a microscope (1000X). Mortality of larvae in the untreated control was 0.3% at 7 DAT and 0.7% at 14 DAT. Mortality of the treated insects was adjusted using Abbott's formula (see table).

The results indicate that *A.cal* NPV is pathogenic to *M. separata.* Differences in insect mortality were greater at 14 DAT. Treated insects that died without being affected by the virus were those that failed to eat during the first few days.

Effects of the viruses in the field would depend on application method and formulation to give proper distribution-deposition and protection from ultraviolet and other adverse factors. The virus is projected to be used at Solrice farm next year, together with the parasite *Apanteles ruficrus* Haliday (Braconidae - Hymenoptera), to control *M. separata.* □

Mortality of *Mythimna separata* (Walk.) treated with nuclear polyhedrosis virus.[a]

Treatment		Mortality [c](%)	
Virus	Dosage[b] (PIB/ml)	7 DAT	14 DAT
*A. cal*NPV	6.675×10^4	3.2 b	6.7 d
	6.675×10^5	10.0 ab	23.3 c
	6.675×10^6	16.3 ab	31.7 bc
	6.675×10^7	15.7 ab	36.7 b
	6.675×10^8	34.7 a	83.3 a
Ms NPV	3.540×10^4	3.0 c	3.3 d
	3.540×10^5	23.7 b	36.7 b
	3.540×10^6	35.7 b	53.3 ab
	3.540×10^7	41.0 ab	83.3 a
	3.540×10^8	62.0 a	96.7 a

[a]Thirty 2d-instar larvae replication, 3 replications/treatment. [b]PIB = polyhedral inclusion bodies. [c]Means in a column followed by common letter are not significantly different by Duncan's multiple range test at 5% level.

Rice leaffolder (LF) complex in Madurai, Tamil Nadu, India

K. Gunathilagaraj and M. Gopalan, Agricultural Entomology Department, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai 625104, Tamil Nadu, India

During 1985–86 rabi (winter Nov planting), recommended chemicals did not give adequate control of LF in the Madurai Agricultural College Farm. The larvae were collected periodically and reared to adults.

We found that LF is a complex of three species: *Cnaphalocrocis medinalis, Marasmia patnalis,* and *Marasmia ruralis.* The first two were abundant on all sampling dates (see table). Insecticides need to be screened against all three LF species. □

Survey of rice LF in Madurai, India, 1985.

Date collected	LF adults that emerged (no.)		
	C medinalis	*M. patnalis*	*M ruralis*
26 Sep	107	115	1
27 Sep	25	17	–
28 Sep	43	46	–
29 Sep	30	30	1
30 Sep	13	3	–
1 Oct	29	25	1
2 Oct	45	38	–
10 Oct	4	16	–
14 Oct	2	7	–
Total	298	297	3

Effect of 3 granular insecticides on brown planthopper (BPH) *Nilaparvata lugens* (Stal) in the Easternghat Highland Zone, Koraput, India

B. Mishra and B. K. Sontakke, Entomology Department, Orissa University of Agriculture and Technology (OUAT), Bhubaneswar 751003, India

In the Easternghat Highland Zone, Koraput district, India, serious BPH outbreaks were observed on irrigated

Effect of granular insecticides on BPH population and rice yield at Semiliguda, Koraput, India, 1981.[a]

Insecticide	Adults/hill (treatment at 15 DT)		Nymphs/hill (treatment at 35 DT)		Yield (t/ha)
	10 DAT	20 DAT	10 DAT	20 DAT	
Untreated	13.7 d	59.0 e	27.0 d	0.0	0.0
BPMC	4.7 a	51.7 de	7.3 b	27.7 b	1.5 a
Carbofuran	5.7 ab	35.7 a	6.3 b	34.7 b	1.8 a
Isoprocarb	7.0 bc	42.3 abc	4.3 a	21.0 a	1.7 a
Phorate	8.0 bc	43.3 bc	19.0 cd	0.0	0.0
Disulfoton	8.7 c	41.3 ab	13.0 c	0.0	0.0
Quinalphos	9.3 c	49.3 cd	18.3 cd	0.0	0.0

[a]In a column, means followed by a common letter are not significantly different at the 1% level after logarithmic transformation. DT = days after transplanting.

summer rice (Feb–May) in 1980 and 1981. No rice varieties grown was found to be resistant. A trial to evaluate six granular insecticides was conducted during 198 1 summer.

