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Trends of Ecofriendly Approach for Sustainable Pest Management

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ABSTRACT: The present study was attempted to investigate the emerging trends of ecofriendly approach for sustainable pest management. An extensive investigation was carried out by using books, reported studies and subject experts respectively. Insecticide application is the most common practice in crop protection. The role of insecticides in crop protection to increase output has been well known and these have been considered essential inputs in crop production. They are highly effective, rapid in curative action, adaptable to most situations, flexible in changing conditions and relatively more economical. It is general consideration that, the use of insecticides is most effective tool to overcome the pest problems. However, the indiscriminate use of insecticides has led to serious problems like, harmful residues in the produce, pesticide resistance and outbreaks of secondary pests. Their toxicity is lethal to all living organisms. Insecticides easily enter our food chain and increase their concentrations to the next trophic levels. This has compelled to consider a complete change in strategy of insect pest management. Most of the agricultural resources are exploited by modern agricultural technologies. Its urgent need to minimize this exploitation for safe hand over the agricultural resources to the next generation. Sustainable agriculture is a holistic approach of ecofriendly agricultural technologies. Insect pest management is the key input in sustainable crop production. It is a multidisciplinary ecofriendly approach for pest management, that is practical, economical, effective and protective to both public health and environment. Integrated pest management fosters the growth of healthy crops with minimum disruption to agroecosystems and encourages ecofriendly pest management systems. The safer insecticide management, Insecticide resistant management and Biorational pest management were screened major ecofriendly approach for sustainable pest management.

Keywords: Ecofriendly approach, Sustainable pest management, Integrated pest management.

I. INTRODUCTION

Insecticide application is the most common practice in crop protection. The role of insecticides in crop protection to increase output has been well known and these have been considered essential inputs in crop production. They are highly effective, rapid in curative action, adaptable to most situations, flexible in changing conditions and relatively more economical. It is general consideration that, the use of insecticides is most effective tool to overcome the pest problems. However, the indiscriminate use of insecticides has led to serious problems like, harmful residues in the produce, pesticide resistance and outbreaks of secondary pests. Their toxicity is lethal to all living organisms. Insecticides easily enter our food chain and increase their concentrations to the next trophic levels. This has compelled to consider a complete change in strategy of insect pest management. Most of the agricultural resources are exploited by modern agricultural technologies. Its urgent need to minimize this exploitation for safe hand over the agricultural resources to the next generation. Sustainable agriculture is a holistic approach of ecofriendly agricultural technologies. Insect pest management is the key input in sustainable crop production. The integrated pest management (IPM) fosters the growth of healthy crops with minimum disruption to agroecosystems and encourages ecofriendly pest management systems. It is multidisciplinary ecofriendly approach for pest management, that is practical, economical, effective and protective to both public health and environment. It is an evolutionary stage in pest management strategy based on ecological principles and integrates multidisciplinary methodologies in developing agroecosystem strategies. So, the integrated pest management is generally termed ecofriendly pest management. Recently, the FAO (Food and Agriculture Organization) has defined, "Integrated pest management means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a

healthy crop with the least possible disruption to agroecosystems and encourages natural pest control mechanisms [5, 7, 12, 15].

There are four basic principles of integrated pest management- (1) Pest surveillance (2) Understanding of ecosystem (3) Utilization of economic threshold level and (4) Application of minimum selective chemicals. Pest surveillance is a primary approach in the integrated pest management. Surveillance is the constant observation of pests and prediction of future incidence of pest population. This is the important method for analysis of population phenomenon. The level of pest population is most important consideration for pest management. The determination of threshold level is pre requisite for pest management strategy. The economic threshold level (ETL) is the pest population density at which control measures should be determined. The application of chemical measures to the management of pest population has to be in such a manner that target pest population are just kept below the threshold of economic injury level (EIL). By the application of minimum selective chemicals, the development of resistant population of pest is avoided or delayed the possibility of resurgence of treated population is decreased, adverse effect on non-target organism and the cost of control is also lowered [3, 8, 11].

