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REVIEW

RICE PEST COMPLEX : AN APPRAISAL

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More than 800 insect species are reported to damage rice crop in varying degrees and only 20 are of major importance and regular occurrence (Grist and Lever, 1969). Occurrence of a large number of insect pests has been cited often as a major bottle-neck in achieving higher yield in rice similar to that, which occurred in wheat following the introduction of high yielding varieties (Pradhan, 1971). Based on the published data, we are able to list 537 organisms on rice, which include 385 insects (Table 1), 51 nematodes, 15 mites, 5 earthworms, 7 snails, 2 tadpole shrimps, 1 eel fish, 9 crabs, 3 large mammals, 4 rodents and 54 birds (Table 2) in our country. Yield loss due to the pests alone was put at 31.5 per cent in Asia (Cramer, 1967). The loss is expected to be much more in endemic areas, as in Maruteru where only 625 kg/ha yield was obtained without any protection as compared to 4504 kg/ha with protection (AICRIP, 1972), suggesting a loss of about 86 per cent.

CHANGING STATUS OF PESTS

During the last two decades, the insect pest complex of the rice crop has undergone a tremendous change (Pathak and Dhaliwal, 1980). Species like leaf folders, whorl maggots, thrips, caseworms, armyworms and cutworms that were minor pests earlier have started appearing in epidemic forms, whereas the incidence of a few like stemborers and rice hispa has declined somewhat (Table 3). Certain insect species that were known to attack rice during a particular crop season only have started occurring throughout the

year (gall midge) while others have expanded the areas of their occurrence. This has given rise to new pest problems in several areas.

The brown planthopper (BPH), *Nilaparvata lugens* (Stal.), a minor pest till mid 1960 has become a major threat since 1970s, causing severe damage in several states of our country (Dyck and Thomas, 1979). Of the various changes in production practices, the increased use of resurgence inducing insecticides has been considered as the major cause of intensified BPH problems in India. The whitebacked planthopper. (WBPH), *Sogatella furcifera* (Horvath), is slowly becoming a major pest in major rice growing tracts, especially in Madhya Pradesh and Punjab (Mochida, 1982). Since 1964, the green leadhopper (GLH), *Nephotettix* spp., has become a chronic pest of rice (Kulshreshtha *et al.* 1970 ; Ling, 1976). The rice gall midge, *Orseolia oryzae* (Wood- Mason) is also spreading its area of occurrence in the country. Even though first reported in neighbouring Bihar in 1880, it was recorded for the first time in 1971 only in Uttar Pradesh (Chaturvedi, 1971) and has become a regular pest since then (Rizvi and Singh, 1980). It was abundant during the wet season only but in the recent years, large infestations have been recorded in the dry season crop also (Kalode, 1974 ; Kalode and Kasi Viswanathan, 1976 ; Panda, 1978). The gall midge has been conventionally a pest of low land irrigated rice, but it has started attacking deep water rice (Venugopala Rao, 1975) and hill rices

Table 1. Insects associated with rice crop in India*

Common name	Scientific name	Family
COLLEMBOLA		
Spring tail	<i>Seira cinerea</i> Yasii	Entomobryidae
ISOPTERA		
Harvester termite	<i>Anacanthotermes viarum</i> (Koenig) <i>Heterotermes indicola</i> (Wasm.) <i>Cycloptermes obesus</i> <i>Microtermes</i> sp. <i>Odontotermes</i> sp. <i>Odontotermes obesus</i> (Shiraki)	Hodotermitidae Rhinotermitidae Termitidae
ORTHOPTERA		
Grasshopper	<i>Acrida exaltata</i> (Walker) <i>Acrida turrata</i> (L.) <i>Acridum flavicorne</i> Oliv. <i>Acrotylus humbertiana</i> Sauss. <i>Aiolopus affinis</i> B. <i>Aiolopus simulatrix</i> (Wlk.) <i>Aiolopus tamulus</i> F. <i>Aiolopus thalassinus tamulus</i> (Fabri.) <i>Catantops pinguis innotabilis</i> <i>Chondracris rosea</i> (De Geer) <i>Colemania sphenariaoides</i> Bol. <i>Cyrtacanthacris tatarica</i> (Linn.) <i>Eyprepocnemis alacris</i> (Serv.) <i>Eyprepocnemis bramina</i> (Saussure) <i>Eyprepocnemis rosea</i> Uvarov <i>Gastrimargus africanus</i> (Saussure) <i>Gastrimargus marmoratus</i> (Thunb.) <i>Heteropternis respondens</i> (Walker) <i>Hieroglyphus banian</i> (F.) <i>Hieroglyphus nigrorepletus</i> Bolivar <i>Hieroglyphus oryzivorus</i> Carl <i>Locusta migratoria manilensis</i> (Meyen) <i>Locusta migratoria migratoria</i> <i>Oedaleus infernalis</i> Saussure <i>Oedaleus marmoratus</i> Thunb. <i>Oxya bidentata</i> (Willemse) <i>Oxya fuscovittata</i> (Marschall) <i>Oxya hyla hyla</i> Serville <i>Oxya japonica japonica</i> (Thunb.) <i>Oxya nitidula</i> (Walker) <i>Oxya velox</i> (Fabricius) <i>Pachytylus danicus</i> L. <i>Parabolocratrus porrectus</i> Walker <i>Parahieroglyphus bilineatus</i> (Bol.) <i>Patanga succincta</i> (L.) <i>Schistocerca gregaria</i> (Forsk.) <i>Trilophidia annulata</i> (Thunberg) <i>Valanga nigricornis</i> Burm. <i>Xenocatantops humilis</i> (Serville)	Acrididae
Sudan Plague Locust		
Grasshopper		
Citrus Locust		
Deccan grasshopper		
Cotton grasshopper		
Short-horned grasshopper		
Grasshopper		
Grasshopper		
Larger rice grasshopper		
Phadka grasshopper		
Rice grasshopper		
Oriental migratory locust		
Asiatic migratory locust		
Lesser paddy grasshopper		
Small rice grasshopper		
Short-horned grasshopper		
Bombay locust		
Desert locust		
Javanese grasshopper		
Spotted Locust		
Tobacco grasshopper		
Surface grasshopper		
Long-horned grasshopper	<i>Aularches miliaris</i> (Linnaeus) <i>Attractomorpha crenulata</i> (Fab.) <i>Chrotogonus</i> sp. <i>Chrotogonus oxypterus</i> (Blanchard) <i>Chrotogonus trachypterus</i> (Blanch.) <i>Pyrgomorpha conica</i> Bl., <i>Concephalus longipennis</i> (de Hann) <i>Euconocephalus</i> sp. <i>Euconocephalus incertus</i> (Walker)	Pyrgomorphidae Tettigoniidae

