

BIOLOGICAL CONTROL OF PADDY PESTS IN SRI LANKA

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The need for pest control arose with the beginnings of agriculture. Even in ancient times some biological methods were practised, such as the plant-derived chemicals and insect predators used to regulate pests in China (Flint and van den Bosch 1981). In Sri Lanka, the need for biological control of paddy pests is felt chiefly due to the following problems arising out of control measures adopted currently.

Direct chemical control has led to certain drawbacks such as increasing resistance to insecticides by rice pests, destruction of useful natural insect fauna and unnecessary contamination leading to health hazards.

The concentration of the present rice breeding programme towards high yielding rice varieties has resulted in the replacement of a wide range of indigenous rice cultivars with a few high yielding rice varieties, thus narrowing the genetic basis of resistance, and increasing susceptibility to rice pests.

Improvement of fertilizer and irrigation practices, regardless of ecological interactions with other aspects of the rice crop, has made the rice crop more suitable for pest build-up.

Introduction of short age varieties and staggered cultivation have ensured pests with a continuing habitat for regular build up of populations.

INSECT PESTS OF THE RICE CROP

At present the insect pests of irrigated rice in Sri Lanka could be listed as major and occasional as follows.

Major Pests:

1. The yellow stemborer, Tryporyza incertulas (Walker)
2. The leaf folder, Cnaphalocrocis medinalis Guenee
3. The paddy gall midge, Oiseolia oryzae (Wood-Mason)
4. The brown planthopper, Nilaparvata lugens (Stal)
5. The rice leafhopper complex:
Nephotettix virescens (Distant)
Nephotettix nigropictus (Stal)
Nephotettix impicticeps Ishihara
Tettigella spectra (Distant)
Inazuma dorsalis (Motschulsky)
6. The rice thrip, Baliothrips biformis (Bagn.)
7. The paddy bug, Leptocoris varicornis Fabricius

Occasional Pests:

1. The stemfly, Atherigona exigua Steiner
2. The whorl maggot, Hydrellia sp.
3. The case bearer, Nymphula depunctalis Guenee
4. The leaf eating caterpillar complex: Spodoptera mauritia Boisduval
Borolia venalba Moore
5. Paddy black bug, Scotinophora lurida Burmeister.

THE PRESENT CONTROL PROGRAMME: HOW IT RELATES TO BIOLOGICAL CONTROL

To consider how the present control programme of paddy pests in Sri Lanka may be extended to include biological control, the following factors are relevant.

1. The availability of knowledge and information on major rice pests.

a) Taxonomy: Information on this aspect is fairly well established and at present work on such aspects as the biotypes of O. oryzae and N. lugens is being conducted.

b) General biology: The knowledge presently available is of a satisfactory standard.

2. Forecasting systems and Economic Injury Levels:

a) There is no established forecasting system for rice pests in Sri Lanka at present. Though light trap surveys are being conducted, this is only at a preliminary level and the data available have not been integrated into a definite forecasting system. Some initial work utilizing pheromone traps is being carried out for the leaf folder, C. medinalis on an experimental basis.

No regular field assessment is being carried out and Economic Injury Levels have not been calculated. An exception is the field survey carried out during brown planthopper outbreaks to establish threshold levels.

SURVEY OF NATURAL ENEMIES

Yellow Stem Borer, Tryporyza incertulas

The yellow stem borer is a serious rice pest in Sri Lanka. It occurs at all stages of growth and is found in all types of the rice crop -- lowland, deepwater, floating and upland. It causes extensive damage and exhibits two kinds of symptoms:

i) dead heart: During vegetative growth stage, stem borer larvae bore into and feed in the leaf sheath, preventing formation of panicles:

ii) white head: Growing plant parts are severed after panicle initiation.

Fernando (1967) reported the following egg parasites in Sri Lanka: two Eulophidae, Tetrastichus schoenobii Fieriere and Tetrastichus israeli Mani and Kurian, one Scellionidae, Telenomus dignus Gahan, and an unidentified species of Trichogramma. T. israeli is rare and at best parasitizes 2% of the second brood of T. incertulas egg masses. Parasitization by T. schoenobii may be as much as 10% in the second brood of egg masses.

T. dignus is the most important egg parasite of T. incertulas in Sri Lanka, being an excellent searcher, and is responsible for approximately 85% parasitization in second brood egg masses, though concomitant loss of crop by T. incertulas to the extent of 20% has been sustained.

Rajapakse and Kulasekera (1980) also reported the following egg parasites of T. incertulas: Trichogramma minutum Riley, T. schoenobii, T. israeli and T. dignus. T. dignus was found on more than 65% of egg masses. Combined parasitization rates averaged 88% (range 77-99%) and were 71% in Dinipitiya, 81% in Matara, 81% in Ambalantota, 86% in Kamburupitiya and 97% in Kekanadura.

Larval parasites of T. incertulas recorded in Sri Lanka are three species of Braconidae: Apanteles flavipes Cameron, Apanteles schoenobii Wilkinson and Shirkia schoenobii Vierreck (dorsalis Matsumura), one Eulophidae, Aprotocetus sp. and an Ichneumonidae, Isocima sp. (Fernando 1967). Parasitization by these parasites, in general, is extremely low and no survey or evaluation of the relative importance of the parasites has yet been done.

Introduction of Telenomus beneficus Zehntner and a number of larval parasites may hold promise for control of T. incertulas.

Leaf folder, Cnaphalacrocis medinalis. The damage to the paddy plant is caused by the caterpillar which folds the leaf blade into tubular structures and feeds on the green leaf tissues within these structures. Usually only one caterpillar is found within each fold.

