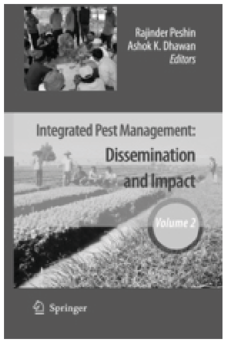
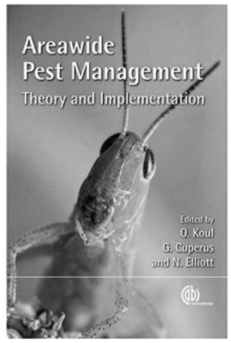
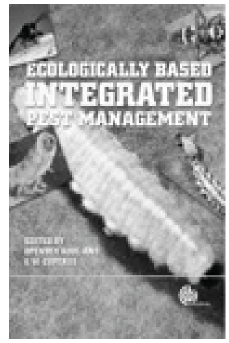
High cost of published books/journals. What libraries can afford to stock them?



$270 or $400 for both volumes



$140



$190

$980/year or $930 on-line

RESEARCH AT IRRI OUTREACH SITES

- Dryland
  - Tanauan, Batangas 1974-80 (volcanic soils)
  - Tupi, S. Cotabato 1989-91 (volcanic soils)
  - Claveria, Misamis Oriental 1984-91 (eroded, acidic soils)
  - Siniloan, Laguna 1983-85 (slash and burn, eroded, acidic soils)
- Rainfed wetland
  - Oton, Iloilo 1976-79 (favorable)
  - Manaoag Pangasinan 1976-80 (favorable)
  - Solana, Cagayan 1980-82 (unfavorable)
- Irrigated double cropped
  - Zaragoza, Nueva Ecija 1978-92
  - Koronadal, S. Cotabato 1983-92
  - Guimba, Nueva Ecija 1984-92
  - Calauan, Laguna 1984-92

ACTIVITIES AT OUTREACH SITES

- Pest and natural enemy surveys
- Yield loss trials
- Control methods
- ‘Nature driven’ ecological studies
- Farmer surveys

Continuum of dryland rice environments

- 1. Siniloan – Slash and burn (forest pests, seedling pests, soil pests, blast, rats) Marginal farming
- 2. Claveria – (acidic soils, eroded landscape, tillage with animal power, large area of grassland mixed with forest, grass pests, soil pests, blast, rats) High yield loss
- 3. Tupi – (recent volcanic soils, good rainfall, coconut/maize ecosystem, farmers use moderate inputs, lower pest pressure) Moderate yield loss
- 4. Tanauan – (recent volcanic soils, good rainfall, sugarcane ecosystem, mostly cropped land, sale of vegetables to Manila markets, 60-90 kgN/ha, most wetland rice pests) Minimal/moderate yield loss

Key dryland insect pests not typically found in wetland culture

- Sown-seed and root pests (ants, field crickets, mole crickets, termites, white grubs, and root aphids)
- Early seedling foliar pests (seedling maggot and flea beetle)
- Minor pests – stemborer, rice bug, whitebacked planthopper

Dryland rice yield loss – Claveria & Tupi

Yield loss determined by partitioned growth stage insecticide check method, Claveria and Tupi, 1985-91.

			Yield (t/ha)		Yield loss (%)					
Site	Crops	Years	Full protection	Untreated	Total	White grubs termites	Seed/ seedling pests	Root aphid	Stemborer/ leaffolder	Ricebug
Claveria	7	1985-91	3.43 a	2.64 b	22.8	8.3	5.0	6.6	0.7	2.2
Tupi	4	1987	3.46 a	2.96 b	15.0	3.3	3.5	5.5	2.5	0.2
		1989-91								

Soil & sown-seed pest control – overseeding or NP with UPLRi5

Dryland rice crop management, Claveria, Mindanao, Philippines, 1988-90

Insecticide	Seeding rate (kg/ha)	N-P-K (kg/ha)	Yield (t/ha) Claveria	Marginal return ($/ha)	Benefit: cost
Full protection	90	50-25-0	3.41 a		
Seed treatment	90	50-25-0	2.85 b		
Seed treatment	50	50-25-0	2.84 b	90	3.0
Untreated	90	50-25-0	2.61 bc	64	3.1
Untreated	50	50-25-0	2.33 c	44	2.8
Untreated	90	0	2.44 c		
Untreated	50	0	2.42 c		

Mean of three crops
Seed treatment is 0.30 kg ai/ carbosulfan ST/ha

Rainfed wetland rice characteristics regarding insect pests in relation to other rice cultures

- Large bunds create dryland habitat for soil insects
- More diverse flora to provide host and refuge for more pest species
- Low insecticide usage so no insecticide resurgence
- Low fertilizer usage limits yield potential and capacity for compensation