Table I. Contd.,

Common name	Scientific name	Family
Field cricket	<i>Brachytripes portentosus</i> Licht. <i>Euscyrus</i> sp. <i>Euscyrus concinnus</i> Hanu. <i>Gryllus conspersus</i> Schaum. <i>Liogryllus bimaculatus</i> de Geer <i>Teleogryllus occipitalis</i> (Serv.) <i>Trigonidium cicindeloides</i> (Serv.)	Gryllidae
Mole cricket	<i>Gryllotalpa</i> sp. <i>Gryllotalpa orientalis</i> Burm. <i>Gryllotalpa africana</i> Palisot de Beauvois	Gryllotalpidae
HEMIPTERA Frog hoppers	<i>Abidama producta</i> Walker <i>Abidama rufia</i> Distant <i>Callitettix versicolor</i> (Fab.) <i>Clovia punctata</i> Walker <i>Cosmoscarta bispecularis</i> White <i>Cosmoscarta</i> sp. <i>Poophilus costalis</i> Walker	Cercopidae
Leafhoppers	<i>Athysanus indicus</i> Distant <i>Athysanus fusconervosus</i> Motsch. <i>Cicadula fascifrons</i> Stal. <i>Cicadulina bipunctella</i> Mats. <i>Cofana spectra</i> (Dist.) <i>Cofana yasumatsui</i> <i>Deltocephalus distinctus</i> (Motsch.) <i>Empoasca notata</i> Melichar <i>Empoasca indica</i> (Datta) <i>Empoasca maculifrons</i> (Motsch.) <i>Empoasca truncata</i> <i>Empoasca</i> sp. nr. <i>ulami</i> <i>Exitianus fusconervosus</i> Motsch. <i>Exitianus indicus</i> (Distant) <i>Hecalus albomaculata</i> Dist. <i>Hecalus porrecta</i> (Walker) <i>Kolla mimica</i> Distant	Cicadellidae
White leafhopper	<i>Nephotettix malayanus</i> Ishi & Kawase <i>Nephotettix modulatus</i> <i>Nephotettix nigropictus</i> (Stal.) <i>Nephotettix virescens</i> (Distant) <i>Nirvana pallida</i> Melichar <i>Nirvana suturalis</i> Melichar	
Blue leafhopper	<i>Parabolocratus porrectus</i> (Wlk.) <i>Paramesus lineaticollis</i> Dist. <i>Recilia dorsalis</i> Motsch. <i>Selenocephalus virescens</i> Dist. <i>Thaia subrufa</i> (Motsch.) <i>Tettigella viridis</i> (L.) <i>Tettigoniella albida</i> Sign. <i>Thomsoniella albomaculata</i> Dist. <i>Zyginidia quyumi</i> (Ahmed)	
Grass leafhopper	<i>Javesella pellucida</i> (F.) <i>Leodelphax striatellus</i> (Fallen) <i>Nilaparvata lugens</i> (Stal.) <i>Peregrinus maidis</i> (Ashm.) <i>Perkinsiella sinensis</i> Kirk. <i>Sogata pusana</i> Dist.	
Green pigmented white jassid Green leafhopper		
Green-yellow striated leafhopper		
Zig zag leafhopper		
Orange headed leafhopper		
Planthopper Smaller brown planthopper Brown planthopper Sorghum shoot bug		Delphacidae

Table 1. Contd.,

Common name	Scientific name	Family
White backed planthopper	<i>Sogatella furcifera</i> (Horvath)	
	<i>Toya</i> sp.	
	<i>Unkanodes sapporonus</i> (Mats.)	
	<i>Oliarius caudatus</i> Walker	Cixiidae
Sugarcane derbid	<i>Proutista moesta</i> (Westw.)	Derbidae
	<i>Nisia nervosa</i> (Motsch.)	
	<i>Eponisia guttula</i> Mats.	
Sugarcane leafhopper	<i>Pyrilla perpusilla</i> Walker	Lophopidae
	<i>Brachysiphoniella montana</i> (van der Goot)	
Root aphids	<i>Chaetogeomys polychaeta</i> Pal & Raychaudhuri	Aphididae
	<i>Geomys lucifuga</i> (Zehner)	
Rusty plum aphid	<i>Hysteroneura setariae</i> (Thomas)	
Leaf aphid	<i>Melanaphis vanderghoffi</i> Raychaudhuri & Banerjee	
Corn aphid	<i>Rhopalosiphum maidis</i> (Fitch)	
Rice root aphid	<i>Rhopalosiphum nigriabdominalis</i> (Sasaki)	
Apple grain aphid	<i>Rhopalosiphum padi</i> (L.)	
Rice root aphid	<i>Rhopalosiphum rufiabdominalis</i> (Sasaki)	
Green bug	<i>Schizaphis graminum</i> (Rond.)	
Ragi root aphid	<i>Tetraneura basui</i> Hille Ris Lambers	
	<i>Tetraneura nigriabdominalis</i> (Sasaki)	
	<i>Tetraneura radicecola</i> Strand	
Rice mealybug	<i>Brevnesia rehi</i> (Lindinger)	Pseudococcidae
Pink mealybug	<i>Saccharicoccus sacchari</i> (Okll.)	
Cotton whitefly	<i>Bemisia tabaci</i> (Gennadius)	Aleurodidae
Lace-wing bug	<i>Baka malayanus</i> (Drake)	Tingidae
Sugarcane blackbug	<i>Cavelerius</i> sp.	Lygaeidae
	<i>Cymodema basicornis</i> (Motsch.)	
	<i>Elasmolomus sordidus</i> (Fabricius)	
	<i>Macropes excavatus</i> (Dist.)	
	<i>Cletus bipunctatus</i> Westw.	Coreidae
	<i>Cletus signatus</i> (Walker)	
	<i>Cletus</i> sp.	
	<i>Cletus trigonus</i> Thunb.	
Rice headbugs	<i>Leptocorisa acuta</i> (Thunb.)	
	<i>Leptocorisa oratorius</i> (F.)	
	<i>Leptocorisa</i> sp.	
	<i>Fabriciella australis</i> (F.)	
	<i>Pendulinus nicobarensis</i> Meyr.	
	<i>Riportortus fuscus</i> F.	
	<i>Trigonotylus doddi</i> (Dist.)	Miridae
Malaysian blackbug	<i>Scotinophara coarctata</i> (F.)	Pentatomidae
Japanese blackbug	<i>Scotinophara lurida</i> (Burmes.)	
	<i>Agonoscelis nubila</i> Fb.	
	<i>Audinetis spinidens</i> Guer.	
Painted bug	<i>Bagrada cruciferarum</i> Kirkaldy	
	<i>Dolycoris baccarum</i> Linn.	
Sorghum earheadbug	<i>Dolycoris indicus</i> Stal.	
	<i>Stollia ventralis</i> (Westwood)	
	<i>Stollia guttiger</i> (Thunberg)	
Orange bug	<i>Menida histrio</i> Fab.	
Green stink bug	<i>Nezara viridula</i> Linn.	
	<i>Stortheocoris nigriceps</i> Horv.	
	<i>Stortheocoris tarsalis</i> Walker	
Striped bug	<i>Tetroda histeroidea</i> (F.)	
PSOCOPTERA		
Stored rice psocid	<i>Liposcellis</i> sp.	Liposcellidae

