REVIEW ARTICLE

Integrated Management of *Spodoptera litura*: A Review

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ABSTRACT- Tobacco caterpillar, *Spodoptera litura* (Fabricius) is a widely distributed pest in South-East Asia, feeding on 63 plant species belonging to 22 families. It is a serious pest of soybean, pulses oilseeds, cotton and vegetables. In an outbreak phase, this insect can completely defoliate large area of crops causing the reduction in yield. Heavy use of synthetic organic insecticides to control this pest resulted in the development of resistance against insecticides of different groups. Although a variety of agrochemicals are used for growing crops, little is known about their direct or indirect effects on nontarget organisms including insect pests. Therefore, alternative control measures have been searched out for this noxious pest. By adopting probable and advanced management practices this important pest can be managed.
Key-words- Bioassay, agrochemicals, Fabricius, Growth and development, Polyphagous pest, *Spodoptera litura*,

INTRODUCTION

S. litura Fabricius commonly known as tobacco caterpillar is a polyphagous pest and cause considerable damage to soybean, cotton, and vegetables [1-3]. Use of insecticides for controlling this pest is on the rise and it has the ability to develop resistance to many insecticides [4-5]. Further, various pesticides viz. herbicides, fungicides have been reported to have detrimental effects on different aspects of a life cycle of the *S. litura* [6-7]. In addition, to understand the influence of agrochemicals on expression of resistance in plants against insects, it is also essential to complete a database on the direct and indirect effect of agrochemicals on insect pests. Therefore, it is essential to know the role of different agrochemicals on the developmental profile of *S. litura*. Such observations have been useful in understanding the shifts in insect pest population on a crop influenced by these molecules. Information on this interesting area of pest management is scanty and therefore, needs more observations [6].

Integrated management options- No doubt, insecticides are most powerful and widely accepted weapons for the control of above mentioned insect pests. However, excessive reliance on insecticides has posed several adverse effects such as a buildup of pest resistance to insecticide, outbreak of secondary pests, harmful to non-target organisms, health hazards and other problems related to environmental pollution. Hence, judicious use of insecticides and use of insecticides with selective action are recommended in insect management practices.

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Newer Insecticides- Newer insecticides are highly effective against many lepidopteran pests, but sensibility of the targeted species varies a lot depending on the mode of exposure. Further, the larvicidal effect of the insecticide was clearly dependent on the concentrations of the insecticide. Bhatnagar *et al.* [8] also reported that the relative toxicity ratio (RTR) of novel molecules at LC_{50} value in comparison to cartap hydrochloride at 24 hrs and 48 hrs were: indoxacarb (66.32, 82.5) > flubendiamide (11.45, 49.5) and at 72 hrs the values were flubendiamide (118.33) > indoxacarb (71). Indoxacarb and flubendiamide with low LC_{50} values demonstrated higher toxicity against *S. litura* than cartap hydrochloride. Further, Horowitz *et al.* [9] reported that according to $LC_{50}$and LC_{90} values, acetamiprid was 10- and 18-folds more potent than imidacloprid to whitefly *Bemisia tabaci* (Gennadius) resulting (with the concentration of 25 ml a.i./l) in adult mortality of 90, 93, and 96% and 76, 84 and 76% after 2, 7 and 14 days of application. Acetamiprid, (E) – N 1- [(6 - chloro -3- pyridyl) methyl] – N 2-cyano-N1-methyl acetamidile, is a new-generation novel insecticide with ground and aerial application. It poses low risks to the environment relative to most other insecticides and its use would pose minimal risk to nontarget plants. Lufenuron is an acylurea insecticide, mainly for the control of lepidopterous pests in field crops, orchards and vegetables [10]. Lufenuron required a maximum time of 120 hrs to kill 50% population which was due to its mode of action through ingestion and affecting the physiological processes. However, disorders in oogenesis and spermatogenesis have also been main features at their chronic dose rates [11]. The LT_{50} values showed that spinosad was highly toxic against *S. litura*. Topical LD_{50} values for lepidopteran pest species range from 0.1 to 3 mg a.i./l, if the compound is applied in earlier instars [12]. Field studies can foster the effectiveness of these and other insecticides for long term and effective management of *S. litura*.