Characteristics cont:

- More fluctuating water levels limit the performance of fertilizer and granular insecticides
- More pest susceptible traditional varieties
- Being tall, traditional varieties elongate longer, thus are more susceptible to stemborers
- Long maturing varieties promote more pest generations
- This is further accentuated by the protracted planting season of 3-4 months

Continued:

- Due to more land fragmentation, sowing and transplanting are more staggered lengthening the host availability
- Long dry season eliminates hosts of both pests and natural enemies
- Stubble management key to stemborer prevalence

Chronic rainfed wetland insect pests

- Whorl maggot
- Naranga/Rivula defoliators
- Caseworm
- Stemborers

Rainfed wetland rice yield loss 1976-82.
The protected treatment is a proxy for Bt rice.
Most loss in vegetative stage.

					Yield loss				
			Yield (t/ha)		Total		By growth stage (%)		
Site	Province	Crops	Protected	Untreated	t/ha	%	Vegetative	Reproductive	Ripening
Single crop transplanted - traditional varieties									
Solana	Cagayan	3	1.84	1.73	0.11	13			
Manaoag	Pangasinan	2	2.58	1.94	0.65	25			
average			**2.21**	**1.84**	**0.38**	**19**	**11**	**5**	**3**
Single crop transplanted - modern varieties									
Solana	Cagayan	3	1.99	1.65	0.34	22			
Manaoag	Pangasinan	5	4.72	3.61	1.12	24			
average			**3.36**	**2.63**	**0.73**	**23**	**10**	**8**	**6**
First crop wet seeded - modern varieties									
Oton/Tigbauan	Iloilo	4	4.52	3.84	0.68	16			
Manaoag	Pangasinan	3	4.10	4.00	0.10	2			
average			**4.31**	**3.92**	**0.39**	**9**	**4**	**3**	**2**
Second crop transplanted - modern varieties									
Oton/Tigbauan	Iloilo	4	3.65	2.56	1.09	28			
Manaoag	Pangasinan	5	3.70	3.02	0.68	18			
average			**3.68**	**2.79**	**0.89**	**23**	**13**	**5**	**6**

Irrigated rice yield loss, 1979-91. Protected treatment a proxy for Bt rice. Loss evenly distributed.

Site	Province	Crops	Yield (t/ha) Protected	Yield (t/ha) Untreated	Yield loss Total t/ha	Yield loss Total %	By growth stage (%) Vegetative	By growth stage (%) Reproducti	By growth stage (%) Ripening
Wet season transplanted - modern varieties									
Zaragoza	Nueva Ecija	12	5.09	4.42	0.70	13			
Koronadal	S. Cotabato	7	5.16	4.55	0.60	11			
Guimba	Nueva Ecija	7	4.39	3.67	0.72	22			
Calauan	Laguna	9	4.61	4.27	0.30	6			
		average	**4.81**	**4.23**	**0.58**	**13**	**5**	**5**	**3**
Dry season transplanted - modern varieties									
Zaragoza	Nueva Ecija	11	6.23	5.50	0.63	10			
Koronadal	S. Cotabato	8	4.85	4.10	0.75	15			
Guimba	Nueva Ecija	6	4.80	4.03	0.77	18			
Calauan	Laguna	8	4.79	4.38	0.39	8			
		average	**5.17**	**4.50**	**0.64**	**13**	**5**	**5**	**3**

Performance of insecticide protection in full protection treatment for insecticide check yield loss trials

- Whorl maggot 55% control
- Stemborer 67% control
- Defoliators 71% control
- Leaffolders 83% control

- Goal is 80% control

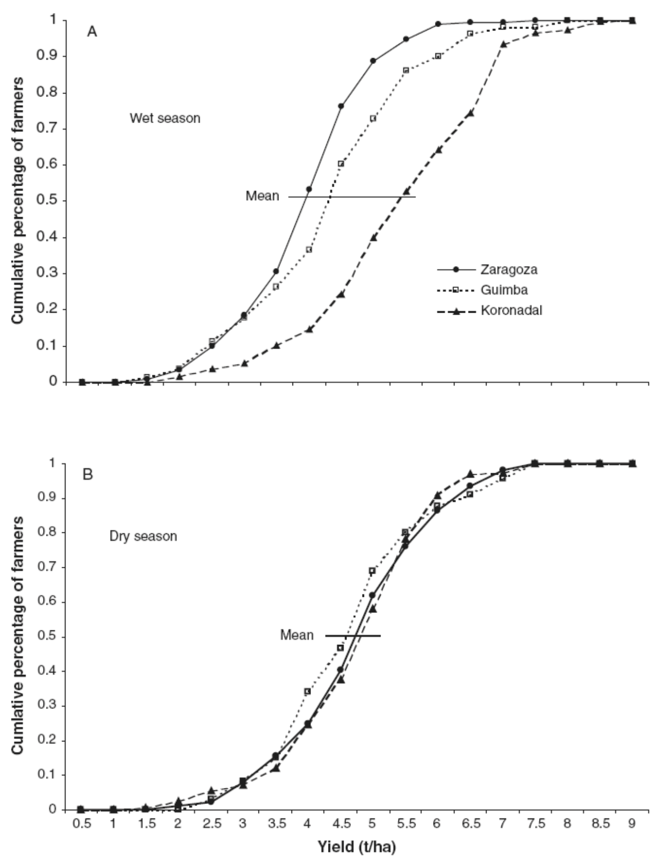
Unexplained yield loss = low insect pest densities

