

Integrating traditional knowledge and field monitoring to assess insect pest tolerance in indigenous rice varieties of Wayanad, Kerala

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Supplementary Data

Supplementary Table S1 — Agronomic traits and pest tolerance of traditional rice varieties documented from farmers in Wayanad, Kerala

Rice variety	Pest tolerance	Crop duration (days)	Grain yield (kg/acre)	Lodging	Aromatic	Straw yield (kg/acre)	Plant height	Farmer observations / notes
<i>Adukkan</i>	Yes	180	7600	Yes	No	7600	Medium	–
<i>Aanakomban</i>	Not known	150	1200	Yes	No	1000	Short	–
<i>Aayiramkana</i>	No	180	2200	No	No	3326	Medium	High tillering
<i>Aayiramkanni</i>	No	180	1600	No	No	600	Long	–
<i>Aayirammeni</i>	Yes	140	2000	No	No	2000	Long	–
<i>Chembakam</i>	Not known	120	200	Yes	No	1500	Medium	–
<i>Chembavu</i>	Not known	150	1500	Yes	No	2250	Short	–
<i>Chettu Veliyan</i>	Not known	180	1800	Yes	No	1200	Long	–
<i>Chenthadi</i>	Yes	170	750	Yes	No	1550	Medium	–
<i>Chennel Thondi</i>	Not known	150	1600	Yes	No	1000	Long	–
<i>Chennellu</i>	Yes	120	1512	Yes	No	1216	Long	–
<i>Chomala</i>	No	120	1233	Yes	No	1986	Long	Low armyworm damage
<i>Chuvanna Thondi</i>	Not known	120	800	Yes	No	1000	Short	–
<i>Edavaka</i>	Yes	130	2500	No	No	2500	Medium	–
<i>Gandhakasala</i>	No	150	825	Yes	Yes	1333	Long	High pest pressure including rice bug, stem borer, leaf folder
<i>Jeeraka Chembavu</i>	Not known	125	370	No	No	500	Short	–
<i>Jeerakasala</i>	No	145	960	Yes	Yes	1382	Long	Susceptible to leaf folder, birds, rodents
<i>Kaakisala</i>	Yes	110	–	No	Yes	–	Medium	Low tillering
<i>Kanakam</i>	Yes	150	1600	Yes	No	1000	Long	–
<i>Kanali</i>	Not known	130	200	Yes	No	1500	Medium	–
<i>Karimbalan</i>	Not known	150	1600	Yes	No	1000	Medium	–
<i>Karuthan</i>	Not known	120	1500	Yes	No	1000	Short	–
<i>Karutha Njavara</i>	Not known	120	800	No	No	1000	Short	–
<i>Kalladiyaaran</i>	Not known	120	1600	No	No	1000	Long	–
<i>Kavungin Poothali</i>	Yes	120	200	Yes	No	1500	Medium	–
<i>Kayama</i>	No	120	2500	No	No	1500	Short	–
<i>Kochuvithu</i>	No	145	961	Yes	Yes	1382	Long	Leaf folder, birds, rodents
<i>Kothambari Kayama</i>	Not known	120	800	No	No	1000	Short	–
<i>Kothandan</i>	Yes	155	925	Yes	No	6100	Long	–
<i>Kunnukulamban</i>	Not known	150	1000	No	No	800	Short	–

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Supplementary Table S1 — Agronomic traits and pest tolerance of traditional rice varieties documented from farmers in Wayanad, Kerala (Contd.)