Fungicides- Pesticides are by and large detrimental to the living being including insects [13-15]. Singh and Bhattacharya [6] also observed that mancozeb at concentration of 0.125% to 0.132% resulted in 62.50 to 92.50% survival of *S. litura* larvae. The larval periods, as well as its mortality, increased with increase in the level of mancozeb in the diet. A significant reduction in pupation percentage and adult emergence was recorded when larvae were reared on diets fortified with 0.0625% of manoczeb. A field dose of 0.25% resulted in 5% pupation and adult emergence. Adamski and Ziemnicki [16] tested ethylene bis-dithiocarbamate fungicide mancozeb on larvae and imago of *Spodoptera exigua* and observed decreased survival, disturbances, and malformations in development, changes in the activity of tested enzymes. Adamski *et al*. [17] observed that mancozeb causes multilevel alterations, within various tissues and systems. The observed malformations are similar to those caused by fenitrothion and carbaryl (carbamate insecticide) in *S. exigua* and *Tenebrio molitor* fat body. Therefore, they seem to be rather universal, caused by a chemical imbalance within cells, not the direct action of pesticides on target tissues and cells. The above mentioned changes are similar to those reported by Sakr *et al*. [18] for mice exposed to mancozeb. These authors reported irregularities of nuclear structure, that led to apoptosis, loss of glycogen, dilated ER. Such changes obviously slow down the activity of cells. Therefore, the activity of a fat body may be decreased. If decreased weight of fat body, reported for *S. exigua*, is a universal phenomenon, the activity of fat body and its effect on insect's development would be drastically decreased. Nasreen *et al*. [19] assessed the toxicity level of some fungicides against *Chrysoperla carnea* (Stephens) larvae and reported that Ridomil caused 4.44 % mortality of 1^{st} and 3^{rd} instars larvae after 24 and 72 hrs. The lowest pupation rate (89.32 %), adult emergence, the longevity of adults and fecundity was recorded in ridomil treated larvae.

Herbicides- Herbicides have been extensively used for the control of weeds in different crops and may also alter the resistance of crop plants by changing the physiology of crop plants. In maize, the incidence of *Thrips tabaci*, *Empoasca* sp. and *Campylomea* sp., and its natural enemies were reduced following the application gesaprin, lasso and sabre [20]. Eigenbrode *et al*. [21] reported the reduction of damage in *Brassica oleracea* due to *Plutella xyllostella*, *Pieris rapae,* and *Trichoplusia ni*, when 5-ethyl dipropylthiocarbonate was applied in the soil. Pre emergence and Post emergence herbicides affect the growth and development of *Spodoptera litura* [22-23].

Plant growth regulator (PGR)- Plant growth regulators (PGRs) are used in several crops like soybean, cotton etc. which regulate the overall vegetative growth of plant resulting in increased yield. However, limited data are available on the possible role of plant growth regulator (PGR) in inducing resistance in the plant against the insect. Singh and Bhattacharya [24,25] also observed that PGRs directly hamper the growth and development of *S. litura.*

CONCLUSIONS

It may be concluded that agrochemicals can serve a practical tool to reduce the *S. litura* and may assume a greater role in more highly integrated programs to manage insect pests and pathogens. Further, Integrated Pest Management is a strategy to manage pests on the basis of a systems approach that looks at the whole crop ecosystem. This includes understanding how the pests interact with their host plants, with the general climatic conditions, plant health, and nutrition and with each other. When implementing an IPM system, growers should select ways to reduce overall pest levels in their orchard and ensure that the management of pests is compatible with their other crop management strategies. It is important that growers realize that IPM system is updated from time to time in response to biological changes that occur in their field and new techniques or technologies are introduced as soon as additional relevant information becomes available.

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