				Yield (t/ha)		
Town	Year	Month	Cultivar	Complete protection	Untreated	Yield gain (%)
Rainfed wetland culture						
Manaoag	1976	Jul	IR28	4.74	3.75	21
		Oct	IR28	3.11	2.65	15
		Nov	IR36	3.82	2.28	40
	1978	Oct	IR36	2.23	1.44	35
	1979	Aug	IR36	5.63	4.27	24
		Nov	IR36	3.53	2.85	19
Oton	1978	Aug	IR36	5.01	3.57	29
Solana	1980	Oct	Wagwag	1.27	0.45	35
Irrigated wetland culture						
Calauan	1988	WS	C1	4.86	3.80	22
Guimba	1984	WS	IR58	1.33	0.41	69
Zaragoza	1979	WS	IR36	7.18	4.81	33
		WS	IR52	5.70	4.77	16
	1988	DS	IR64	6.63	5.25	21
Koronadal	1986	2nd	IR62	5.37	4.15	25
	1987	1st	IR62	5.69	4.84	15

Farmers' Yield WS

Range in yield 2-8 t/ha in farmers' surveys

Farmers' Yield DS



Individual farmer's yields based on farmer surveys over 18 crops. Difference in yield up to 1.8-7.1 t/ha or 394%.

Yield from two farmers surveyed, Koronadal, S. Cotabato, 1983-91

Year	Season	Rombaoa 1.75 ha	Nelmeda 1.5 ha
'83	DS	4.7	5.1
'83	WS	4.4	**5.9**
'84	DS	5.5	4.8
'84	WS	**7.1**	5.7
'85	DS	**1.8**	4.7
'85	WS		5.3
'86	DS	4.8	
'86	WS	3.7	
'87	DS	5.0	5.6
'87	WS	4.3	5.6
'88	DS	6.4	**2.7**
'88	WS	5.0	
'89	WS		5.5
'89	DS	6.2	3.9
'90	WS	6.0	5.3
'90	DS	5.3	5.0
'91	DS	6.6	4.8
'91	WS	5.6	5.1

Individual farmer's yields based on surveys over 9 crops. Range of yields for two farmers 2.4-6.5 t/ha, a difference of 270%.

Yields of two farmers in Zaragoza, Nueva Ecija, 1983-91.

Year	Season	Espiritu 2.5 ha	Legazon 2.5 ha
'83	DS	2.5	
'84	WS	**2.4**	4.5
'85	DS	5.4	4.4
'85	WS	3.5	
'86	DS	6.0	**5.4**
'86	WS	4.3	2.9
'87	DS	**6.5**	5.0
'87	WS	5.1	4.2
'91	WS	4.4	**2.8**

Why are farmers' yields so variable?

Heinrichs trial at IRRI field, multiple pest infestation. Synergistic losses?

Table 16.3 Yield of IR36 based on single and multiple artificial infestations by three insect pesets, IRRI field, Philippines, 1982 wet season

Pest	Yield (g/m^2)
Caseworm (1)	514a
Whorl maggot (2)	514a
Yellow stemborer (3)	458b
1+2	426bc
1+3	413c
2+3	419c
1+2+3	402c

1982 IRRI Annual Report

Multiple pest/stress damage

- Three possible outcomes or modes for yield loss
  - Additive (1 + 1 = 2)
  - Antagonistic (1 + 1 = 1)
  - Synergistic (1 + 1 = 3)

Whorl maggot + Defoliators

Comparison of the level of damage and yield loss on IR64 rice when whorl maggot (Wm) and defoliators (Def) were artificially infested as individual species or combined using data from the 90 kg N/ha treatment in the damage function trials, Zaragoza, Nueva Ecija, 1989 wet and 1990 dry seasons.

