

REVIEW OF LITERATURE

Cantelo and Pholboon (1965) reported that there were 66 species of insect that attack sugarcane in Thailand. There were 88 species of insect pests of sugarcane but only 16 species caused economic loss only when their populations reached density levels in sugarcane fields (Prachuabmoh and Pitaksa, 1987)

The sugarcane stem boring grub, Dorysthenes buqueti Guerin (Coleoptera : Cerambycidae). It originated in North India, Assam, Burma, Malaya, Java and Laos, particularly in mountainous regions where its host is the bamboo root (Gressitt et al., 1970). Chieng (1982) reported that D. walkeri (Waterh) caused considerable damage to sugarcane on Hainan Island, China. Prachuabmoh and Pitaksa (1987) stated that first record of sugarcane stem boring grub D. buqueti Guerin attacked sugarcane in Thailand. Soil insect pest of cane was reported by Willson (1969) the long-horn beetle, D. hydropicus tunnels into the underground portions of the sugarcane plant in Taiwan.

Prachuabmoh et al. (1984) reported that white grubs, (Lepidoptera stigma Fabricius) lay their eggs in soil. The egg, the larva and the pupa stages takes 18 days, 8-9 months and 30-40 days respectively. The sugarcane stem boring grub D. buqueti Guerin lays eggs singly in the soil and the period of development of the adult

are 15-20 days and the egg stage takes 15-18 days. Charoensom (1982) reported that the sugarcane stem boring grub, Dorysthenes buqueti Guerin lays 500-600 eggs per female. The eggs, larva, pupa and adult stages take 15-20 days, 9 months, 15 days and 1 month respectively.

An analysis of the spatial distribution of the population of a single species is important to ecologists because it can be used as a powerful theoretical tool for determining the most efficient procedures for statistical analysis of field data. The statistical method most widely applied to for a positively contagious empirical distribution is the negative binomial distribution (Fisher, 1941) which can be considered a generalization of the Poisson distribution in which the true mean varies in space (Taylor, 1953). The Poisson distribution may be tested by Chi-square (Steel and Torrie, 1960) negative binomial may be tested by using Morisita Index (Morisita, 1959 ; 1962). Two conditions must be met for the Poisson distribution to occur : (1) the environment must be homogeneous and (2) the presence or absence of any organism at any location must be independent of all other organisms (Student, 1919). The distribution of insects has been classified into three general types random, over-dispersed clumping, (contagious or aggregate) and under-dispersed even or regular.

The index of dispersion (Southwood, 1968) may be found as

If $S^2/X = 1$ random

$S^2/X < 1$ regular

$S^2/X > 1$ contagious

Morisita index of aggregation (Thennissen, 1982) may be found as

If $I_m < 0.7$ regular

I_m between 0.7-1.3 random

$I_m > 1.3$ contagious

Sequential sampling, initially developed by Wald (1945), is one of the best methods suited to such a purpose and it has hitherto been used for estimating several animal populations (Oakland, 1950; Water, 1955; Gonzalez, 1970; Pieters and Sterling, 1974). To apply this method, it is necessary to determine what type of mathematical distribution can be fitted to the observed counts.

Recent criticism of Iwao's (1975) sequential sampling model (Nyrop and Simmons, 1984) has shown that the use of the confidence interval for generating sequential stop values violates several rules and thus can lead to observed error rates which are much higher than expected error rate. These authors recommended simulation as one method for adjusting the stop values so they provide the correct type I and type II error rates. Sequential sampling model has also been suspected of such violations (Ives and Moon, 1987) but the nature and severity of errors is not known. Therefore intensive computer-simulated binomial sampling experiments, were conducted by using the binomial confidence interval to determine appropriate values for the standard normal deviation, (Nachapong et al., 1989). These experiments suggested that a standard normal deviation of 2.01 provide maximum allowable type I and type II error rates that were essentially 0.1. This value was used to generate lower and upper sequential sampling stop values for each AT (Action Threshold). Prachuabmoh and Pitaksa (1988) reported that Economic Threshold of sugarcane stem boring grubs were 24 per cent in infested stools.

Sequential sampling models are used in integrated pest management (IPC). This can reduce time by 76 per cent in sampling arthropods in cotton fields. Sterling (1975), Wald (1945) and Water (1955) reported that sequential sampling can save 50 per cent of time in sampling.

