N4	2.49	2.50	2.56	**2.52** a
N5	1.99	2.49	2.65	**2.38** ab
N6	2.78	2.72	2.53	**2.68** a
Mean	**2.32**	**2.35**	**2.43**	

	Significance	CV (%)
Water Management	ns	15.54
N Levels	**	14.35
W x N Levels	ns	10.27

Harvest Index

Table 6. Harvest Index of PSB Rc82 as affected by water management and N levels. PhilRice Batac. WS2014.

Treatment	Harvest Index			Mean
	W1	W2	W3	
N1	0.41	0.46	0.51	0.46
N2	0.41	0.42	0.47	0.43
N3	0.42	0.44	0.46	0.44
N4	0.43	0.43	0.50	0.45
N5	0.43	0.47	0.47	0.46
Mean	**0.42** b	**0.44** ab	**0.48** a	

	Significance	CV (%)
Water Management	**	8.89
N Levels	ns	5.81
WR x N Levels	ns	7.15

Nitrogen-use Efficiency

Table 7. Nitrogen-use efficiency of PSB Rc82 as affected by water management and N levels. PhilRice Batac. WS2014.

Treatment	Nitrogen-use efficiency			
	W1	W2	W3	Mean
N1	-	-	-	-
N2	12.16	4.21	16.75	**11.04[a]**
N3	12.06	9.15	14.72	**11.98[a]**
N4	10.93	5.37	17.58	**11.29[a]**
N5	12.66	9.30	16.09	**12.68[a]**
Mean	**9.56[b]**	**5.61[c]**	**13.03[a]**	9.40

	Significance	CV (%)
Water Management	**	34.11
N Levels	**	36.71
W x N Levels	ns	34.78

Nitrogen-use Efficiency

Table 8. Nitrogen-use efficiency of PSB Rc82 as affected by water management and N levels. PhilRice Batac. WS2015.

Treatment	Nitrogen-use Efficiency				
	W1	W2	W3	Mean	
N1	-	-	-	**-**	
N2	7.63	6.52	11.75	**8.63**	ab
N3	9.47	10.77	9.83	**10.02**	ab
N4	14.67	13.72	21.14	**16.51**	a
N5	20.27	11.59	15.74	**15.87**	a
N6	11.81	9.32	9.21	**10.11**	ab
Mean	**10.64**	**8.65**	**11.28**	10.19	

	Significance	CV (%)
Water Management	ns	56.48
N Levels	**	35.38
W x N Levels	ns	33.64

Leaf Area Index

Table 9. Correlation analysis of yield and agronomic and physiological parameters of PSB Rc82 in two seasons.

Parameters	2014		2015	
	p-value	r^2	p-value	r^2
Tiller count	0.57	0.640	0.01	0.938
Panicle length	0.24	0.342	0.07	0.778
Seed weight	0.21	0.937	0.55	0.313
Percent filled grains	0.87	0.672	0.75	-0.166
Plant height	0.04	0.993	0.02	0.936
Days to maturity	0.01	-0.754	0.52	0.329
Harvest index	0.02	-0.950	0.14	-0.667
NUE	0.00	0.898	0.01	0.954
Leaf area index	0.14	0.954	0.08	0.759
Brown spot infection	0.76	-0.192	0.07	-0.770

Weeds

Table 10. Weed incidence as affected by water management and N levels. PhilRice Batac. 2014 WS.

Treatment	Weed Incidence (g/m^2)			Mean
	W1	W2	W3	
N1	6.00	3.00	5.66	**4.89** b
N2	9.33	7.33	1.33	**6.00** ab
N3	5.33	0.33	3.00	**2.89** b
N4	16.00	8.00	3.33	**9.11** a
N5	13.00	0.33	5.33	**6.22** ab
Mean	**9.93**	**3.80**	**3.73**	**5.82**

	Significance	CV (%)
Water Management	ns	151.94
N Levels	**	76.76
W x N Levels	ns	67.67

Weeds

Table 11. Weed incidence as affected by water management and N levels. PhilRice Batac. 2015 WS.

N Levels	Water Management			Mean
	W1	W2	W3	
N1	10.41	6.03	7.30	7.91[b]
N2	23.56	23.50	19.20	22.09[a]
N3	8.53	8.71	8.30	8.51[b]
N4	13.40	6.56	9.06	9.67[b]
N5	16.53	16.90	6.90	13.44[b]
N6	14.53	14.50	10.93	13.32[b]
Mean	14.49[a]	12.70[a]	10.28[b]	12.49

	Significance	CV (%)
Water Management	**	17.76
N Levels	**	29.64
W x N Levels	ns	66.11

Brown Spot

Table 12. Brown spot infection (%) as affected by water management and N levels. PhilRice Batac. 2015 WS.

