IPM – a strategy since 1959 – Mini Review

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Abstract

A brief view on the importance of Integrated Pest Management (IPM) is given by discussing the concept since it was first advocated in 1959 up to the adoption of IPM as a policy within the European Union. Reference is made to the need for crop monitoring and improved application techniques as well as non-chemical controls.

Keywords: IPM, Cotton pests, Pesticide application, Resistance

Integrated Pest Management (IPM) is now part of the European policy within the Sustainable Use of Pesticides Directive. 91/414/EEC in the form of a Regulation (EC Regulation 1107/2009), which came into force in June 2011. However, the concept of IPM, began nearly 60 years ago when Stern *et al.* [1] argued that chemical control should be employed to reduce a pest population which rises to a dangerous level when natural controls are inadequate. When such a pesticide is used, the cost must cover not only the amount lost due to pest damage but also the effect of possible deleterious impacts there may be on the ecosystem. Essentially chemical control should only be used when natural controls are inadequate and should act as a complement to biological control.

At the same time, Tunstall *et al.* [2] set out to introduce chemical control of insect pests on cotton in Central Africa and concluded that it was important to establish an economic spraying routine suitable for small-scale farmers *in conjunction with* other methods of control. To minimize bollworm populations, a closed season (a period of at least 2 months without cotton in fields prior to sowing the next crop), had already been established in 1936 and the arrival of a variety of cotton (Albar) resistant to bacterial blight disease and jassid (*Jacobiasca facialis*) in the late 1950s enabled significantly higher yields to be obtained on farms. Integration of chemical sprays with the existing non-chemical approaches was achieved by introducing crop monitoring to time applications with a knapsack sprayer fitted with a rear-mounted vertical boom, which allowed the dose of DDT or carbaryl to be adjusted in relation to plant growth. Improved distribution of spray aimed at young larvae allowed much lower dosages of insecticides than those recommended on cotton in the USA. Subsequently, tractor-mounted equipment with a similar vertical arrangement of nozzles was also introduced.

Since then there has been a great argument as to what IPM actually meant. Some were convinced that pesticides should be banned and advocated a combination of biological control methods, including the use of pheromones. Others realized that farmers frequently needed a quick response to serious pest infestations, which required pesticides. The search was for selective pesticides, that had little or no impact on natural enemies, but over the years, very few selective insecticides meeting these criteria have been commercialized. This is because companies need large potential markets to justify the enormous costs of research and development and registration of a new product.

Selective Insecticides in IPM

On many crops, aphids were considered to be the major pests, so there was a need to determine if a chemical with greater selectivity could be used to control aphids without adverse impacts on natural enemies. Thus, some of the older selective insecticides, such as pirimicarb, were aimed at aphid control. Subsequently, buprofezin, a thiadiazine insecticide was marketed as a moulting inhibitor for whitefly and abamectin, a natural fermentation product of the soil actinomycete bacterium *Streptomyces avermitilis*, and the related product emamectin was commercialized as a selective acaricide, to control phytophagous mites and other pests. [3]. Similarly since 2000, indoxacarb has been used on a wide range of crops to control certain Lepidoptera, cockroaches and ants.

Pesticide Application

Since the commercialization of DDT and herbicides such as 2,4-D, in the late 1940s, both farmers and the agrochemical industry thought that pesticides should be applied the same way as pre-1900. Bordeaux mixture was the first widely used fungicide to be applied, diluted in water as a hydraulic spray through cone and fan nozzles. High volumes of spray liquid, often over 1000 litres per hectare were used in the mistaken belief that all crop surfaces needed to be completely wetted for optimum pesticide effect. However, later spray volumes decreased for increased cost-effectiveness on arable crops and 200 litres/hectare became the standard. Whether the concern about pesticides that are formulated to mix with water reach ground water, ditches and rivers will lead to a change in methods of application is not known.

In Africa, however, water is not readily available in many agricultural systems, so the concept of ultra-low volume (ULV) spraying was introduced in the 1950s. This was initially for locust control when only 1 litre of an oil formulation was sprayed per hectare, using aircraft over large areas to control locust hoppers and swarms. Several years later in the 1970s in West Africa, ULV sprays were shown to be effective controlling bollworms on cotton using insecticides applied through hand-held sprayers with battery-operated spinning disc atomizer to generate the spray droplets.

Research on spray application technology has been increasingly neglected by agricultural research institutes, the agrochemical industry and universities possibly due to the multi-disciplinary nature of the subject. More recently, there has been greater interest in the development of seed treatments, especially using neonicotinoid insecticides. By early season seed treatment, farmers no longer needed to spray insecticides on crops, such as oilseed rape, eliminating the risk of 'spray drift' having an adverse impact on natural enemies and pollinators.

The Agrochemical Industry has become increasingly involved in plant breeding with a major development in genetically modified crops. Genes to produce toxins from *Bacillus thuringiensis*, incorporated into crops, apply a 'pesticide' within the plant to control lepidopteran pests. In parallel plants are modified to tolerate certain herbicides. For example, a broad-spectrum herbicide glyphosate can be applied selectively when the crop is established. These developments have undoubtedly simplified crop protection within some cropping systems. However, while bollworms may be controlled in cotton, many other sucking pests, such as whiteflies, can thrive and continue to transmit viruses. In addition, it is inevitable that the prolonged overuse of a single herbicide on many crops has led to the evolution of 'superweeds' resistant to glyphosate.

The Adoption of IPM Policies

IPM, now adopted as a policy, has stimulated the development of biological control methods. Within the agrochemical industry specialist, biological companies have been incorporated to expand their product portfolio. These developments have also served as a strong 'wake-up call' of the need to protect our environment and the values of integrating a wide spectrum of options within an IPM programme. One approach in Africa has been a 'push–pull' system to manipulate insect pests and their natural enemies using stimuli to protect a crop by 'pushing' pests away from a crop towards an attractive plant (pull) from which the pests can be subsequently removed [4].

Resistance to Pesticides

Pests and diseases continually exposed to the same pesticides inevitably become resistant and even development of new more resistant varieties has led to pests and diseases to adapt and still damage crops. Apart from registration of new pesticides, we need greater management of pesticides with different modes of action combined with a return to intelligent rotation of crops and the preservation and management of dedicated areas of land, as a landscape approach for natural pest enemies and pollinators, all essential ingredients for twenty-first century crop protection. New technology will allow better detection of pest problems, while precision farming utilizing improved application technology and targeting of pesticide delivery to control pests will minimize damage to the environment.

References

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About the authors

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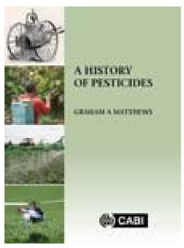

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