Rice variety	Pest tolerance	Crop duration (days)	Grain yield (kg/acre)	Lodging	Aromatic	Straw yield (kg/acre)	Plant height	Farmer observations / notes
<i>Kunjicheera</i>	Not known	150	1800	No	No	1000	Short	–
<i>Kunjoonji</i>	Not known	150	1800	No	No	1000	Short	–
<i>Kunjootti</i>	No	210	1600	No	No	1400	Long	–
<i>Kurumbali</i>	Not known	150	1600	Yes	No	1000	Long	–
<i>Kuruva</i>	Not known	150	1600	No	No	1000	Short	–
<i>Kuruvatti</i>	Yes	125	3000	No	No	1800	Long	Resistant to <i>Leptocorisa oratorius</i>
<i>Kutti Veliyan</i>	Yes	160	800	Yes	No	820	Long	–
<i>Mannu Veliyan</i>	Yes	155	1500	Yes	No	800	Medium	–
<i>Marathondi</i>	Yes	140	1533	Yes	No	2066	Long	Post-harvest pest issues
<i>Mullan Channa</i>	Yes	120	650	Yes	Yes	650	Short	–
<i>Mullan Kayama</i>	Not known	170	825	Yes	Yes	1225	Long	Bacterial/fungal tolerance
<i>Mullan Punja</i>	Not known	130	1600	Yes	No	1280	Medium	–
<i>Njavara</i>	Yes	70	1600	No	No	6600	Short	Resistant to <i>Leptocorisa oratorius</i> , leaf folder
<i>Onamottan</i>	Not known	120	1500	Yes	No	10000	Long	–
<i>Pal Kayama</i>	Not known	150	800	No	No	700	Short	–
<i>Pal Thondi (Matta)</i>	No	120	1115	Yes	No	1800	Medium	–
<i>Pal Thondi (Vella)</i>	Yes	170	750	Yes	No	1550	Medium	–
<i>Peruvaazha</i>	Not known	150	1000	Yes	No	1500	Short	–
<i>Punnaadan Thondi</i>	Not known	150	1500	Yes	No	1000	Short	–
<i>Thaichingan</i>	Yes	140	600	Yes	No	2000	Medium	–
<i>Thondi</i>	Yes	120	1040	Yes	No	1770	Medium	–
<i>Thonmuram Thondi</i>	Not known	120	1500	Yes	No	1000	Short	–
<i>Urunikayama</i>	Not known	150	1200	Yes	Yes	3200	Long	–
<i>Valiya Chennellu</i>	Yes	150	2000	Yes	No	1400	Long	–
<i>Vasumathi</i>	Not known	120	1600	No	No	1000	Long	–
<i>Veliyan</i>	Yes	180	1030	Yes	No	1635	Medium	Tolerant to yellow stem borer, leaf folder, and rice bug
<i>Velumbala</i>	Yes	180	1266	Yes	No	1700	Long	–
<i>Vellathooval</i>	Yes	120	1600	Yes	No	–	Long	–
<i>Velli Muthu</i>	Not known	150	1600	Yes	No	1000	Long	–
<i>Vethandam</i>	Not known	150	1600	Yes	No	2250	Short	–

Supplementary Table S2 — Folk taxonomy and justification of vernacular names of rice pests in Wayanad, Kerala

Scientific Name	Vernacular Name(s)	Literal Meaning / Translation	Justification of Name
<i>Ampittia dioscorides</i>	<i>Pacha Puzhu, Ponthachadan</i>	Green worm, bush-jumper	Adult seen jumping between bushes; “ <i>pontha</i> ” = bush, “ <i>chadan</i> ” = jumper.
<i>Cnaphalocrocis medinalis</i>	<i>Ila Churutti Puzhu, Olappuzhu</i>	Leaf-folding worm	Rolls/folds leaves to feed and pupate; “ <i>ila</i> ” = leaf, “ <i>churutti</i> ” = folded. “ <i>Ola</i> ” = leaf, “ <i>puzhu</i> ” = worm
<i>Dicladyspa armigera</i>	<i>Kaara Vandu</i>	Spiny beetle	Has hard, ridged (spiny) body; “ <i>Kaara</i> ” refers to rough texture.
<i>Euproctis</i> sp.	<i>Choriyan Puzhu</i>	Itch worm	Has long body hairs (setae)
<i>Helcystogramma arotraeum</i>	<i>Ila Churutti Puzhu</i>	Leaf-folding worm	Similar to <i>C. medinalis</i> , same leaf-folding behavior.
<i>Hieroglyphus banian</i>	<i>Pulchaadi, Pacha Thullan, Pacha Kuthira</i>	Grass-jumper, green jumper, green horse	Named for size, color, and jumping action; “ <i>Pulchaadi</i> ” = grass-jumper, “ <i>Kuthira</i> ” = horse.