N Levels	Water Management			Mean
	W1	W2	W3	
N1	100.00[a]	96.67[a]	96.67[a]	97.78
N2	100.00[a]	96.67[a]	96.67[a]	97.78
N3	96.67[a]	96.67[a]	96.67[a]	96.67
N4	96.67[a]	93.33[a]	80.00[ab]	90.00
N5	93.33[a]	93.33[a]	83.33[ab]	90.00
N6	86.67[a]	93.33[a]	70.00[b]	83.33
Mean	95.56	95.00	87.22	

	Significance	CV (%)
Water Management	ns	5.88
N Levels	ns	7.44
W x N Levels	**	6.10

Conclusion

- Rice yield in rainfed areas may not decline even without supplemental irrigation if the required soil water moisture is attained during the critical periods.
- However, supplemental irrigation at panicle initiation, flowering and early grain filling stage may improve seed weight, harvest index and NUE.
- The application of 120 kg N/ha provides higher yield, more tillers, longer panicles, denser grains, and higher LAI than other rates up to 150 kg N/ha.
- Increasing the general fertilizer recommendation for rice from 90 kg N/ha to 120 kg N/ha provides 23% yield increase.

Conclusion

- In contrast, increasing N level to 150 kg N/ha results in 9.5% decline in yield.
- Application of 90 kg N/ha gives the highest NUE particularly when water is limiting.
- Other effects of limited water are manifested on pest and disease occurrences, particularly, weed growth and brown spot infection.
- When water is limiting and N fertilizer level is low, plants are less vigorous resulting in higher incidence of diseases and pest damage.

Thank You

Postharvest Management Key Checks and Best Practices for Improving the Rice Postproduction System

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Introduction

BACKGROUND

- Philippine rice production system improved thru PalayCheck® (PhilRice 2007)
- But the postproduction system has to keep pace with this.

PROPOSED SOLUTIONS

- Develop an integrated postharvest management protocol anchored on the PalayCheck® system.
- Reduce postharvest losses in the different stages of post-production
- Improve rice trade standards

Objectives

- To develop a system of key checks and best practices for an integrated rice postharvest management covering harvesting to milling.
- To validate the postharvest key checks and best practices thru field and lab experiments, and refine the system.
- To package an improved PalayCheck® system enhanced with an appropriate postharvest management protocol.

Methodology

- Development of PalayCheck® protocol for rice postharvest management
  - Through multi-sector workshops, identify and select key checks for postharvest operations from harvesting to milling, and recommend best practices
  - Validation of the key checks thru field and lab tests
  - Protocol refinement
  - Further field validation
  - Finalization of protocol

Methodology

- Field validation (2014-2015, 4 cropping seasons)

Field experiment lay-out for the 2.2-ha paddy field with 3 cultivars.

Manual rice reaping (left) and collecting and piling (right)

Mechanical rice threshing (left) and combine harvesting (right).

Methodology

- Field validation (2014-2015, 4 cropping seasons)

Storage methods: (1) sack pile of paddy at ambient air condition without pallet (left); (2) sack pile of paddy at ambient air condition with pallet (middle); and (3) sack pile of paddy inside a PhilRice SACLOB (right).

Results

- Rice postharvest management key checks
  1. Harvesting and threshing: Cut, piled and threshed palay at the right time
  2. Pre-Drying Storage: Palay sorted according to variety type, moisture content, discoloration and damage
  3. Drying: Dried palay with good quality
  4. Cleaning: Palay with premium purity
  5. Storage: Market quality preserved and losses to pests prevented during storage
  6. Milling: Maximized milling and head rice recovery
  7. Packaging: Milled rice protected from spillage, pest, contamination, and humidity

Results

- Best practice(s) to achieve key check

Recommendations to achieve KC 1

☑Reap and thresh within the day or the following day. Use a thresher or combine with the correct machine settings.

Recommendations to achieve KC 2

Pre-Drying Storage

☑ Classify and sort according to variety type, moisture content, discoloration and damage.

☑ Stack bags with sufficient space for natural aeration.

☑ Wet grains should be the priority in drying.