The trial was laid out in a randomized block design with three replications. Pest-susceptible cultivar Suphala (TNl/Tl41) was transplanted on 21 Feb 1981. Insecticide granules at 1.5 kg ai/ha were broadcast at 15 and 35 d after transplanting, when heavy migratory hopper populations appeared. BPH adult and nymph populations were recorded at 10 and 20 d after treatment (DAT) on a random sample of 10 hills after each application.

Heavy adult population was recorded at 10 DAT, increasing up to 20 DAT with a continuous influx of emigrant hoppers. Hopperburn was noticed with phorate, quinalphos, and disulfoton treatments, resulting in a total yield loss (see table).

The superiority of isoprocarb, carbofuran, and BPMC was evident 10 d after the second treatment, with a significant reduction in nymph population. □

Insect pests of wet season rice in Jabalpur, India

B.C. Shukla, JNKVV Zonal Agricultural Research Station, Raipur 492012, Madhya Pradesh; and R.K. Agrawal and S.M. Vaishampayan, Entomology Department, JNKVV, Jabalpur 482004 Madhya Pradesh, India

Wet season rice grown after wheat in Jabalpur is attacked by several insect pests. In a 1984 survey, whitebacked planthopper was a major pest at the vegetative stage, 8-107 hoppers/hill (see table). Rice hispa, although sporadic, was 0.3-12/hill and caused 17-28% damaged leaves.

Rice whorl maggot damage was recorded in this region for the first time during that survey with 5% damaged leaves in early August, increasing to 16%. Populations of rice armyworm started at 0.2 larva/ hill and reached 2 larvae/hill. The 1.3 larvae/ hill during the first week of Oct coincided with booting and panicle development. That population was higher than the economic threshold level of 1 larva/hill.

Insect pests of rice at Jabalpur, India, 1984.

Pest	Economic *status*[a]	Damage or population[b]
Whitebacked planthopper *Sogatella furcifera* (Horvath)	Major (R)	107 hoppers/hill Jul planting
Rice hispa *Dicladispa armigera* (Olivier)	Major (S)	12 hispas/hill and 28.3% leaf damage in Jul planting
Rice whorl maggot *Hydrellia philippina* Ferino	Minor	16% leaf damage in Jul planting
Rice armyworm *Mythimna separata* (Walker)	Major (R)	1.8 larvae/hill in Jul-Aug planting
Rice green leafhoppers *Nephotettix* spp.	Minor (R)	1-3 hoppers/hill
Yellow stem borer *Scirpophaga incertulas* (Walk.)	Minor (R)	1.4% deadhearts
Rice satyrid butterfly *Melanitis leda ismene* (Cramer)	Minor (S)	Traces
Rice gundhi bug *Leptocorisa acuta* (Thunberg)	Minor (S)	1-2 bugs/hill

[a]R = regular, S = sporadic, [b]Peak population or damage during season.

Trace numbers of yellow stem borer, rice skipper *Pelopidus* sp., rice satyrid butterfly, and rice gundhi bug *Leptocorisa acuta* (Thunberg) [=varicornis (Fab)] were found. □

Biogas to control rice storage pests

P.T. Palaniswamy and A. Dakshinamurthy, Postharvest Technology Scheme, Tamil Nadu Agricultural University, Coimbatore 641003, India

The major insect pests of stored rice are the Angoumois grain moth *Sitotroga cerealella,* the lesser grain borer *Rhizopertha dominica,* and the rice weevil *Sitophilus oryzae.* We tested controlling these pests with biogas from cow dung, consisting of 60% methane, 30-35% carbon dioxide, and traces of other gases.

Effect of biogas on rice storage pests.

Insect	Biogas dose	Time to 10% mortality	
		Without grain	With grain
S. cerealella	20 liters/min	30 s	4 h
S. oryzae	20 liters/min	35 s	4 h 50 min
R. dominica	20 literslmin	50 s	6 h

Twenty-five adults of each pest were placed in 1-kg-capacity closed glass containers and subjected to biogas at 20 liters/min, at 28°C room temperature and 80% relative humidity. Within 30-50 s, all test insects died. No insects died in the untreated check.

Test insects were subjected to 20 liters biogas/min in the presence of 1 kg rough rice. The time to 100% death was 4-6 h (see table). *S. cerealella* was easily killed, followed by *S. oryzae* and finally *R. dominica.* The same treatment also was highly effective in controlling rats. □