Rice Pest Complex : an Appraisal

Table 1. Contd.,

Common name	Scientific name	Family
THYSANOPTERA		
Leaf sheath thrips	<i>Anaphothrips sudanensis</i> (Try.)	Thripidae
Rice thrips	<i>Stenchaetothrips biformis</i> (Bagnall)	
Rice ear thrips	<i>Haplothrips ganglbaueri</i> Schm.	Phloethripidae
LEPIDOPTERA		
Leaf folder	<i>Brachmia arotiae</i> Meyr.	Gelechiidae
Angoumois grain moth	<i>Sitotrga cerealella</i> (Oliv.)	
Slug caterpillar	<i>Parasa bicolor</i> (Walker)	Limacodidae
	<i>Niphadoses gilviberbis</i> (Zell.)	Galleriidae
Rice moth	<i>Corcyra cephalonica</i> St.	
Root caterpillar	<i>Acigona chrysographella</i> (Koll.)	Crambidae
Gold-fringed borer	<i>Chilo auricilius</i> Dudge.	
Shoot borer	<i>Chilo infuscatellus</i> (Snell.)	
Striped stemborer	<i>Chilo partellus</i> (Swinhoe)	
Dark-headed borer	<i>Chilo polychrysa</i> (Meyr.)	
Sugarcane stemborer	<i>Chilo sacchariphugus indicus</i> (Kapur)	
Striped rice borer	<i>Chilo suppressalis</i> (Walker)	
Ragi white borer	<i>Saluria inficita</i> Walker	Phycitidae
Fig moth	<i>Ephestia cautella</i> (Walker)	
	<i>Bradina admixtalis</i> (Walker)	Pyraustidae
Rice leaf folder	<i>Cnaphalocrocis medinalis</i> (Guen.)	
Leaf folder	<i>Cryptoblabes gnidiella</i> (Milliere)	
	<i>Herpetogramma licarsisalis</i> (Walker)	
	<i>Lygropis obrinusalis</i> Walker	
	<i>Mabra erykalis</i> Walker	
African White rice borer	<i>Maliarpha separatella</i> Rag.	
Leaf folder	<i>Marasmia bilinelais</i> Hampson	
	<i>Marasmia exigua</i> (Butler)	
	<i>Marasmia patnalis</i> (Bradley)	
	<i>Marasmia ruralis</i> (Walker)	
Sorghum leafroller	<i>Marasmia trapezalis</i> (Guen.)	
Sugarcane leafroller	<i>Neomarmasia suspicollis</i> Wik.	
Rice caseworm	<i>Nymphula depunctalis</i> (Guen.)	
	<i>Nymphula fluctuosalis</i> Z.	
	<i>Ostrinia nubilalis</i> (Hubn.)	
	<i>Psara phaeopteralis</i> Guen.	
Leaf folder	<i>Pyrausta coclesalis</i> Walker	
Sugarcane topborer	<i>Scirpophaga excerptalis</i> Wik.	
Yellow stemborer	<i>Scirpophaga incertulas</i> (Wik.)	
White borer	<i>Scirpophaga innotata</i> (Wik.)	
	<i>Schenobius immeritalis</i> Wik.	
	<i>Sylepta balteata</i> (F.)	
Hairy caterpillar	<i>Metanastria</i> sp.	Lasiocampidae
	<i>Matanastria hyrtaca</i> C.	
	<i>Leonodra vittata</i> Walker	
	<i>Nisaga simplex</i> Walker	Eupterotidae
Tussock caterpillar	<i>Euproctis subnotata</i> Walker	Lymantriidae
	<i>Euproctis varians</i> (Wik.)	
	<i>Euproctis virgo</i> Swinhoe	
	<i>Euproctis virguncula</i> Walker	
	<i>Laelia fasciata</i> (Moore)	
	<i>Laelia lilacina</i> Moore	
	<i>Laelia suffusa</i> Walker	
	<i>Lymantria obfuscata</i> Wik.	
Yellow hairy caterpillar	<i>Psalis pennatula</i> (F.)	
Rice bag worm	<i>Mahasena graminivora</i> Hampson	Psychide