Results

- Best practice(s) to achieve key check

Recommendations to achieve KC 3

☑Dry the palay immediately after threshing. If it is not possible, aerate fresh palay by spreading thinly under shade on concrete pavement, tarpaulin, plastic net, or canvas .

☑Make sure that the drying area is free from impurities such as pebbles, sand, and other debris. Spread the grain 2-4 cm. thick and stir every 30 minutes.

☑If using a mechanical dryer, dry the palay according to the recommended drying temperature (43°C for flatbed dryer and 60°C for recirculating dryer).

☑Avoid drying palay on roads to reduce loss, grain breakage, and contamination.

Results

- Best practice(s) to achieve key check

Recommendations to achieve KC 4

☑Clean palay using a blower, fan, or seed cleaner.
☑Use appropriate air flow adjustment and grain feeding rate.

Recommendations to achieve KC 5

☑Storage area should be clean, orderly, free from leaks and holes, and not prone to flooding.
☑Use pallets and sacks that are free from residual infestation.
☑To prevent pests, spray insecticides on the walls, floors, and beams of storage area before storing palay.
☑Provide adequate space from walls and in-between piles for ventilation, cleaning, and pest control purposes.

Results

- Best practice(s) to achieve key check

Recommendations to achieve KC 6

☑Milling machines should be operated by a trained and skilled operator.
☑Use machines that can produce at least 65% milling recovery and 80% head rice on milled rice basis.

Recommendations to achieve KC 7

☑Use a durable packaging material.
☑Follow the recommended color-coded packaging to indicate quality: blue (special or fancy rice), yellow (premium), white (grade 1-5 with 1 being 90% head rice and 5 being 55%). See PGSP Table 2.

Results and Discussion

In this study, only key checks 1 and 3 through 6 were validated from 2014 dry season to 2015 wet season. The 2014 and 2015 dry season and wet season grain loss data for the different harvest times and methods across the three varieties are shown in Tables 1 and 2, respectively.

Results and Discussion

Table 1. Mean grain loss across rice varieties MS-16, Mestizo 1, and NSIC Rc160 harvested at three different harvest times using four different methods (2014 DS and WS, PhilRice CES, Muñoz, Nueva Ecija

Harvest Method	Mean Grain Loss (% of Field Yield) Across 3 Varieties					
	5 Days Early Harvest		*Optimum Harvest Time*		*5 Days Late Harvest*	
	2014 DS	2014 WS	2014 DS	2014 WS	2014 DS	2014 WS
Cut on 1st day, pile on 2nd day, and thresh on	6.79	7.92	5.82	6.94	17.99	18.56
Cut and pile on 1st day, and thresh on 2nd day	4.25	5.41	4.21	5.02	10.99	12.42
Cut, pile, and thresh on 1st day	2.19	3.21	1.04	1.85	6.96	7.97
Combine Harvesting	1.40	2.03	1.16	1.56	2.76	3.50

Results and Discussion

Table 2. Mean grain loss across rice varieties MS-16, Mestizo 1, and NSIC Rc160 harvested at three different harvest times using four different methods (2015 DS and WS, PhilRice CES, Muñoz, Nueva Ecija).

Harvest Method	Mean Grain Loss (% of Field Yield) Across 3 Varieties					
	5 Days Early Harvest		*Optimum Harvest Time*		*5 Days Late Harvest*	
	2015 DS	2015WS	2015 DS	2015WS	2015 DS	2015WS
Cut on 1st day, pile on 2nd day, and thresh on 3rd day	6.87	8.23	6.14	7.12	18.52	18.96
Cut and pile on 1st day, and thresh on 2nd day	5.22	5.69	4.43	5.19	11.50	12.70
Cut, pile, and thresh on 1st day	2.42	3.28	1.16	2.00	7.32	8.21
Combine Harvesting	1.54	2.09	1.19	1.61	2.90	3.54

Results and Discussion

Results showed that the aggregate losses for reaping or cutting, piling and threshing operations across seasons were less than the national average of 5.2% (Francisco 2010) for the three operations when the crop was either cut, piled, and threshed on the same day or combine harvested, both at five days early harvest and optimum harvest times.

However, when harvest time was five days late all harvest methods, except combine harvesting, incurred losses more than the national average.

The 2014 & 2015 DS and WS evaluation results of drying and storage methods for rice varieties MS-16, Mestizo 1, and NSIC Rc160 in terms of germination rate, storage loss, milling recovery and head rice recovery are shown in Tables 3 and 4, respectively.