	Damaged leaves (% at 35 d after transplanting)				Yield loss (%)				
Crop	Wm (A)	Def (B)	Sum (A + B)	Combined infestation Wm + Def	Wm (C)	Def (D)	Sum (C + D)	Combined infestation Wm + Def	mode
Wet season	34.8 a	31.7 a	66.6 b	49.3 ab	4.6 a	-4.5 a	0.1 a	27.0 b	Synergistic
Dry season	24.7 a	20.7 a	45.4 b	40.9 b	11.7 a	6.1 a	17.8 ab	29.6 b	Additive

Whorl maggot + Defoliators: Yield loss synergistic

Yield loss from rice whorl maggot (Wm) and *Rivula* and *Naranga* defoliators (Def) artificially infested as individual species or combined on IR64 rice grown under two sources of N, Guimba, Nueva Ecija, 1990 wet season

	Yield (t / ha) Infested plots			Yield loss							
				Whorl maggot		Defoliators		Wm + Def		Sum	
N source	Whorl maggot	Defoliators	Wm+ Def	t/ha	%	t/ha	%	t/ha	%	%	mode
Urea	3.85 c	4.11 bc	3.42 d	0.29 b	7.0	0.03 a	0.1	0.72 c	17.4	7.1	Synergistic
S. rostrata	4.31 ab	4.54 a	4.03 c	0.11 a	2.5	- 0.12 a	- 2.7	0.39 b	8.8	-0.2	Synergistic

Why is loss synergistic from WM + Defoliators?

- 3 yield loss studies on IRRI farm showed no yield loss (Heinrichs, Shepard, Mochida)
- 1 study at UPLB by Ferino and on-farm trials by us in two sites in particular showed yield loss (Zaragoza, S. Cotabato)

Is whorl maggot a pest?
None of the studies was wrong!
How to explain differences in yield loss between experimental sites.

- IRRI Farm
  - Seedbed nursery in soft soil (mild transplanting shock)
  - 20-day old seedlings
  - No defoliators
- Outside of IRRI Farm
  - Seedbed not well prepared and soil hard (severe transplanting shock after pulling seedlings)
  - 30-day old seedlings
  - Defoliators

An hypothesis to explain synergistic yield loss

- Multiple stress produced from: Insect damage + transplanting shock + older seedlings
- Defoliation also prolongs transplanting shock by limiting root growth
- On IRRI farm the crop devoid of stress except for whorl maggot thus the crop could tolerate

Multiple infestation: Stemborer in reproductive + ripening stages, both damage and yield loss additive

Comparison of the level of damage and yield loss on IR64 when stemborer was infested in the reproductive or ripening stage or the combination using data from the 90 kg N/ha treatment in the artificial infestation trials, Zaragoza, Nueva Ecija 1989 wet and 1990 dry seasons.

	Deadhearts + whiteheads (%)				Yield loss (%)				
Crop	Reproductive (63 DT) (A)	Ripening (10 d before harvest) (B)	Sum (A + B)	Infested at both reproductive + ripening	Reproductive (C)	Ripening (D)	Sum (C + D)	Infested at both reproductive + ripening	Mode
Wet season	18.5 a	17.7 a	36.2 b	42.7 b	18.8 a	22.4 a	41.2 b	37.2 b	Additive
Dry season	26.3 a	29.5 a	55.8 b	51.6 b	14.7 a	19.5 a	34.2 b	29.6 b	Additive

Combinations of insect pests, losses mostly addtive

Artifical infestation in 25 m^2 plots of IR64, Guimba 1992 DS

Treatments	Yield (t/ha)	Yield loss (%) Actual	Yield loss (%) Added	Mode
Natural infestation	4.13 a			
Defoliator (Def)	4.20 a	-1.8		
Leaffolder (LF)	3.70 ab	10.3		
Deadhearts (DH)	3.33 b	19.4		
Whiteheads (WH)	3.51 ab	15.0		
Def + LF	3.52 ab	14.8	8.5	Additive
Def + WH	3.63 ab	12.1	13.2	Additive
LF + WH	3.08 bc	25.5	25.3	Additive
DH + WH	2.58 c	37.6	34.4	Additive
Def + LF + WH	3.05 bc	26.1	23.5	Additive
LF + DH + WH	2.99 bc	27.6	44.7	Antagonistic
Def + LF + DH + WH	2.48 c	40.0	42.9	Additive