Rajapakse and Kulasekera (1982) reported the following parasites of C. medinalis in Sri Lanka, in and around the southern town of Matara: three Braconidae, Apanteles ruficus (Haliday), Apanteles flavipes (Cameron) and Microbracon hebetor Say, one Elasmidae, Elasmus sp. and a Tachinidae (Diptera), Bactromyia franssoni Bar. Parasitization rates were 38% in Denipitiya, 48% in Kamburupitiya, 53% in Matara, 60% in Hakmana and 70% in Malpana.

Paddy Gall Midge, Orseolia oryzae

The paddy gall midge is a major pest of paddy in the wet zone of Sri Lanka and in certain parts of the dry zone. In these areas about 10% of the tillers of the paddy crop are affected by this pest. Prolonged periods of overcast skies coupled with light to moderate rains favour heavy crop infestation by this pest. Under such conditions of high humidity, up to 40% of the tillers of the paddy shoots have shown silver shoots. The pest attacks seedling paddy. Only on rare occasion does it attack mature paddy. O. oryzae produces no silver shoots on mature paddy, but causes the last emerging leaf to become undersized and transversely crumpled.

Very little information is available in Sri Lanka on the population fluctuation of O. oryzae in paddy fields. The first appearance of silver shoots in the fields is still the only indication of the presence of this pest.

Two hymenopteran parasites Platygaster oryzae Mani (Scelionidae) and Dinarmus sp. (Pteromalidae) and two predators, the carabid, Casnoidea interstitialis and the reduviid Nabis capsiformis Germar have been observed to exert a low degree of natural control of O. oryzae in the field (Fernando 1967). The parasites have been observed emerging from the pupae of O. oryzae. C. interstitialis feeds on the pupae of O. oryzae inside the galls while N. capsiformis attacks the adults.

Brown Planthopper, Nilaparvata lugens

The brown planthopper is one of the most destructive pests of the rice crop in Sri Lanka. It was first recorded as a pest of rice under the name Nilaparvata greeni (Distant) in Kalutara district in 1912 (Fernando et al. 1979). Since then sporadic outbreaks have occurred in several areas, mainly in southwestern Sri Lanka. In the last two decades, it has been appearing in large numbers in several districts, especially in Amparai and Batticaloa, and occasionally causing hopperburn -- a drying up of plants in large patches (Fernando 1975; Dyck and Thomas 1979).

Parasitism has generally been recognized as causing less brown planthopper mortality than predation. Most parasites of the brown

planthopper are low and appear to have limited value for checking planthopper population. However such a limitation may be overcome by the combined effects of several parasites that attack sequentially during the development of pest insect outbreaks.

Parasitization of this pest in Amparai district is caused mainly by Strepsiptera, but parasitization is generally low, according to Otake et al (1976). They observed the following predators in Amparai district: spiders, the Carabid Casnoidea interstitialis, two species of Coccinellids, an assassin bug (Reduviid) and Cryptorhinus sp. (a Mirid). They also reported high parasitic activities by Elenchidae, Dryinidae, Pipunculidae and nematodes in Kandy district. But these were sporadic and afforded no effective control.

Rajendram (1982) collected an Anthocorid, the Mirid Cryptorhinus lividipennis Reuter and two Coccinellids in the paddy fields of Amparai and Batticaloa districts, Pseudogonotopus sp. (Dryinidae) in Batticaloa district and Mymarids and Trichogrammatids, parasitizing eggs of N. lugens, in Kandy district.

In the northern province, Rajendram and Devarajah collected C. lividipennis from Paranthan Kalmadu and Jaffna (Rajendram 1982). Studies have indicated C. lividipennis to be an effective predator of N. lugens (Devarajah and Rajendram 1982). It was possible to mass culture C. lividipennis successfully in the laboratory with a view to releasing it in the rice fields (Devarajah and Rajendram 1981). However, sampling of paddy fields in Karadianaru (Rajendram and Devarajah 1981), Kilinochchi and Jaffna (Rajendram 1982) over a 2 year period did not reveal any appreciable population in these locations.

Leafhopper complex: Nephotettix virescens
Nephotettix nigropictus
Nephotettix impicticeps
Tettigella spectra
Inazuma dorsalis

Santa et al (1973) reported that the most prevalent leafhopper species were N. virescens and N. nigropictus in paddy fields in Kandy district, comprising as much as 37.2% of the insect population.

These were observed to increase very gradually till the heading stage of the crop, and sharply after the heading stage. Occasionally, Nephotettix sp. peak population was noted before maximum tillering. They also reported parasitization of adults and nymphs by Dorilas sp. up to 8.1%. Since increase in parasite population was observed when crop is heading than at two weeks after transplanting, the lowering of the pest population may be due to high parasitic activity. Hence pest epidemic may be avoided by an increasing population of natural enemies. The predator C. lividipennis was observed to comprise 25% and spiders 4.1% of the insect population.

Devarajah (1983) reported the following general predators in paddy fields, during a 2 year survey: the Coccinellids Adalia indica and Coccinella octomaculata and the Odonata Lestes sp., and Pseudagrion sp. in Karadianaru, Kilinochchi and Jaffna and Orthetrum sp. and Anax sp. in Karadianaru and Kilinochchi.

The present survey indicates the presence of endemic parasites and predators that could be manipulated in biological control of pests of the rice crop. Where the local stock of natural enemies is inadequate to achieve satisfactory biological control, these can be supplemented with introduced exotic natural enemies.

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