Results and Discussion

Table 3. Evaluation of drying and storage methods for rice vareties MS-16, Mestizo 1, and NSIC Rc160 in terms of germination rate, storage loss, milling recovery and head rice recovery (2014 DS & 2014 WS, PhilRice CES, Munoz,Nueva Ecija)

	Drying/Storage Method and Variety																	
Evaluation Parameter	*Sun drying and ambient file storage without pallet*						*Sun drying and ambient file storage with pallet*						*Flatbed drying and hermetic cocoon(saclob) storage*					
	MS-16		Mestizo 1		NSIC Rc 160		MS-16		Mestizo 1		NSIC Rc 160		MS-16		Mestizo 1		NSIC Rc 160	
	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS
Germination rate (%) before Storage	100	98	N.D.		100	99	100	98	N.D.		100	99	100	98	N.D.		100	99
Germination rate (%) after Storage	87.5	85	N.D.		85.5	86	87.5	82	N.D.		89	85	97	98	N.D.		98	98
Storage Loss (%) after 6 months *	9.99(DS)/10.85(WS)						8.89(DS)/9.60(WS)						0.00(DS)/0.00(WS)					
Milling Recovery (%) after 6 months	59.87	61.87	57.87	53.53	56.87	49.54	61.55	62.77	58.73	57.73	60.5	50.67	66.34	64.42	62.31	60.13	67.55	56.27
Head Rice (%) after 6 months	58.99	58.03	55.64	47.53	54.98	41.54	58	59	52.73	51.73	58.9	47.37	62	60.26	59.9	57.26	63.9	51.27

N.D.- Not Determine because Mestizo 1 harvest is not F1 seed: * Aggregate for the three varieties

Results and Discussion

Table 4. Evaluation of drying and storage methods for rice vareties MS-16, Mestizo 1, and NSIC Rc160 in terms of germination rate, storage loss, milling recovery and head rice recovery (2015 DS & 2015 WS, PhilRice CES, Munoz,Nueva Ecija)

	Drying/Storage Method and Variety																	
Evaluation Parameter	*Sun drying and ambient file storage without pallet*						*Sun drying and ambient file storage with pallet*						*Flatbed drying and hermetic cocoon(saclob) storage*					
	MS-16		Mestizo 1		NSIC Rc 160		MS-16		Mestizo 1		NSIC Rc 160		MS-16		Mestizo 1		NSIC Rc 160	
	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS
Germination rate (%) before Storage	100	99	N.D.		99	99	100	99	N.D.		99	99	100	99	N.D.		99	99
Germination rate (%) after Storage	87	83	N.D.		89	85	88	85	N.D.		89	87	98	98	N.D.		98	99
Storage Loss (%) after 6 months *	9.60(DS)/10.25(WS)						8.50(DS)/8.90(WS)						2.50(DS)/1.15(WS)					
Milling Recovery (%) after 6 months	59.97	60.87	57.97	52.53	56.97	51.34	62.55	62.57	59.73	58.13	61.5	53.4	67.44	64.02	63.41	59.85	67.58	56.57
Head Rice (%) after 6 months	58.23	58.52	55.12	48.45	43.98	47.5	58.5	59.5	53.6	52.73	58.8	50.3	59.12	61.26	56.55	58.96	60.12	54.27

N.D.- Not Determine because Mestizo 1 harvest is not F1 seed: * Aggregate for the three varieties

Results and Discussion

Viability of paddy seeds was preserved well through flatbed drying and hermetic storage in a plastic cocoon (PhilRice SACLOB), with germination rates decreasing only from 100% to 97–98% for MS-16 and from 99–100% to 98% for NSIC RC160 after six months.

Germination rates dropped by 10 percentage points or more after six months with ambient pile storage, with or without plastic pallet, although the viability of the paddy seeds is above the norm set by the Bureau of Plant Industry – National Seed Quality Control Service which is 85%.

Conclusions

We conclude that attaining at least five (1, 3–6) of the seven key checks by following their corresponding best practices will significantly reduce postharvest losses and considerably improve product quality in terms of seed viability and milling recovery.

Recommendations

1. The system of seven key checks and their corresponding recommended best practices for an integrated rice postharvest management, covering harvesting, threshing, hauling, cleaning, drying, storing, and milling operations, will have to be pilot tested first in farmers' fields and commercial rice mills for further refinement.

2. Thereafter, the improved postharvest management protocol should be used to enhance the existing PalayCheck® system and come up with a holistic integrated crop and product management system.

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