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Supplementary Table S2 — Folk taxonomy and justification of vernacular names of rice pests in Wayanad, Kerala (Contd.)

Scientific Name	Vernacular Name(s)	Literal Meaning / Translation	Justification of Name
<i>Leptispa pygmaea</i>	<i>Ela Churutti Vandu</i>	Leaf-folder beetle	Feeds inside folded leaves; combines leaf-folding and beetle traits.
<i>Leptocorisa oratorius</i>	<i>Chaazhi</i>	Chaff pest	Sucks sap from grains causing them to be chaffy or unfilled.
<i>Melanitis leda ismene</i>	<i>Pacha Komban Puzhu</i>	Green horned worm / Pale worm	Green body with curved extensions; “ <i>komban</i> ” = horn-like projections.
<i>Mythimna separata</i>	<i>Pattala Puzhu</i>	Armyworm	“ <i>Pattalam</i> ” = army; named for group movement resembling marching army.
<i>Naranga aenescens</i>	<i>Pacha Puzhu</i>	Green worm	Generic name used for various green-colored larvae.
<i>Nilaparvata lugens</i>	<i>Munja</i>	Dry pest	Causes plant drying.
<i>Oxya hyla</i>	<i>Pulchaadi, Pacha Thullan, Pacha Kuthira</i>	Grass-jumper, green jumper, green horse	Reflects appearance and behavior — leaping, green, horse-like stature.
<i>Orsotriaena medus</i>	<i>Vella puzhu</i>	White worm	“ <i>Vella</i> ” = white, describes white coloration.
<i>Paraponyx stagnalis</i>	<i>Kuzhal Puzhu</i>	Pipe worm	Forms tubes in submerged stems; “ <i>Kuzhal</i> ” = pipe.
<i>Parnara sp.</i>	<i>Ila Madakki, Pacha Puzhu</i>	Leaf roller, green worm	Rolls leaves during larval stage; “ <i>madakki</i> ” = rolled.
<i>Pelopidas agna</i>	<i>Ila Madakki, Pacha Puzhu</i>	Leaf roller, green worm	Same behavior as <i>P. bada</i> .
<i>Pelopidas mathias</i>	<i>Ila Madakki, Pacha Puzhu</i>	Leaf roller, green worm	Similar naming rationale due to identical feeding patterns.
<i>Scirpophaga incertulas</i>	<i>Thandu Thurappan, Chaazhi</i>	Stem borer	“ <i>Thandu</i> ” = stem, “ <i>Thurappan</i> ” = breaker; causes ‘dead heart’ symptom. “ <i>Chaazhi</i> ” = dry chaff; because of panicle damage symptoms are similar to <i>L. oratorius</i>
<i>Scirpophaga innotata</i>	<i>Thandu Thurappan, Chaazhi</i>	Stem borer	Identical damage and symptoms as <i>S. incertulas</i> .
<i>Spodoptera litura</i>	<i>Pattala Puzhu, Karutha Puzhu</i>	Armyworm / Dark caterpillar	Dark in color; “ <i>Karutha</i> ” = black. Moves in groups like an army.
<i>Spodoptera mauritia</i>	<i>Pattala Puzhu</i>	Armyworm	Shows similar armyworm behavior as <i>S. litura</i> .
<i>Trilophidia annulata</i>	<i>Thavittu Pulchaadi, Pulchaadi</i>	Brown grass-jumper	“ <i>Thavittu</i> ” = brown; “ <i>Pulchaadi</i> ” = grass-jumper, brownish coloration with sharp jumping reflex.