Multiple stresses combined with stemborer: losses synergistic

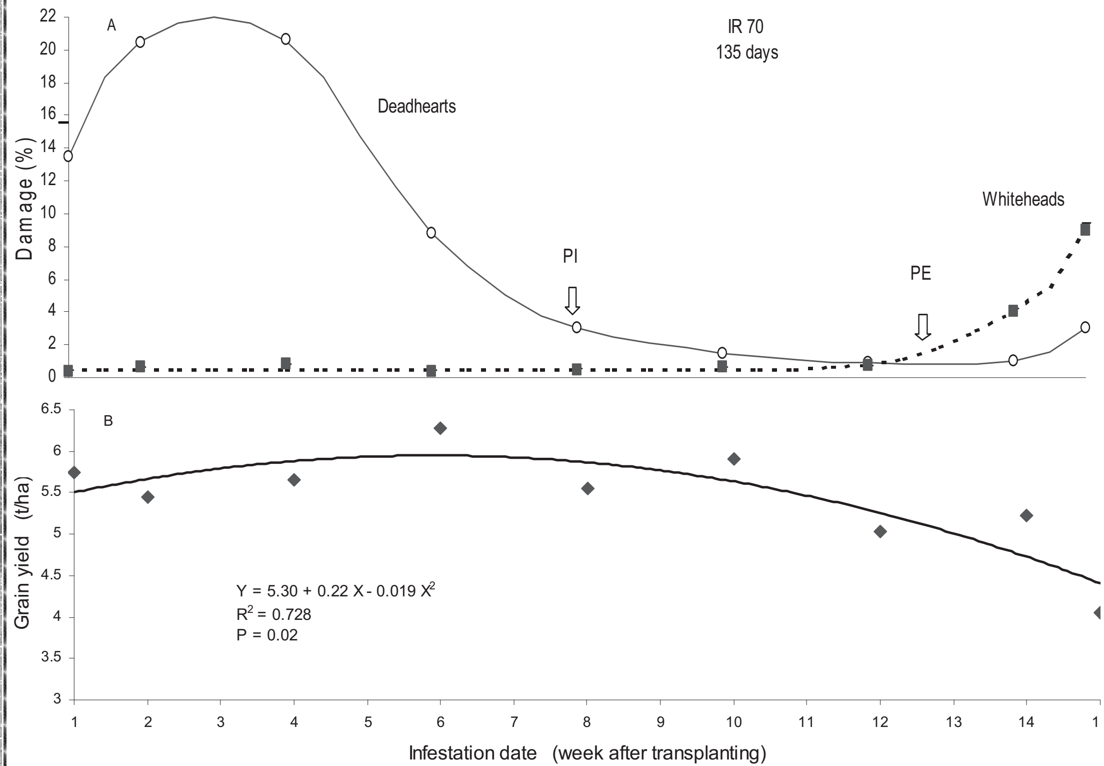
The effect of artificially infesting stemborer alone or combined with drought stress, a weed, or a plant disease on yield in field plots of IR64 rice, Giuimba, Nueva Ecija, 1992 dry season.

Treatment [2]/	(t/ha)	Yield loss (%) Actual	Yield loss (%) Added	Mode
Natural infestation	5.14 a			
Stemborer whiteheads (WH)	5.20 a	-1.2		
Sheath blight (ShB)	5.07 a	1.4		
Echinochloa (Ech)	4.85 ab	5.6		
Drought stress (DS)	4.57 b	11.1		
Ech + WH	4.60 b	10.5	4.4	Synergistic
ShB + WH	4.58 b	10.9	0.2	Synergistic
DS + WH	4.03 c	21.6	9.9	Synergistic
Ech + ShB + DS + WH	3.67 d	28.6	17.0	Synergistic

Modern varieties possess great powers of compensation to counteract insect pest injuries and crop stresses in general

The key tolerance-promoting character is tillering ability which is of greater benefit than the contribution from genetic pest resistance

Natural resistance to stemborers in probably occurs in all cultivars, Zaragoza 1991



Long maturing rices tolerate more pest injury

Comparison of two varieties differing in growth duration on their tolerance of yield loss from insect damage on irrigated transplanted rice, Zaragoza, Nueva Ecija,1990 wet season

Variety/ days to maturity	Insect protection	Panicles (no. / m^2)	Filled grains (no./panicle)	Yield (t/ha)	Yield loss %	Yield loss t/ha	Yield loss P
IR58 90 days	Insecticide	501 a	17.2 a	5.07 a	14.2	0.72	< 0.0001
	Untreated	462 b	13.1 b	4.35 b			
IR74 125 days	Insecticide	532 a	20.6 a	5.23 a	4.0	0.21	ns
	Untreated	520 a	16.7 a	5.02 a			

Yield loss determined by the insecticide check method

Plant maturity x seedling age

Interaction between two varieties differing in maturity and two seedling ages at transplanting with and without insecticide protection on irrigated double crop rice, Koronadal, S. Cotabato, 1992 dry season