Presence-absence sequential sampling plan for the sugarcane shoot borers may result in as much if not more, saving in time, because users are not required to count all the insects in each sample unit; a simple recognition of one or more target species is adequate (Pitaksa *et al.*, 1989).

Economic thresholds are generally recognized as being complex (Stern, 1973) and influenced by such factors as the value of the crop at the time of its sale, the cost of insecticide control measures the expected yield and the expected reduction in yield caused by insect pests (Legg and Barny, 1988). Loss due to pests or disease is best expressed as the reduction in potential \bar{X}_2 , which is the actual yield, can be expressed as a percentage of \bar{X}_1 , which represents the maximum, or pest-free yield. Walker (1980) assessed yield loss $(P) = (\bar{X}_1 - \bar{X}_2) / \bar{X}_1 \times 100$.

Crop yield may be a general term for the amount of harvestable economic product, either as directly harvested grain, fruit, tubers, sugarcane, hay etc or as a processed product such as flour, juice, sugar or protein. The amount can be expressed per unit of crop, such as per plant, tree, cane or bunch, but yield is commonly given in terms of a constant base such as area : kilogram/hectare, tons/acre. Experiments give details of the number of grains, stems, tillers, plants or canes per hectare to enable yield to be expressed per unit of area. Grams per plot are meaningless to the

farmer. There are 5 methods of establishing the relationship between infestation and yield : 1) using natural infestation , 2) using chemicals , 3) using artificial infestation , 4) using simulated damage and 5) using resistant varieties (Walker, 1987).

Jenkyn (1980) reported that in Asia sugarcane losses due to insects, diseases, weeds and other factors were 25, 20, 20 and 15 per cent respectively. Ruinard (1971) reported that the ultimate loss in yield due to stalk borer infestation may be as large as 1 per cent for each 1 per cent of joints bored, all forms of injury included.

The sugarcane stem boring grub is an important pest of sugarcane in the Eastern region of Thailand. Chlordane and heptachlor are the most effective insecticide against this pest (Pitaksa and Prachuabmob, 1987). A combination of chemical and cultural controls was found to be the only effective mean of controlling cane grub (Downs, 1982).

Currently an insecticide applied for control of the sugarcane stem boring grub, terbufos is an organophosphate insecticide. This insecticide has excellent initial and residual activity against a wide range of soil insects and other soil arthropods.

Turbufos 5 % G at a rate of 2.0 kilograms a.i./ha or 4.0 kilograms a.i./ha is also effective against the white grubs, Alissonotum impressiolle and the wire worm, Melonotus tamsayensis (F.E. Zuellig (Bangkok) Ltd., no date).

Endosulfan + BPMC contains organochloride (endosulfan) and a carbamate (BPMC). Endosulfan is a autonomic nervous system stimulant. BPMC is a chlinesterase inhibitor. Endosulfan + BPMC 4.5 % G at a rate of 3.5 kilograms/rai (1 ha = 6.25 rai) is effective against brownplant hopper (Hoechst Thai Ltd., no date).

Chlorpyrifos has a broad range of insecticidal activity and effective by contact ingestion and vapour action. It has systemic activity. It has been used for the control of mosquitoes, many soil and foliage crop pests (F.E. Zuellig (Bangkok) Ltd., 1985).

Tefluthrin is the first pyrethroid insecticide which is stable in the soil and is effective against a wide range of soil pests ICI Asiatic (Agriculture Company Limited) no date.

Three sugarcane varieties F140, F156 and U-Thong I were used in this study. F140 is an excellent in growth with an average yield of 10-12 tons per rai. For quality point of view, F140 has an average CCS of more than 12. It is a moderate ratooning ability but susceptible to sugarcane scale but resistant to stalk borer. The

F156 variety grows rapidly in sandy loam soil. This variety is resistant to sugarcane scale and stalk borer. Its yield is about 12-15 tons per rai, but the CCS is below 12 (Sooksathan et al., 1977). U-Thong 1 variety is resistant to lodging and gives excellent ratoon. It produces high yields of 12-15 ton per rai (in rainfed areas and 15-20 ton per rai in irrigated areas) with an average CCS of 11-12. It is resistant to smut, but susceptible to root rot. It has low infestation of shoot borer (Petcharaburanin and Janboonmee, 1993).