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Advancement in Integrated Pest Management (IPM)

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Editorial

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INTRODUCTION

The Sumerians used sulphur compound to control insects and mites in about 4500 years ago. Mercury and arsenical compounds were used by the Chinese to control body lice in about 3200 years ago. As there was no any chemical industry, almost all products used for pest control derived naturally either from plant or animal or available minerals. Such era of natural products continued until use of paris green in 1867 in USA to control Colorado potato beetle.

After discovery of insecticidal property of DDT (Dichloro Diphenyl Trichloroethane), pest control was experienced with use of synthetic pesticides as ‘Dark Age’ during 1940 to 1962. The term ‘Supervised Control (SC)’ was coined in late 1950’s by entomologist of California University emphasizing conservation of natural enemies through selective use of chemicals. It was accepted as ‘Pest Management (PM)’ in the early of 1960’s. It included other suppressive tactics including semio-chemicals, host plant resistance and cultural control. Simultaneously, Rachel Carson wrote a book entitled ‘Silent Spring’ in 1962, wherein she mentioned negative effect of chemical pesticides on environment. This great book created doubt among scientific communities about indiscriminate use of chemical pesticides for pest management. With the passage of time SC and PM became synonymous resulting intelligence integrating various control tactics to manage pests referring chemical pesticides as one of the tools rather than the only tool. Ultimately, Smith and Van Dan Bosch (1967) innovated for first time the term “Integrated Pest Management (IPM)” which was formally recognized in 1969 by the US National Academy of Sciences. A definition was given by the Food and Agriculture Organization (FAO) in 1968 as ‘A pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest population at levels below those causing economic injury’.

There have been dramatic technological acceptance, consideration and rejection with respect to IPM during last four and half decade globally. In the 1970’s, DDT was widely banned due to environmental risks. The Environment Protection Agency (EPA) of United States (US) cancelled the registration of organophosphate parathion in US in 1972. In the same year, bio-insecticides based on Bacillus thuringiensis were released for control of Lepidopteran insects. In 1983, synthetic pyrethroids gained momentum to become more mainstream as pesticides. The 1970s and 1980s also experienced the introduction of herbicides (glyphosate, sulfonylurea and imidazolinone), insecticides (avermectins, benzophenylureas) and fungicides (triazole, morpholine, imidazole, pyrimidine and dicarboxamide families). Many of the agrochemicals introduced at this time had a single mode of action making them more selective, problems with resistance and management.

In the 1990s new families of agrochemicals (triazolopyrimidine, triketone and isoxazole as herbicides; strobilurin and azolone as fungicides and chloronicotinyl, spinosyn, fiprole and diacylhydrazine as insecticides) had been introduced for resistance management and improved selectivity along with the refinement of mature products in terms of use patterns, user-friendly and environmentally safe formulations. In most cases pesticides use per hectare reduced from kilogram to gram quantities with adoption of these new chemicals in IPM.

Integrated Crop Management (ICM), Integrated Resource Management (IRM) and Sustainable Agriculture (SA) are other terms which have been used since 1980's to refer IPM into a more encapsulated holistic approach that emphasizes the consideration of other components of the ecosystem than just the pests. Transgenic pest resistant crops were released in 1996, representing the biggest step in technology for pest management in IPM. It is now playing significant role in IPM including Bt cotton against borer complex, herbicide tolerant crops like soyabean and corm etc. In 2000, 122 nations signed a treaty intended to completely phase out persistent organic pollutants including DDT. EPA passed Pesticide Registration Improvement Act (PRIA) in 2003.

Declining trend in use of chemical pesticides has been recorded since 1990s. On the other hand technological development on application of biopesticides including Trichoderma sps., Psedomonas fluorescens, Beauveria bassiana, Metarhizium anisopliae, Verticillium lecanii, nuclear polyhedrosis viruses, entopathogenic nematodes, neem based pesticides have proved potentiality to successful management of some dangerous pests of crops. But, progress in adoption of biopesticides as an important component of IPM still is hardly around 5% of the pesticide market.

In respect to present climate change, infestation of sucking pests on several crops is increasing. Some minor pests have already emerged as major in some crop environment. The evil of 3R's i.e. Resistance, resurgence, residue is one among burning issues of today's crop protection. The European countries have put restriction on use of neonicotinoid insecticides for sucking insects due to their colony collapsing effect in honey bee industry. India may also govern the same in near future.

With these ups and downs in pest management, there has taken place some other recent advancement under IPM that may play significant role in coming future to minimize crop loss due to pest presently from around 15-20% to required extent.

i) Judicious use of pesticides: Pesticide players from private industry, central and state government has to come together to design a road map for right use of pesticides and stopping the spurious one.

ii) Novel insecticides: Excellent efficacy, high selectivity and low mammalian toxicity make novel insecticides as attractive replacement for organophosphates, pyrethroids and carbamate. Majority of them are considered as 'reduced risk' insecticides. The wide variety of new modes of action is extremely helpful for delaying resistance in key pests.

iii) Seed treatment: It must be used as basis for successful validation and implementation of IPM in farmers' field with proper process, appropriate treating agents and due precautions.

iv) Safe for pollinators: Bee pollination would be made as an essential component of IPM. It is essential to devise location specific IPM modules that will not affect pollinators. Chemical pesticides may be used as last resort that too using safer newer selective insecticidal molecules sparing the pollinators.

v) Better pesticide formulations: Effectiveness of any pesticides under IPM largely depends on its types of formulation. New generation formulations (Water Dispersible Granule-WDG, Suspension Concentrate-SC, Concentrated Emulsion-CE, Microemulsion-ME, Controlled Release (CR), Suspo Emulsion (SE), Tablet Formulation (WT), Multiple Emulsion Formulation and Nanoformulation) are relatively more effective, safe, easy to handle and environment friendly compared to conventional formulations.

vi) Balanced nutrition and good crop health: Pest preference and their multiplication remains less in nutritionally balanced healthy crops. The role of beneficial elements like Silicon (Si) is to be checked in understanding pest population dynamics and pest-disease resistance.

vii) Pesticides resistance management as part of IPM: There is now strong recommendation that Resistance Management Programme is to be developed within the framework of an overall IPM approach for a given pest and cropping system. Tactics developed for resistance management include mixtures of pesticides, rotation of pesticides, use pesticides with different mode of action, need based application of pesticides, use effective pesticides with recommended doses etc.

viii) Agro advisory in IPM: It is now great useful for agromateorologist, forecasters, modelers, farmers and other stakeholders to harness the potentialities of weather based pest forecasting, weather pest calendar and e-pest surveillance resulting value addition in form of farmers' advisory with special reference to IPM.

ix) Diagnostic service: Specific right diagnosis of plant pathogens is considered as important step of IPM. In this regard, opportunities have been opened for rapid diagnosis of plant parasitic nemetodes and viruses applying molecular technology.

x) Contingency plan for pest outbreak: Pest scenario in particular cropping system is already experienced with any time alteration due to climate uncertainty. So, contingency IPM plan could be available in hand to manage any sudden pest outbreak situation.

xi) Plant growth promoting rhizomicroorganisms (PGPR): Bio-inoculants in the form of living microorganisms (bio-fertilizer and bio-pesticide) when applied to seed, root zone or plant surface promotes holistic plant growth that contributes plant resistance against pests.