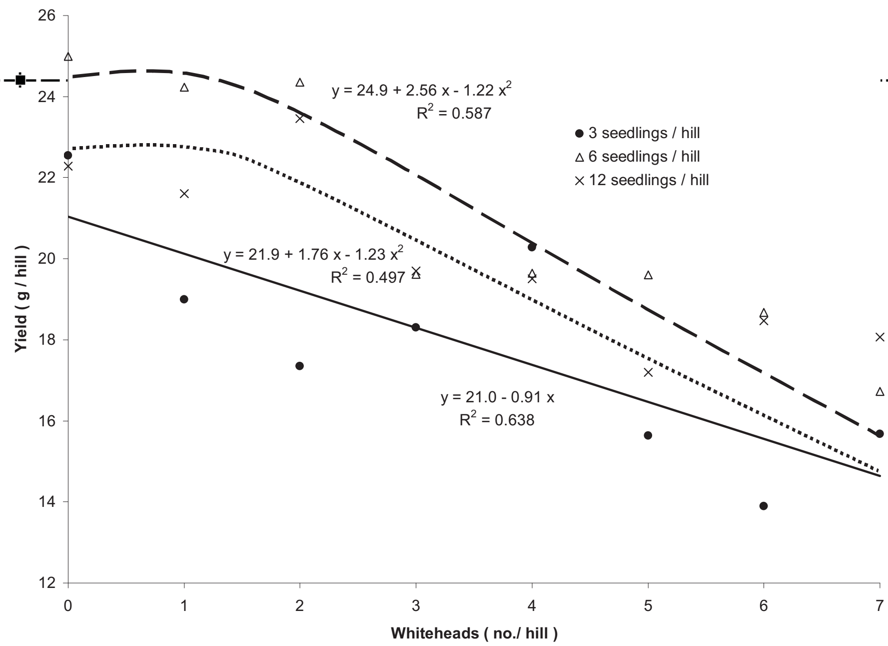
Variety/ days to maturity	Seedling age (d)	Panicles (no. / m^2)	Filled grains (no./panicle)	Yield (t/ha)	Yield loss %	P
IR 60 109 days	20	488 a	13.8 a	4.20 b	5.6	ns
	30	402 b	14.4 a	3.37 c	17.4	< 0.0001
IR74 125 days	20	501 a	15.7 a	4.87 a	3.0	ns
	30	445 a	13.9 a	4.55 ab	2.6	ns

N increases whiteheads, but more importantly yield.
Why do farmers use more N than recommended?
When agronomists determined N recommendations did they eliminate pest stresses? Reductionist methods to determine recommendations.

Effect of N rates on yield and stemborer incidence on irrigated IR64 transplanted rice, Guimba, Nueva Ecija.

Nitrogen treatment	N (kg/ha)	Whiteheads (%)	Panicles (no./m^2)	Filled grains (no./panicle)	Yield (t/ha)
Wet season 1991					
Untreated check	0	4.2 c	387 b	14.7 b	4.16 c
Researchers' practice	70	6.1 b	426 ab	17.3 b	4.98 b
Farmer's practice	122	9.8 a	538 a	24.3 a	5.56 a
Dry season 1992					
Untreated check	0	2.1 b	414 c	12.4 b	3.70 b
Researchers' practice	80	5.8 a	516 b	22.6 a	5.16 a
Farmer's practice	150	5.6 a	581 a	21.1 a	5.22 a

Optimal seedling density increases tolerance to stemborer



Stemborer damage functions as influenced by three seeding rates on IR74 irrigated rice, Zaragoza, Nueva Ecija, 1989 dry season.

Yield loss equation

- Yield loss = Loss from multiple stresses – degree of tolerance or compensation afforded by agronomic practices and weather
- Low yields due to many stresses acting on the crop in a synergistic fashion

Explaining the unexplained yield losses

- When a stress such as insect pest damage is lessened or removed there may be a synergistic yield gain
- Therefore part of the yield gain may be compensation for non-insect caused injury
- If this is true, then what did our insecticide check yield loss trials measure?
- How important were the management practices in the yield loss trials in determining the losses measured?

Lessons for crop management

- As a preventative measure, the farmer should adopt best management practices
- The farmer needs to recognize the stresses in his field
- Research needs to tell the farmers which combinations have the most potential for loss
- Farmer does not have to correct all of the stresses

Some outcomes from this interpretation of yield loss mechanisms

- Whorl maggot + defoliators
  - Reduce transplanting shock (compost in seedbed) SRI
  - Sow young seedlings
  - As last resort, target defoliators with insecticides as easier to control
- Stemborer
  - Do not attempt to control with insecticide
  - Rely on increasing tolerance of crop
- Bt rice would solve most of the insect pest problems and promote synergistic yield gains such as those measured in the full protection treatment of our yield loss trials

Results of action threshold testing

Pest	Best Performing Action Threshold Character	% Fields Where AT was Surpassed	Accuracy (Correct to Treat + Correct Not to Treat)
Whorl maggot	1-2 eggs/hill or 15-30% damaged leaves in earlier planted fields	40%	85-90%
Defoliators	10% damaged leaves in earlier planted fields	12%	90%
Leaffolder	15% damaged leaves	12% reproductive and 4% ripening stages	95%
Stemborers	Deadhearts (15% vegetative, 25% reproductive, 10% ripening stages)	4% reproductive and 5% ripening stages	95%

Outstanding questions about yield loss assessments

- AT values to be based on crop management practices, what stresses are present, weather forecast?
- How to measure yield loss for a region when management practices, stresses, and weather differ for each field and conditions in each field will change each cropping season?