Table 1. Contd.,

Common name	Scientific name	Family
Red hairy caterpillar	<i>Amsacta albistriga</i> Walker	Arctiidae
	<i>Amsacta lactinea</i> Cramer	
	<i>Amsacta lineola</i> Fabricius	
	<i>Amsacta moorei</i> Butler	
Hairy caterpillar	<i>Cretonotus gangis</i> L.	
	<i>Dinara combusta</i> Walker	
Bihar hairy caterpillar	<i>Estigmene lactinea</i> Cramer	Noctuidae
Greasy cutworm	<i>Agrotis ipsilon</i> (Hufnagel)	
	<i>Agrotis segetum</i> (Schiff.)	
Semilooper	<i>Amathes c-nigrum</i> (L.)	
	<i>Chrysodeixis chalcites</i> (Esper)	
	<i>Grammodes geometrica</i> (F.)	
Gram caterpillar	<i>Helicoverpa armigera</i> (Hubner)	
	<i>Lithacodia signifera</i> Walker	
Semilooper	<i>Mocis frugalis</i> (F.)	
	<i>Mocis trifasciata</i> Steph.	
Climbing cutworm	<i>Mythimna albistigma</i> (Moore)	
	<i>Mythimna insularis</i> (Butler)	
	<i>Mythimna irregularis</i> (Walker)	
	<i>Mythimna micacea</i> (Haw.)	
	<i>Mythimna loreyi</i> (Dup.)	
	<i>Mythimna separata</i> (Walker)	
Rice ear-cutting caterpillar	<i>Mythimna roseileina</i> (Walker)	
Climbing cutworm	<i>Mythimna venalba</i> Moore	
	<i>Mythimna yu</i> (Guenee)	
Green semilooper	<i>Naranga aenescens</i> Moore	
	<i>Naranga diffusa</i> Walker	
	<i>Nodaria externalis</i> Guenee	
Leaf caterpillar	<i>Rivula basalis</i> Hmps.	
	<i>Rivula bioculalis</i> Moore	
Pink stemborer	<i>Sesamia inferens</i> Walker	
	<i>Sesamia uniformis</i> (Dudgeon)	
Armyworms	<i>Spodoptera abyssinia</i> Guenee	
	<i>Spodoptera ciliun</i> Guenee	
	<i>Spodoptera compta</i> (Moore)	
	<i>Spodoptera exigua</i> (Hubner)	
	<i>Spodoptera litura</i> (F.)	
Tobacco leaf caterpillar	<i>Spodoptera mauritia</i> (Boisd.)	
Paddy swarming caterpillar	<i>Spodoptera pecten</i> Guenee	
Army worm	<i>Melanitis leda ismene</i> Cramer	
Green horned caterpillar	<i>Melanitis determinata</i> (Butl.)	Satyridae
	<i>Orsotriaena mandata</i> Moore	
	<i>Orsotriaena medus</i> Moore	
	<i>Mycalesis mineus</i> Linnaeus	
	<i>Mycalesis patnia</i> Moore	
Leaf butterfly	<i>Mycalesis perseus</i> F.	
	<i>Precis almana</i> (L.)	
	<i>Catopsila crocale</i> F.	
Skipper butterfly	<i>Eurema hecabe</i> (Linnaeus)	Pieridae
	<i>Amphittia dioscorides</i> (F.)	
	<i>Caltoris bevani</i> (Moore)	
	<i>Gegenes nostradamus</i> (Fab.)	
	<i>Parnara bada</i> Moore	
	<i>Parnara colaca</i> Moore	
	<i>Parnara guttata</i> Bremer & Grey	
Rice skipper	<i>Pelopidas mathias</i> F.	Hesperiidae
Skipper butterfly	<i>Taractrocera nicevillei</i> Watson	

Rice pest complex : an appraisal

Table 1. Contd.,

Common name	Scientific name	Family
Sugarcane skipper	<i>Telicota augias</i> (L.) <i>Telicota ohara</i> Plotz.	
HYMENOPTERA		
Ants	<i>Solenopsis geminata</i> (Fabricius) <i>Pheidole</i> sp. <i>Pheidolegenton</i> sp.	Formicidae
DIPTERA		
Rice gall midge	<i>Orseolia oryzae</i> (Wood-Mason)	Cecidomyiidae
Rice whorl maggot	<i>Hydrellia philippina</i> Ferino <i>Hydrellia sasakii</i> Yuasa and Isitani <i>Hydrellia griseola</i> Meyr.	Ephydriidae
Seedling root fly	<i>Notiphila</i> sp. <i>Notiphila dorsopunctata</i> Wied.	
Seedling fly	<i>Atherigona exigua</i> Stein.	Muscidae
Stem fly	<i>Atherigona indica</i> Malloch.	
Seedling fly	<i>Atherigona orientalis</i> Schiener.	
Rice stem fly	<i>Atherigona oryzae</i> Malloch.	
Sorghum shoot fly	<i>Atherigona soccata</i> Rond.	
Frit fly	<i>Oscinella</i> sp. <i>Oscinella frit</i> <i>Gaurax</i> sp. <i>Steleocerus ensifer</i> (Thomson) <i>Conostia irrorata</i> Wied.	Chloropidae
Leaf miner	<i>Pseudonapomyza asiatica</i> (Spencer) <i>Pseudonapomyza atra</i> (Meig.) <i>Cerodontha oryzivora</i>	Tipulidae Agromyzidae
COLEOPTERA		
Root grub	<i>Alissonotum simile</i> Arrow <i>Anomala dimidiata</i> (Hope) <i>Anomala dimidiata</i> var. <i>barbata</i> Burm. <i>Anomala polita</i> Blanch. <i>Anomala rugosa</i> Arrow <i>Anomala varians</i> (Oliv.) <i>Adoretus caliginosus</i> Burm. <i>Heteronychus lioderes</i> Redt. <i>Heteronychus poropygus</i> Bates <i>Holotrichia consanguinea</i> Blanch. <i>Holotrichia longipennis</i> Blanch. <i>Holotrichia</i> sp. nr. <i>reynaudi</i> <i>Holotrichia seticollis</i> Moser <i>Eutheola rugiceps</i> (Lec.) <i>Phyllognathous dimysinus</i> (F.) <i>Popillia cupricollis</i> Hope <i>Popillia schizonychia</i> Arrow <i>Xylotrupes gideon</i> (Linn.)	Scarabaeidae
Black beetle		
Bhatula beetle		
White grub		
Pollen beetle	<i>Oxycetonia albopunctata</i> Fb. <i>Ora picta</i> (F.)	Cetoniidae Dascillidae
Flower beetle	<i>Cryptocephalus ovalum</i> Suffrian <i>Cryptocephalus sehestedtii</i> Fb.	Cryptocephalidae
Leaf beetle	<i>Chaetocnema</i> sp. <i>Chaetocnema basalis</i> Baly. <i>Chaetocnema concipennis</i> Baly. <i>Ligyris rugiceps</i> Lec. <i>Luperodes</i> sp. <i>Phyllotreta chotonica</i> Quv. <i>Altica caerulea</i> Oliv.	
Flea beetle	<i>Oides affinis</i> Jac.	Galerucidae
Spotted leaf beetle		