Supplementary Table S3 — Correspondence between farmer-identified (folk) pest names and validated scientific taxa recorded in Wayanad, Kerala. Matching based on morphology, feeding behaviour, and characteristic damage symptoms

Folk / Vernacular Name(s)	Scientific Name	Farmer-identified traits / damage symptoms	Scientific confirmation / reference
<i>Ila Churutti Puzhu / Ila Madakki</i>	<i>Cnaphalocrocis medinalis</i> (Rice Leaf Folder)	Folds/rolls leaves, feeds inside folded leaf, leaves show white streaks	Sarao & Mahal (2013); Pathak & Khan (1994)
<i>Thandu Thurappan / Chaazhi</i>	<i>Scirpophaga incertulas</i> (Yellow Stem Borer)	Dead-heart/dried central shoot; white chaffy grains at maturity	Pathak & Khan (1994); Conde <i>et al.</i> (2025)
<i>Chaazhi</i>	<i>Leptocorisa oratorius</i> (Rice Earhead Bug)	Unfilled grains, bad odour from panicles, grains shrivel	Pathak & Khan (1994)
<i>Pulchaadi / Pacha Kuthira</i>	<i>Oxya hyla</i> (Rice Grasshopper)	Green coloured, jumps when disturbed, feeds on leaves	Sreejina <i>et al.</i> (2025)
<i>Pattala Puzhu / Karutha Puzhu</i>	<i>Spodoptera litura</i> (Armyworm)	Moves in groups, defoliation, dark body colour	Muralikrishnan <i>et al.</i> (2021)
<i>Vella Puzhu</i>	<i>Orsotriaena medus</i> (Rice white caterpillar)	White body caterpillar feeding on leaves	Field observation + expert confirmation
<i>Kuzhal Puzhu</i>	<i>Paraponyx stagnalis</i> (Rice Caseworm)	Tubular case on submerged stems, strips leaf surface	Pathak & Khan (1994)
<i>Karutha Puzhu</i>	<i>Spodoptera mauritia</i>	Blackish body, severe leaf feeding, “army-like” movement	Literature + field match
<i>Pacha Komban Puzhu</i>	<i>Melanitis leda ismene</i>	Green larva with horn-like projections	Pathak & Khan (1994)
<i>Kaara Vandu</i>	<i>Dicladyspa armigera</i> (Rice Hispa)	Shiny metallic beetle; scraping “windowpane” damage on leaves	Conde <i>et al.</i> (2025)
<i>Ila Churutti Vandu</i>	<i>Leptispa pygmaea</i>	Beetle but causes leaf folding/rolling	Sreejina <i>et al.</i> (2025)
<i>Pacha Puzhu</i>	Multiple larvae (e.g. <i>Naranga aenescens</i>)	Generic name for green caterpillars feeding on leaves	Cross-verification with entomologists

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Supplementary Table S3 — Correspondence between farmer-identified (folk) pest names and validated scientific taxa recorded in Wayanad, Kerala. Matching based on morphology, feeding behaviour, and characteristic damage symptoms (Contd.)

Folk / Vernacular Name(s)	Scientific Name	Farmer-identified traits / damage symptoms	Scientific confirmation / reference
<i>Olappuzhu</i>	<i>Cnaphalocrocis medinalis</i>	Leaf folding and feeding from inside	Same as above
<i>Chaazhi</i>	<i>Nilaparvata lugens</i> / <i>Scirpophaga</i> spp.	Drying of grains or stem → empty grains; pest damage seen as “dry husk”	Pathak & Khan (1994); farmer logic
<i>Pattala Puzhu</i>	<i>Mythimna separata</i>	Gregarious feeding, marching behaviour	Pathak & Khan (1994)

Supplementary Table S4 — Farmer-Identified Indicators of Pest Tolerance / susceptibility in Traditional Rice Varieties