II. MATERIALS AND METHODS

An extensive investigation was studied on emerging trends of ecofriendly approach for sustainable pest management. Ecofriendly pest management and sustainable crop production are holistic approach worldwide. The varieties of techniques have been practicing for pest management since traditional to modern. The integrated pest management termed ecofriendly pest management have been added varieties of new advances to discourage the development pest population onwards [16]. The pest management techniques were investigated to screen ecofriendly pest management techniques. This investigation was undertaken on emerging trends of ecofriendly approach for sustainable pest management by using books [3, 8, 11] reported studies and subject experts respectively.

III. RESULTS AND DISCUSSION

There were different available techniques of pest management included in the study for extensive investigation. Safer insecticide management, Insecticide resistance management and Biorational management were screened emerging trends of ecofriendly approach for sustainable pest management.

A. Safer insecticide management

The suppression of pest population is a function of the ecosystem itself by means of bioagents and other factors. The bioagents in agroecosystems are threaten by pesticides application. The manipulation in pesticides application for pest management is the most important techniques for conservation bioagents. Insecticides application can be manipulated to conserve bioagents in the ways of treatment need, economic thresholds observed, less toxic formulations apply, pesticides at lowest effective rate and timing apply and temporal & spatial separation of bioagents and pesticides follow. The ecological selectivity is the judicious use of pesticide to favour bioagents. It is based on critical selection, timing, dosages, placement and formulations with the goal of maximizing bioagents populations. Of course, the use of selective pesticides is the most powerful tool can be conserved bioagents diversity. Some of the important insecticides reported as comparatively safe to bioagents are given in Table 1.

Table 1: Insecticides reported as comparatively safe to natural enemies [1, 10].

Sr.No.	Bioagents	Status	Safe insecticides
1.	*Lycosa* spp.	Preadator	Imidacloprid, Cartap hcl, Phosphamidon,
2.	*Coccinella septempunctata*	Preadator	Cartap Hcl, Imidacloprid, Methyl demeton
3.	*Cyrtorhinus lividipennis*	Preadator	Phosalone, Phosphamidon, Imidacloprid
4.	*Chrysoperla carnea*	Preadator	Phosalone, Fenvalerate, Imidacloprid
5.	*Trichogramma* spp.	Egg parasitoid	Diazinon, Fenvalerate, Diflubenzuron
6.	*Telenomus remus*	Egg parasitoid	Phosalone, Imidacloprid
7.	*Bracon brevicornis*	Larval parasitoid	Phosalone, Imidacloprid
8.	*Apanteles* spp.	Larval parasitoid	Phosalone, Fenvalerate, Imidacloprid
9.	*Tetrastichus pyrillae*	Egg- larval parasitoid	Quinalphos, Imidacloprid
10.	*Chelonus blackburni*	Egg- larval parasitoid	Phosalone, Permethrin, Diflubenzuron, Dimethoate, Fenpropathrin, Imidacloprid

B. Insecticide resistance management

The insecticide resistance is the most important constraint serious in insect pest management. Insecticide resistance is the result of continuously intensive use, misuse and overuse of insecticides. Therefore, the Insecticide resistance management is an important component of integrated pest management. There have been three chemical strategies of resistance management- (1) management by moderation, (2) management by multiple attack and (3) management by saturation suggested by Georghiou (1983) [6]. The management by moderation aims to reduce selection pressure by low doses of insecticides to the target population for spread, severe depletion of susceptible genes. This is based on novel chemicals, short persistence chemicals and cost-effective non-chemical methods. The management by multiple attack aims to reduce selection pressure by alternation of insecticides

to the target population for trap, cross resistance and multiple resistance. This is based on mixtures of chemicals and alternation of chemicals. The management by saturation aims to reduce selection pressure by high doses of insecticides to the target population for spread, severe depletion of resistant genes. This is based on suppression of detoxification mechanisms *i.e.*, ovicides and synergists. Some of the important metabolic resistance mechanisms and synergists for insecticides are given in Table 2.