Table 1. Contd.,

Common name	Scientific name	Family
Leaf beetle	<i>Phidodonta modesta</i> Wied.	Chrysomelidae
Rice hispa	<i>Dicladispa armigera</i> (Oliv.) <i>Dactylispa dilaticornis</i> Duv. <i>Hispa stygia</i> (Chapuis)	Hispidae
Paddy leptispa	<i>Leptispa pygmaea</i> Baly <i>Rhadinosa lebhongensis</i> Maulik	
Earhead beetle	<i>Cyaneolytta actaeon</i> (Lap.) <i>Cylindrothorax ruficollis</i> (Fab.) <i>Cylindrothorax tenuicollis</i> Pall. <i>Epicauta hirticornis</i> Haag.	Meloidae
Grey blister beetle	<i>Epicauta hirtipes</i> Waterh.	
Blister beetle	<i>Lytta ruficollis</i> Ol. <i>Mylabris macilentas</i> Mars. <i>Mylabris phalerata</i> Thunb. <i>Psalydolytta rouxi</i> (Lap.)	
Corn sap beetle	<i>Carpophilus dimidiatus</i> (Fabricius)	Nitidulidae
Dried fruit beetle	<i>Carpophilus hemipterus</i> (L.) <i>Donacia aeraria</i> Baly.	Donaciidae
Pollen beetle	<i>Alesia discolor</i> F. <i>Alesia univittata</i> Hope	Coccinellidae
Khapra beetle	<i>Trogoderma granarium</i> (Everts.)	Dermestidae
Lesser grain borer	<i>Rhyzopertha dominica</i> (Fb.)	Bostrychidae
Cadelle	<i>Tenebroides mauritanicus</i> (Linn.)	Ostomatidae
Flat grain beetle	<i>Laemophloeus minutus</i> Oliv. <i>Cryptolestes pusillus</i> (Schonherr) <i>Cryptolestes ferrugineus</i> (Stephens)	Cucujidae
Rusty grain beetle	<i>Oryzaephilus surinamensis</i> Linn.	Silvanidae
Saw toothed grain beetle	<i>Alphitobius piceus</i> Oliv.	Tenebrionidae
Lesser mealworm	<i>Arthrodeis</i> sp.	
Root grub	<i>Gonocephalum</i> spp.	
False wireworm	<i>Latheticus oryzae</i> Waterhouse	
Flour beetle	<i>Palorus ratzeburgii</i> (Wissmann)	
Small eyed flour beetle	<i>Tenebrio molitor</i> Linn.	
Yellow mealworm	<i>Tribolium castaneum</i> Hebst.	
Red flour beetle	<i>Tribolium confusum</i> J. du Val <i>Thorictodes heydeni</i>	Thorictidae
Confused flour beetle	<i>Alcidodes fabricii</i> F. <i>Athesapeuta oryzae</i> Mshl. <i>Cyrtozemita</i> sp.	Curculionidae
Stem weevil	<i>Attactogaster inducens</i> (Walker) <i>Echinocnemus oryzae</i> Mshl. <i>Hydronomidius mollitor</i> Faust	
Rice root weevil	<i>Myllocerus blandus</i> Faust <i>Myllocerus dentifer</i> (F.) <i>Myllocerus discolor</i> Boh. <i>Manophyes</i> sp.1 <i>Manophyes</i> sp.2	
Grey weevil	<i>Phytoscaphus triangularis</i> (Oliv.) <i>Sitophilus oryzae</i> Linn.	
Root weevil	<i>Sitophilus granarius</i> (Linnaeus) <i>Tanymecus chloroleucus</i> Wied. <i>Tanymecus hispidus</i> Marshall	
Rice weevil	<i>Tanymecus indicus</i> Faust <i>Xanthochelus faunus</i> (Oliv.)	
Granary weevil	<i>Centrocorynus rufulus</i> Voss. <i>Centrocorynus scutellaris</i> (Gyll.)	Attellabidae

* From several sources including Ernst and Araujo (1986) and Centre for Overseas Pest Research (1982)