Rice stemborer ecology

- Yellow, white, striped, pink, gold fringed stemborers
- What are the characteristics of each species that determines prevalence in a particular location?
- Let’s update Cendaña and Calora 1967

Stemborer relative abundance

Relative stemborer species abundance determined from tiller or stubble dissections in three rice cultures and three island groups in the Philippines.

		Relative abundance (%)				
		Yellow / white	Striped	Pink	Gold fringed	*Maliarpha*
Dryland						
	Claveria	24	68	8	0.2	0.1
	Tupi	66	30	2	3	0
	Tanauan	81	1	13	5	0
	Los Baños	42	46	9	1	1
	mean	**53**	**36**	**8**	**2**	**< 1**
Rainfed wetland						
	Oton	60	24	8	8	0
	Manaoag	100	0	0	0	0
	Solano	77	4	13	6	0
	mean	**79**	**9**	**7**	**4**	**0**
Irrigated wetland						
	Guimba	100	0	0	0	0
	Zaragoza	100	0	0	0	0
	Calauan	97	2	0	0	0
	Santa Maria	64	28	8	0	0
	Koronadal	70	28	2	0	0
	mean	**83**	**15**	**2**	**0**	**0**

El Niño drought of 1982-83 probably caused the shift

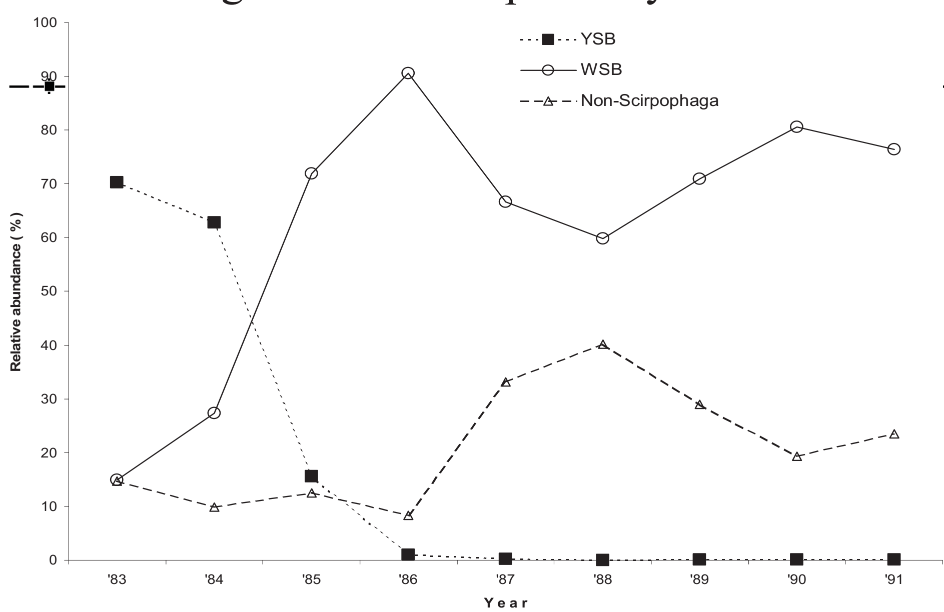


Figure 2. The relative abundance of rice stemborers collected in kerosene light traps in four villages in Koronadal, S. Cotabato from 1983-91 in irrigated rice fields. Data are the average of a pair of light traps per village averaged over villages each year beginning in April. Two villages planted double cropped rice in the Marbel Irrigation system while the two other villages were in a communal irrigation system with artesian water supply thus they attempted to plant 5 crops in two years. The main non-Scipophaga stemborers were mainly Maliarpha sp., SSB, PSB, and GFSB.

