LITERATURE REVIEW

Taxonomic Status

The soybean stem fly, Melanagromyza sojae (Diptera: Agromyzidae) was described in 1900 by Zehntner. Adult of this species is a small metallic green fly measuring approximately 2 mm. long with mat black frons and moderately shining orbits and ocella triangle. The mesonotum is largely black but sometimes with detectable greenish tinge and a conspicuously shining greenish abdomen. The wing is approximately 1.8 to 2.1 mm. long with the costa extending strongly to vein M1 + 2 the first crossvein slightly before midpoint of discal cell and the last section of M3 + 4 slightly more than half of the penultimate. The squamae and fringe are entirely white. The full grown larva is white or pale yellowish white, ca. 3 to 3.4 mm. long (Spencer 1973).

Soybean Stem Fly Biology

M. sojae feeds internally into the pith and tunnels down to the roots until it is fully grown. The puparium is yellowish brown with black posterior spiracles and distinctly protruded caudad with several pointed teeth. Pupation takes place deep within the stem but the larva eats out a channel to the epidermis first which will eventually facilitate the subsequent emergence of the adult. Up to six larvae can be found in one plant (Titayavan 1987). The whole life cycle is completed within 21 days with at least four generations may be repeated until soybean harvest.

Status of Soybean Stem Fly as a Pest

Soybean stem fly is a serious pest of beans in the Old World tropics (Spencer 1973). Specific reports from Africa, India, Indonesia, Malaysia, and the Philippines (Rose et al. 1976) indicated that it feeds on a wide variety of cultivated and wild leguminosae within several genera (Spencer 1973). In Java the main host among cultivated plants is *G. soja* and attack on this host has been reported to vary from 70-100%. On *Cajanus cajan* Spreng. and *Phaseolus* spp., the attack is always limited to very young plants and older plants appear to be avoided (Spencer 1973). This species infests soybean in the unifoliate and early trifoliate leaf stages, but infestation rarely results in plant death (Talekar and Chen 1986). Yield loss varies according to location. In Taiwan, the loss was 31% (AVRDC 1981). In Japan it may cause a 100% infestation and thus, a considerable reduction in soybean yields (Kato 1961). In India it seems to be the most common stem fly and a major pest of soybean planted on the rainy and spring season (Gangrade and Kogan 1980). The adults feed on the upper surface of leaves by making multiple punctures that appear as white spots mainly on leaves of soybean seedlings. Most injury to crops however, is caused by the maggots that mine the leaves and tunnels petioles and stems, eventually destroying the plants (Gangrade and Kogan 1980). In Thailand the percentage reduction in potential yields ranges from 16-26% in the Chiangmai valley (Titayavan 1987) but can reach up to 100% crop loss when climatic conditions are favorable Sepsawadi et al. 1984 (quoted in Titayavan 1987).

Management of the Stem Fly

Several measures to control the stem fly can be applied but the importance of protecting the plant in the seedling stage however, is still emphasized (Talekar and Chen 1986). Van der Goot 1930 (quoted in Talekar and Chen 1986) and Talekar and Chen (1986) found that beanfly infestation is reduced when soybean is planted during the rainy season. Van der Goot 1930 (quoted in Talekar and Chen 1984) further reported that plant mortality was significantly less in the rainy season even though the beanfly population was equal to that found in the drier months which was attributed to the higher vigor of plants during this period.

Talekar and Chen (1986) documented the effects of parasites on the reduction of beanfly infestation. Ten parasites have already been identified attacking *Melanagromyza sojae* in Taiwan and Java.

The Environmental Control of Soybean Stem Fly Using Different Ecological Conditions

Several records of pest outbreaks have been related to the use of monocultures (Altieri and Gliessman 1983, Altieri 1987, Conway 1987). This kind of cropping systems are said to open the way for insect infestations by providing concentrated resources and uniform physical conditions that encourage insect invasions (Root 1973). He added that herbivorous insect pests are more likely to colonize and remain longer on crop hosts that are concentrated because the entire life requirements of the pests are met in this simplified environments. As a consequence, populations of specialized pests attain economically undesirable levels (Altieri 1987).

The concept of diversity as a means of controlling insects has long been practiced by soybean farmers in many parts of the world. In Thailand, Puttachareon (1988) reported that populations of the aphid parasite (*Aphidius* sp.) was highest when corn was planted simultaneously with soybean. The reduction in pest numbers associated with diversity (Murdoch 1972, Murdoch

1975, Litsinger and Moody 1976, Cromartie 1981, Risch 1981, Altieri and Letourneau 1982, Altieri 1983, Risch 1983, Altieri et al. 1986, Conway 1987, Altieri 1988) can be explained by two ecological hypothesis (Root 1973). The natural enemies hypothesis predicts that there will be a greater abundance and diversity of natural enemies of insect pests in polycultures than monocultures due to a greater array of alternative prey and microhabitats in complex environments (Altieri et al. 1986). The resource concentration hypothesis explains that the concentration and spatial dispersion of food plants influence insect populations either by affecting colonization rates of herbivores or their behavior (Root 1973). Risch (1981) reported that the number of chrysomelid beetles in polycultures with a non-host plant was significantly lower relative to the numbers of beetles on host plants in monocultures.

Weed diversity in the form of weed borders, alternate rows or by providing weeds in certain periods of the crop growth can also have a major impact on insect dynamics (Altieri and Letourneau 1982). Much evidence suggests that the encouragement of specific weeds in crop fields may improve the regulation of certain insect pests (Altieri and Whitcomb 1979). In collard systems, with "relaxed" weeding regimes, flea beetle densities were at least five times greater on a per plant basis on Brassica campestris (the dominant plant of weed community) than on collards. B. campestris L. germinated quickly and flowered early, each plant averaging a height of 38 cm., with 12 leaves and 16 open flowers, 60 days after germination. This apparent preference of Phyllotreta cruciferae (Goeze) for B. campestris over collards resulted in a higher concentration of flea beetles on the wild crucifer, diverting flea beetles from collards. Collards grown under various levels of weed diversity exhibited significantly less leaf damage than monoculture collards grown in weed-free situations (Altieri and Gliessman 1983). Altieri et al. (1981) observed that populations of the velvetbean caterpillar Anticarsa gemmatalis (Hubner) and of the southern green stink bug Nezara viridula L. were greater in weed-free soybeans than in either soybeans left weedy for two or four weeks after crop emergence, or for the whole season. In Indonesia, intercropping soybean with eggplant and yambean is a common practice among Javanese farmers to reduce bean fly infestation (van der Goot 1930 quoted in Talekar and Chen 1986). Altieri et al. (1981a) reported that parasitization of Heliothis zea (Boddie) by

Trichogramma sp. was significantly higher in soybean-corn intercropping plots and weedy soybean plots than in weed-free soybean monocultures.

No literature relating the effect of vegetation textures on the density and herbivory of M. sojae associated with soybean has been published in Thailand.