Table 2. Non-insect pests associated with rice crop in India*

Common name	Scientific name	Family
NEMATODA		
Rice stem nematode	<i>Ditylenchus angustus</i> (Butler) Filipjev	Anguinidae
Rice white-tip nematode	<i>Aphelenchoides besseyi</i> Christie <i>Aphelenchoides saprophilus</i> Franklin	Aphelenchoididae
Ring nematode	<i>Caloosia exilis</i> Mathur, Mathur & Handa <i>Caloosia heterocephala</i> Rao and Mohan Das <i>Criconemella onoensis</i> (Luc) Luc & Raski <i>Criconemella ornata</i> <i>Hemicriconemoides ecophilus</i> (Loos) Chitwood and Birchfield <i>Hemicriconemoides mangiferae</i> Siddiqui	Criconematidae
Rice cyst nematode	<i>Heterodera oryzae</i> Luc & Berdon <i>Heterodera oryzicola</i> Rao & Jayaprakash <i>Heterodera zae</i> Koshy, Swarup & Sethi	Heteroderidae
Spiral nematodes	<i>Helicotylenchus abanaamai</i> Siddiqi <i>Helicotylenchus crenicauda</i> Sher <i>Helicotylenchus crenatus</i> Das <i>Helicotylenchus dishystera</i> (Cobb) Sher. <i>Helicotylenchus indicus</i> Siddiqi <i>Helicotylenchus pseudorobustus</i> (Steiner) Golden <i>Helicotylenchus pterocercus</i> <i>Helicotylenchus trivandranus</i> Mohan Das <i>Rotylenchus secundus</i> Mulk. & Jairajpuri	Hoplolaimidae
Lance nematodes	<i>Hoplolaimus columbus</i> Sher <i>Hoplolaimus indicus</i> Sher	
Needle nematodes	<i>Paralongidorus beryllus</i> Siddiqi & Hussein <i>Paralongidorus citri</i> (Siddiqi) Siddiqi, Hopper & Khan <i>Siddiqia boshi</i> <i>Siddiqia citri</i> (Siddiqi) Khan, Chawla & Saha	Longidoridae
Root-knot nematodes	<i>Meloidogyne</i> sp. <i>Meloidogyne graminicola</i> Golden & Birchfield <i>Meloidogyne javanica</i> (Treub) Chitwood	Meloidogynidae
Reniform nematode	<i>Rotylenchulus reniformis</i> Linford & Olieveria <i>Boleodoroides oryzae</i> Mathur, Khan & Prasad	Nacobbiidae Nothotylenchidae
Pin nematode	<i>Gracilacus janai</i> Bagri	Paratylenchidae
Rice root nematodes	<i>Hirschmanniella gracilis</i> (de Man) Luc & Goodey <i>Hirschmanniella mangalorensis</i> Mathur & Prasad <i>Hirschmanniella mucronata</i> Das (Luc & Goodey) <i>Hirschmanniella oryzae</i> (Van Breda De Haan) Luc & Goody <i>Hirschmanniella shamimi</i> Ahmad <i>Pratylenchus coffeae</i> (Zimmerman) Filipjev & Sch. Stek <i>Pratylenchus thornei</i> Sher & Allen <i>Pratylenchus zae</i> Graham	Pratylenchidae
Root-lesion nematode	<i>Paratrichodorus porus</i> (Allen) Siddiqi	Trichodoridae
Stubby root nematode	<i>Tylenchorhynchus annulatus</i> (Cassidy) Golden <i>Tylenchorhynchus mashhoodi</i> Siddiqi & Basir <i>Tylenchorhynchus brassicae</i> Siddiqi <i>Tylenchorhynchus vulgaris</i> Upadhyay, Swarup & Sethi <i>Tylenchorhynchus zae</i> Sethi & Swarup	Tylenchorhynchidae
Stunt or stylet nematodes	<i>Xiphinema elitum</i> Khan, Chawla & Saha <i>Xiphinema insigne</i> Loos <i>Xiphinema orbium</i> Siddiqi	Xiphinemidae
ACARINA		
Flour mite	<i>Acarus siro</i> Linnaeus	Acaridae
Seedling mite	<i>Caloglyphus berlesii</i> Michael	
White mite	<i>Tyrophagus palmarum</i> Oudemans	
Spider mite	<i>Oligonychus indicus</i> (Hirst) <i>Oligonychus manishi</i> Gupta	Tetranychidae

Table 2. Contd..

Common name	Scientific name	Family
Paddy mite	<i>Oligonychus oryzae</i> (Hirst)	
Cereal mite	<i>Schizotetranychus andropogoni</i> (Hirst)	
	<i>Schizotetranychus masoni</i> Gupta	
Sheath mite	<i>Ogmotarsonemus</i> sp.	Tarsonemidae
	<i>Steneotarsonemus spinki</i> Smiley	
Tarsonemid mite	<i>Tarsonemus</i> sp.	
Flour mite	<i>Chelacaropsis moorei</i> Baker	Cheyletidae
Eriophyid mite	<i>Cheiracus sulcatus</i> Keifer	Rhyncaphytoptidae
Soil mite	<i>Ololaelaps holaspis</i>	Laelaptidae
Oribatid mite	<i>Scheloribates zealandicus</i>	Oribatulidae
ANNELIDA		
Earthworms	<i>Malabaria paludicola</i> Stephenson	Ocnerothrilidae
	<i>Malabaria sulcata</i> Gates	
	<i>Aphanascus oryzivorus</i>	
	<i>Criodrilus lacuim</i> Hoffmstr.	Lumbricidae
	<i>Drawida pellucida</i>	Honilligastridae
GASTROPODA		
Snails	<i>Indoplanorbis exustus</i> (Deshayes)	Bulinidae
	<i>Lymnea acuminata</i> L.	Lymnaeidae
	<i>Pila globosa</i> (Swainson)	Ampullariidae
	<i>Pila polita</i> Deshayes	
	<i>Pila virens</i> L.	
	<i>Viviparus variatus</i> F.	Viviparidae
	<i>Crytozona belangiri</i> Deshayes	
CRUSTACCEA:BRACHIOPODA		
Tadpole shrimps	<i>Triops cancriformis kashmirensis</i>	
	<i>Triops granarius</i>	
MALACOSTRACA		
Field crabs	<i>Geacarcinucus jacquemonti</i> M.E.	Gecarinidae
	<i>Paratelfusa guerini</i> M.E.	
	<i>Paratelfusa jacquemontii</i> Rathb.	
	<i>Paratelfusa hydrodromus</i> Herbst.	
	<i>Paratelfusa spinigera</i> Wood-Mason	
	<i>Paratelfusa sexpunctatum</i>	
	<i>Paratelfusa mansoniana</i>	
	<i>Paratelfusa napae</i>	
	<i>Potamon martensi</i> Wood-Manson	Potamonautidae
MAMMALIA		
Rhesus monkey	<i>Macaca mulatta</i> Zimmerman	Cercopithicidae
Elephant	<i>Elephas maximus</i>	
Indian wild boar	<i>Sus scrofa</i> L.	
PISCES		
Eel Fish	<i>Ophichthys boro</i> H.	
RODENTIA		
Lesser bandicoot	<i>Bandicota bengalensis</i> (Gray and Hardwicke)	
Grass rat	<i>Millardia meltda</i> (Gray)	
Gerbil rat	<i>Tatera indica</i> H.	
Indian field mouse	<i>Mus booduga</i> (Gray)	
AVES		
Rufostailed Finch Lark	<i>Ammomanes phoenicurus</i> Franklin	Alaudidae
Pintail	<i>Anas acuta</i> Linnaeus	Anatidae
Common Teal	<i>Anas crecca</i> Linnaeus	
Wigeon	<i>Anas penelope</i> Linnaeus	
Mallard	<i>Anas platyrhynchos</i> Linnaeus	
Spotbill duck	<i>Anas poecilorhyncha</i> J.R.Forster	
Garganey	<i>Anas querquedula</i> Linnaeus	
Gad wall	<i>Anas strepers</i> Linnaeus	