White stemborer

- Can survive in dormancy for 10-12 months rice stubble (van der Goot 1925)
- Needs to stay in diapause for 4 months (van der Goot 1925)
- Resurgence in Mindanao due to El Niño drought
- Distribution mirrors ITCZ climate near equator
- Thrives because early maturing rices ensure 4 months of diapause in dry season
- Held in check in Koronadal in asynchronous cropping system by 4 species of egg parasitoids (65% mortality) and generalist predators (44% mortality) and stubble plowdown
- Control WSB by growing medium maturing varieties to limit the dry fallow to < 3-4 months

Yellow stemborer

- If there is flooding, no other borer species will survive (almost 100% mortality in flooded areas) thus adapted to monsoon climate. Pupa stays dry.
- Both WSB and YSB larvae are small and thus more adapted to narrow stemmed MVs < 5 mm diameter
- Dormancy in semi-tropics where wheat grows best
- Thrives best in rice bowls especially where there are other rice crops being nearby planted in different months so it can disperse from crop to crop yearround

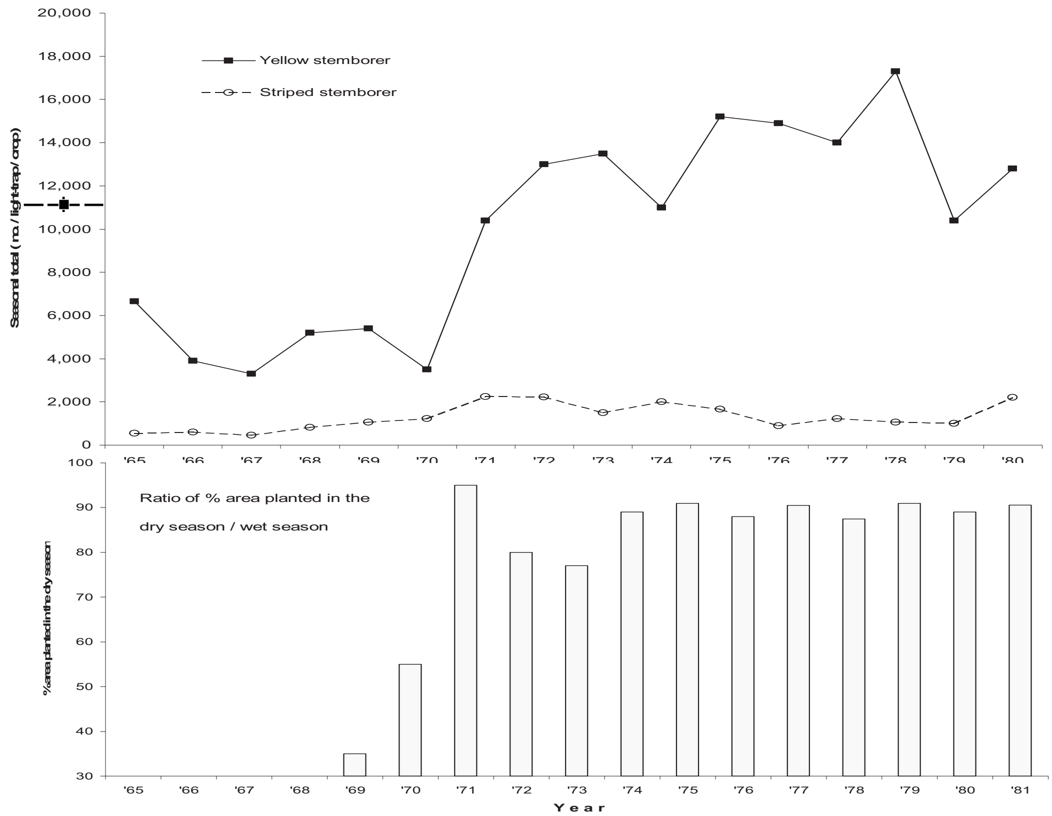


Figure 1. Changes in stemborer abundance during a period of change from single to double rice cropping in Laguna province, 1965-81. Irrigated area data are from the National Irrigation Authority for Mabacan and Santa Cruz River Irrigation System. Data presented on a per season basis averaged from four electric light traps on the IRRI farm. (After Loevinsohn, 1984).

Striped stemborer

- 1/3 larger larva than YSB or WSB thus more adapted to tillers with a wider diameter such as traditional types
- Being larger and not being restricted to one larva/tiller, probably causes higher yield loss than YSB on a per larva base
- Can only attack MVs in later growth stages when tillers are wider
- More common in areas where there is no flooding and maize is grown
- High tolerance to low temperatures where it survives via larval diapause in N Asia

Generalizations looking at Asia as a rice growing region

- In the extreme north and mountainous areas SSB dominates as only it can tolerate cold winters
- At the equator, WSB dominates as only it can tolerate long droughts, but other species can come in between droughts while it cannot cope outside of this zone
- In the monsoon zone of tropics and semi-tropics YSB dominates especially in rice bowls
- YSB dominant in competition with WSB and SSB due non-dormancy and therefore more generations per year
- SSB, PSB and other Chilo are more adapted to other grass crops (maize, sorghum, sugarcane) and not highly specialize to rice
- Conclusion is that YSB is the overall dominant rice stemborer