Table 2: Major metabolic resistance mechanisms and synergists [9, 13].

Resistance mechanisms	Synergists	Insecticides
Dehydrochlorinase	DMC, FDMC, WARF	DDT
Epoxide hydrase	ETP, ETN	Dieldrin
Amidase	TPP, IBP, TBPT	Dimethoate
Carboxyesterase	TPP, IBP, TBPT, PSCP	Permethrin
Phosphatase	TPP, IBP, TBPT	Parathion, Dimethoate
Transferase	CH3I, Diethylmaleate,	Parathion, Dimethoate
Type I MFO	PBO, Sulfoxide, Sesamex	Parathion, Dimethoate, Methomyl Fenvalerate, Permethrin
Type II MFO	N-declyimidazole, WARF, MGK-264,	Malathion, Parathion, Dimethoate, Carbaryl, Methomyl,

DMC= Chlorfenethol, FDMC= bis (p-chlorophenyl) trifluoro-methylcarbinol, WARF= N,N-dibutyl-4-chloro benzenesulfonamide, ETP= 1,1,1-trichloro-2,3-expoxypropane, ETN= 1,2-epoxy-1,2,3,4-tetrahydronapthalene, TPP= Triphenylphosphate, IBP= Iprobenfos, TBPT= 5,5,5-tributylphosphorotrithioate, PSCP= Phenylsaligenin cyclic phosphate, PBO= Piperonyl butaoxide, MGK-264= (2-ethylhexyl)-8,9,10-trinorborn-5-ene-2,3-dicarboxamide.

C. Biorational pest management

The biorational approach is the manipulation of insect pests behaviour in agroecosystems. It involves integration of stimuli among insect pests and ecosystems. The Push and pull technique involve biorational approach of insect pests and their natural enemies by integration of stimuli. It is based on unattractive or unsuitable as push and an attractive as pull to the pest, and resulting pests are subsequently removed from the protected resources. The pests are repelled or deterred away from the resource by using stimuli that mask host apparency. The pests are simultaneously attracted, using highly apparent and attractive stimuli, to other areas such as traps or trap crops, where there concentrated, facilitating their elimination. The Push and pull techniques are under development and applied in major areas of pest management. The most successful example currently used in practice was developed in Africa for the management of Lepidopteran stemborers like *Chilo partellus, Eldana saccharina, Busseola fusca* and *Sesamia calamistis* in maize and great millet. The technique involves the combined use of intercrops and trap crops using plants that are appropriate to the formers and that also exploit bioagents. The stemborers repelled from the crops by repellent nonhost intercrops, particularly molasses grass (*Melinis minutiflora*), silverleaf desmodium (*Desmodium uncinatum*) (push). These are concentrated on attractive trap plants, primarily napier grass (*Pennisetum purpureum*) or sudan grass (*Sorghum sudanense*) (pull) [2, 4, 14].

IV. CONCLUSION

It is general consideration that, the use of insecticides is most effective tool to overcome the pest problems. However, the indiscriminate use of insecticides has led to serious problems like, harmful residues in the produce, pesticide resistance and outbreaks of secondary pests. Their toxicity is lethal to all living organisms. Insecticides easily enter our food chain and increase their concentrations to the next trophic levels. This has compelled to consider a complete change in strategy of insect pest management. The integrated pest management (IPM) fosters the growth of healthy crops with minimum disruption to agroecosystems and encourages ecofriendly pest management systems. The Safer insecticide management, Insecticide resistant management and Biorational pest management were screened as emerging trends of ecofriendly approach for sustainable pest management. Of course, the present study would be revival of effective strategy for ecofriendly management pest.

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