Table 2. Contd.,

Common name	Scientific name	Family
Vakta or Comb Duck	<i>Sarkidiornis melanotus</i> (Pennant)	
Blue Rock Pigeon	<i>Columba livia</i> Gmelin	Columbidae
Purple Wood Pigeon	<i>Columba punicea</i> Blyth	
Spotted Dove	<i>Streptopelia chinensis</i> (Scopoli)	
Ring Dove	<i>Streptopelia decaocto</i> (Frisvaldszky)	
Rufous Turtle Dove	<i>Streptopelia orientalis</i> (Latham)	
Little Brown dove	<i>Streptopelia senegalensis</i> (Linnaeus)	
Red Turtle Dove	<i>Streptopelia tranquebarica</i> (Hermann)	
Lesser Whistling Teal	<i>Dendrocygna javanica</i> (Horsfield)	Dendrocygnidae
Yellow breasted Bunting or Golden Bunting	<i>Emberiza aureola</i> Pallas	
Pine bunting	<i>Emberiza leucocephala</i> Gmelin	
Black headed Bunting	<i>Emberiza melanocephala</i> Scopoli	
Masked Bunting	<i>Emberiza spodocephala</i> Pallas	
Demoiselle Crane	<i>Anthropoides virgo</i> (Linnaeus)	Gruidae
Common Crane	<i>Grus grus</i> (Linnaeus)	
Red Munia	<i>Estrilda amandava</i> (Linnaeus)	Passeridae
Rufous bellied Munia	<i>Lonchura kelaarti</i> (Jerdon)	
White-throated Munia	<i>Lonchura malabarica</i> (Linnaeus)	
Black headed Munia	<i>Lonchura malacca</i> (Linnaeus)	
Spotted Munia	<i>Lonchura punctulata</i> (Linnaeus)	
Whitebacked Munia	<i>Lonchura striata</i> (Linnaeus)	
Java Sparrow	<i>Padda oryzivora</i> (Linnaeus)	
House Sparrow	<i>Passer domesticus</i> (Linnaeus)	
Yellow throated Sparrow	<i>Petronia xanthocollis</i> (Burton)	
Black throated Weaver Bird	<i>Ploceus benghalensis</i> (Linn.)	
Streaked Weaver Bird	<i>Ploceus manyar</i> (Horsfield)	
Finn's Baya	<i>Ploceus megarhynchos</i> Hume.	
Baya Weaver Bird	<i>Ploceus philippinus</i> (Linnaeus)	
Grey Quail/Common Quail	<i>Coturnix coturnix</i> (Linnaeus)	Phasianidae
Swamp Partridge	<i>Francolinus gularis</i> (Temminck)	
Grey Partridge	<i>Francolinus pondicerianus</i> (Gmelin)	
Common Peafowl	<i>Pavo cristatus</i> Linnaeus	
Indian Redbreasted Parakeet	<i>Psittacula alexandri</i> (Linnaeus)	Psittacidae
Blossomheaded Parakeet	<i>Psittacula cyanocephala</i> (Linnaeus)	
Large Indian Parakeet	<i>Psittacula eupatria</i> (Linnaeus)	
Rose ringed Parakeet	<i>Psittacula krameri</i> (Scopoli)	
Whitebreasted Waterhen	<i>Amaurornis phoenicurus</i> (Pennant)	Rallidae
Coot	<i>Fulica atra</i> Linnaeus	
Watercock or Kora	<i>Gallicrex cinerea</i> (Gmelin)	
Indian Moorhen	<i>Gallinula chloropus</i> (Linnaeus)	
Purple Moorhen	<i>Porphyrio porphyrio</i> (Linnaeus)	
Water Rail	<i>Rallus aquaticus</i> L.	
Painted Snipe	<i>Rostratula benghalensis</i> (Linnaeus)	Rostratulidae
Ruff and Reeve	<i>Philomachus pugnax</i> (Linnaeus)	Scolopacidae
Indian Myna	<i>Acridotheres tristis</i> (Linnaeus)	Sturnidae
Rosy Pastor	<i>Sturnus roseus</i> (Linnaeus)	

* From several sources including Jairajpuri and Baqri (1991) and Salim Ali and Dillon Ripley (1989).

(Muthuswami, 1988). Also normally gall midge infestation does not occur beyond panicle initiation stage of crop growth, but recently it has been found to attack the crop even at the flowering stage (Rajamani *et al.*, 1979). Until the 1960s, the stemborers especially *Scirpophaga incertulas* (Walker) were generally considered the most

serious pests of rice throughout India. However, even though still a serious pest, the damage by stemborers seems to have somewhat declined in recent years and is attributed to the introduction of high yielding varieties, at least in Punjab (Dhaliwal, 1980). Another reason postulated is that the larvae of stemborers aestivate in stubbles and

Table 3. Recent changes in overall status of rice pests*

MAJOR PESTS	
Increased severity	
Brown planthopper, Whitebacked planthopper, Green leafhopper, Gall midge	
Some decline in importance	
Stem borer, Rice hispa (except North Eastern states)	
MINOR PESTS	
Becoming major problem	
Leaf folder, Whorl maggot, Thrips, Caseworm, Armyworm, Cutworm, Blackbug	
New records in certain areas	
Smaller brown planthopper, Leaf miners, Aphids, Planthoppers, Grasshoppers Earthworms, Tadpole shrimps, Eel fish, Grey blister beetle, Mirids, Oribatid mites	
New records as rice pests	
Sugarcane leafhopper, Rusty plum aphid, Cauliflower stunt nematode	