Indicator / Trait	Description / Farmer observation	Associated varieties	Pests Targeted / Effect
Field Experience Over Time	Tolerance judged based on long-term field performance	<i>Edavaka, Marathondi</i>	General pest tolerance
Visible Damage Assessment	Leaf or grain damage used to rate susceptibility or tolerance	<i>Chomala</i>	Leaf folders, stem borers, earhead bugs
Recovery Post-Infestation	Varieties showing regrowth (e.g., tillering) seen as more resilient	<i>Veliyan, Aayiramkana</i>	General resilience
Morphological Traits	Height, deep rooting, high tillering linked to tolerance	<i>Thondi, Chenthadi, Gandhakasala, Jeerakasala, Chomala</i>	General tolerance, long stem cause susceptibility to stem borer
Multiple Stress Tolerance	Varieties resilient to both pest and abiotic stress (drought, salinity)	<i>Veliyan, Thondi</i>	Combined pest and environmental stress tolerance
Low Pest Incidence History	Consistently low pest presence across seasons	<i>Edavaka, Kanakam</i>	Broad pest avoidance
Community Knowledge Sharing	Knowledge passed through farmer networks	<i>Edavaka, Marathondi, Thondi</i>	Local experience-based selection
Ecological Adaptation	Better performance in specific agro-ecologies	<i>Veliyan</i> (flood-prone), <i>Kalladiyaaran</i> (drought-prone)	Environment-linked pest avoidance
Leaf Texture / Toughness	Leathery or thick leaves discourage larval feeding or oviposition	—	Tolerance to leaf folders, leaf rollers
Aroma / Odor Characteristics	Natural aroma believed to interfere with pest host location	<i>Jeerakasala, Gandhakasala</i>	Attractant to rice bugs
Crop Duration / Maturity	Early or uniform maturity helps escape pest peaks	<i>Thondi</i>	Stem borers, brown planthopper (BPH), leaf folders
Healthy leaf / Glossiness	Glossy or healthy leaf appearance linked with fewer pest attacks	—	General tolerance
Leaf color	Purple colored leaves susceptible to pest attack	<i>Nasar bath, Kalabathi</i>	Susceptible to leaf folders, hairy caterpillars (<i>Psalis pennatula</i>)
Stem Strength / Tillers	Robust stems resist dead heart and damage from borers	—	Stem borers (e.g., <i>Scirpophaga incertulas</i>)
Natural Predator Presence	Observed presence of spiders, ants, and other predators	—	Ecological pest suppression
Relative Pest Avoidance	Some varieties attacked less despite proximity to susceptible types	<i>Kanakam, Velumbala</i>	General repellency
Symptom-Based Identification	Recognition of pest presence via leaf folds, empty grains, or damaged tissues	—	Used as a diagnostic approach for susceptibility or tolerance



Supplementary Fig. S1 — Common rice insect pests in Wayanad, (1) *Ampittia dioscorides* (adult), (2) *A. dioscorides* (larva), (3) *Cnaphalocrocis medinalis* (Adult), (4) *C. medinalis* (larva), (5) *Helcystogramma arotraeum*, (6) *Leptocorisa oratorius*, (7) *Paraponyx stagnalis*, (8) *Hieroglyphus banian*, (9) *Oxyahyla*, (10) *Scirpophaga innotata*, (11) *Orsotriaena medus* (Adult), (12) *O. medus* (larva), (13) *Parnara* sp. (Adult), (14) *P. bada* (larva), (15) *Spodoptera mauritia* (larva), (16) *S. Mauritia* (adult), (17) *Naranga aenescens*, (18) *Melanitis leda ismene* (larva), (19) *M. leda ismene* (adult), (20) *Euproctis* sp., (21) *Pelopidas agna* (larva), (22) *P. agna* (adult), (23) *Mythimna separata*, (24) *Scirpophaga incertulas*, (25) *Dicladispa armigera* (larva), (26) *Spodoptera litura* (adult), (27) *S. litura* (larva), (28) *Leptispa pygmaea*, (29) *Pelopidas mathias* (adult), (30) *P. mathias* (larva)