* Adapted from Pathak and Dhaliwal (1980)

are destroyed by the dry season land preparation. for the change in the insect pest fauna in rice
Crop intensification has been suggested as a reason (Loevinsohn, 1985). Intensification involves (1) an

Table 4. Status of rice pests in different states (Chelliah *et al.*, 1989)

Pest	Intensity	Occurrence (States)
Major Pests		
Gall Midge	Severe	Madhya Pradesh, Orissa
	Moderate to severe	Bihar, Karnataka, Kerala, Uttar Pradesh, West Bengal, Andhra Pradesh
Leaf folder	Moderate to severe	Andhra Pradesh, Kerala, Maharashtra, Punjab, Tamil Nadu
	Light to moderate	Assam, Bihar, Gujarat, Haryana, Jammu and Kashmir, Karnataka, Madhya Pradesh, Orissa, Punjab, Uttar Pradesh, West Bengal
Brown planthopper	Moderate to severe	Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Orissa, Tamil Nadu.
	Low to moderate	Assam, Maharashtra, Rajasthan, Uttar Pradesh
Green leafhopper	Moderate to severe	Andhra Pradesh, Madhya Pradesh, Tamil Nadu.
	Low to moderate	Assam, Bihar, Gujarat, Himachal Pradesh, Jammu and Kashmir, Uttar Pradesh, West Bengal.
Yellow stem borer	Severe	Maharashtra
	Moderate to severe	Andhra Pradesh, Kerala, Madhya Pradesh, Orissa
	Low to moderate	Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.
Minor Pests		
Whitebacked planthopper	Moderate to severe	Madhya Pradesh, Punjab, Uttar Pradesh
	Light to Moderate	Bihar, Gujarat, Haryana, Himachal Pradesh, Orissa
Hispa	Moderate to severe	Assam, Himachal Pradesh, West Bengal
	Light to moderate	Bihar, Gujarat, Haryana, Madhya Pradesh, Orissa, Punjab, Uttar Pradesh
Earhead bug	Light to moderate	Bihar, Gujarat, Haryana, Madhya Pradesh, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal
Armyworm	Light to moderate	Bihar, Gujarat, Maharashtra, Punjab
Sporadic Pests		
Caseworm		Kerala, Orissa, Tamil Nadu
Cutworm		Uttar Pradesh
Grasshopper		Maharashtra
Thrips		Kerala, Tamil Nadu
Root weevil		Bihar

increase in the number of crops grown per year. (2) an increase in the use of agricultural chemicals (fertilizers and pesticides) (3) planting of varieties responsive to fertilizers and pesticides, and (4) increased plant densities.

In addition, there are new records of many insect and non-insect pests in several areas indicating the increasing severity of the pest problems. For example, the smaller brown planthopper, *Laodelphax striatellus* Fallen, which is a severe pest of rice in Japan and Korea, has also been recently recorded from India (Shukla, 1979). A few other examples of new pests include a planthopper, *Unkanodes sapporonus* (Misra, 1975) and an aphid, *Tetraneura radicola* (Rai, 1975). Several others viz., sugarcane pyrrilla (Sukhani, 1971), rusty plum aphid, *Carolinaia (Hysteroneura) setariae* (Garg and Sethi, 1976), painted bug, *Bagrada cruciferarum* Kirkaldy (Sandhu, 1975), hairy caterpillar, *Leonodra vittata* Wik. (Rai and Gavi Gowda, 1975), *Cryptoblabes gnidiella* (Sasmal and Kulshreshtha, 1985) and field cricket, *Euscyrtus concinnus* Hanu (Sasidharan Pillai and Saradamma, 1979), hitherto unknown to attack rice were recently recorded infesting rice in our country. The status of important rice pests in different rice growing states in India is presented in Table 4 (Chelliah *et al.*, 1939).

With the pest status of most of the rice associated organisms still uncertain, it is imperative on the part of the rice entomologists to concentrate on the insect diversity of the rice crop before rice is tampered with by the biotechnologists. It is futile for the entomologists to manipulate the rice crop with toxin genes and inhibitor genes without attempting to know the ecological niche of the organisms associated with it.

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MORPHOLOGICAL, CULTURAL, PHYSIOLOGICAL AND NUTRITIONAL STUDIES OF NEW *Fusarium* WILT PATHOGEN OF BRINJAL

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ABSTRACT

A new species of *Fusarium* causing wilt on brinjal was identified as *F.oxysporum* f.sp. *melongenae* on the basis of morphological, cultural, physiological and nutritional studies. The fungus produces hyaline, septate, cottony white to pink mycelium. The macroconidia were oval, hyaline, mostly non-septate or with a single septa. The pathogen produces abundant pale brown chlamydo spores either singly or in chains. Richard's agar as well as potato dextrose agar medium was the basal medium for growth and sporulation of the fungus. It utilises glucose, sucrose, lactose, xylose, sorbitol and dextrin as a carbon sources while potassium and ammonium nitrate as a nitrogen sources. The optimum temperature and pH for the growth of fungus was $28 \pm 1^\circ\text{C}$ and 5.7 respectively whereas the thermal death point for the fungus was 59 to 60°C .

KEY WORDS : *Fusarium*, wilt pathogen, brinjal

Brinjal (*Solanum melongena* L.) is one of the most important vegetable crops grown throughout India. Among various pathogens infecting brinjal, *Fusarium* wilt is a serious one. The various species of *Fusarium* infecting brinjal are *F.oxysporum* Schl. (Ganacharya and Wankar, 1976), *F.solani* (Fournet and Jacqua, 1978) and a recently identified *F.oxysporum* f.sp. *melongenae* in India (Mandhare et al. 1989). However, causal agent of wilt of brinjal was first reported in the Netherlands (Steekelenbug and Van, 1976). Though the morphological, cultural, physiological and nutritional aspects of these various species are known, there is no literature on newly identified

F.oxysporum f. sp. *melongenae*. It was, therefore, studied and presented herewith.

MATERIALS AND METHODS

Morphological studies

The *Fusarium* cultures used under study were obtained from single spore isolation. To determine size of conidia/chlamydo spores, one hundred spores were measured under high power (45 X) using micrometers.

Cultural studies

Culture media viz., potato dextrose agar, Richards' agar, Ashbys' agar, oat meal agar,