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Review

Integrated pest management and cultural control of vertebrate pests in Nigeria

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Plant products has since the creation of the world been the source of livelihood for both animals and man. These plants which are the primary producers have always been infested with pests and diseases. The use of IPM (integrated pest management. The control of these pests and diseases has become difficult in recent time and has also increased the economic losses while lack of effective control has always reduced yield. This in turn affects the sustainability of bumper harvest thereby hampering food security. Many methods have always been suggested for control of these common enemies of plants. These methods and measures include physical, cultural, biological and chemical. Physical includes the use of hand operations – hand picking, trapping burning etc. to reduce the pest populations in our farms. The cultural on the other hand involves cultivation operation which include crop rotation, tillage, flooding adjustment of planting and harvesting time, mulching etc. While biological control encourages the suppression of the pests through the action of some living organisms may include the use of vertebrate and invertebrate animals. All these have so far been tried as an effective control measures that have not left an undesired effect either on the plant or on the environment, the integrated pest management still deserve serious attention even though it has taken a center stage. A practical approach study and use of the IPM in the National research institute has proved to be a more dogmatic approach to the control of pests.

Key words: IPM, levels threshold, predators, rodents, vertebrate pests, vulnerable.

INTRODUCTION

In time past, most control measures that are used against pests were based on pesticide usage resulting to some problems. For example, worldwide, hundreds of pest species have developed resistance to various pesticides. Over-reliance on a particular type of chemical control measure can also lead to the replacement of one set of pests by another. These facts, together with the loss of some existing pesticides due to more stringent regulations, illustrate the need to employ as wide as variety of pest control measures as possible.

Integrated Pest Management (IPM) according to Bennett et al., (2010) refers to a system of managing pests through a wide variety of management practices and control measures that are environmentally sound and economically feasible. The main objective of an IPM system is to keep the population density of pest population below the level that causes

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economic loss. It is also an important step in blocking the development of pesticide resistance. IPM systems must be adaptable to changes in the environment, farming practices or the economic climate. Due to variability in climate and pest complexes, IPM systems are usually specific to a region and to a particular type of crop production. This paper x-rays the different aspects of IPM and their implications on the cropping system in Nigeria.

Basic Components of IPM: Fall *et al*., (1993) reported that IPM systems have three important components, which include information collection, threshold identification and control measures.

While it is known that millions of people in Nigeria share their meager households and foods with vertebrate pests rats, mice, and birds, Farm families, living in or near poverty and nutritional catastrophe, suffer a double loss- a portion of their crop both before as well as after harvest. While field crops are usually vulnerable to vertebrate pests damage during a short portion of the growing season, stored foods are vulnerable for as long as they are held in storage, sometimes for 6-112 months. Most storage of harvested crops occurs in farm household structures in the tropics and subtropics invariably are infested by one or more species of commensally and/or indigenous rodents and possibly depredations birds. Stored foods are regularly lost due to the consumption, contamination, wastage, and spoilage by vertebrate pests. Most serious of all is the loss of seed for the next crop (Steve and Dreistadt, 2004).

IMP System is Designed around these Basic Component

Acceptable Pest Levels: The emphasis is on control, not eradication. IPM holds that wiping out an entire pest population is often impossible, and the attempt can be expensive and unsafe. IPM programmes first work to establish acceptable pest levels, called action thresholds, and apply controls if those thresholds are crossed. These thresholds are pest and site specific, renaming that it may be acceptable at one side to have a weed such as white clover, but not at another site. Allowing a pest population to survive at a reasonable threshold reduces selection pressure.

Preventive Cultural Practices: Selecting varieties best for local growing conditions and maintaining healthy crops is the first line of defense. Plant quarantine and 'cultural techniques' such as crop sanitation are next, e.g., removal of diseased plants, and cleaning pruning shears to prevent spread of infections. Beneficial fungi and bacteria are added to the potting media of horticultural crops vulnerable to root diseases, greatly reducing the need for fungicides.

Monitoring: Regular observation is critically important. Observation is broken into inspection and identification, visual inspection, insect and spore traps, and other methods are used to monitor pest levels. Record-keeping is essential, as is a thorough knowledge target pest behaviour and reproductive cycles. Since insects are cold-blooded, their physical development is dependent on area temperatures. Many insects have had their development cycles modeled in terms of degree-days. The degree days of an environment determines the optimal time for a specific insect outbreak. Plant pathogens follow similar patterns of response to weather and season.

Mechanical Controls: Should a pest reach an unacceptable level, mechanical methods are the first options. They include simple hand picking, barriers, traps, vacuuming and tillage to disrupt breeding.

Biological Controls: Natural biological processes and materials can provide control, with acceptable environmental impact, and often at lower cost. The main approach is to promote beneficial insects that eat or parasitize target pests. Biological insecticides, derived from naturally occurring microorganisms (e.g. entomopathogenic fungi and entomopathogenic namatodes), also fall in this category. Further 'biology-based' or 'ecological' technique are under evaluation.

Use of the Economic Threshold in IPM

Complete control of pests is neither necessary lin most cases for maximum yields not appropriate for IPM. Nearly all crops can tolerate a certain amount of pest damage without appreciable effects on vigor and yield. For most of the key pests, quantitative studies of the amount of damage versus reduction in crop yield have established allowable levels of damage or population density. These measures of tolerable damage or density are referred to economic injury level" or "economic thresholds", which are fundamental to the goals of IPM. Without an estimate of the pest density that can be tolerated, there can be no reasonable safeguard against either overtreatment with pesticides or unacceptable crop damage.

Economic Injury Level (EIL): The lowest pest population level that will cause economic damage or the critical population density where the loss cause by the pest equals in monetary value to the cost of management.

Economic Threshold or Action Threshold (AT): The point at which management actions should be taken to prevent an increasing pest population from exceeding the economic injury level. The ET always represents a pest density or level of pest damage lower than the EIL.

Justification for IPM

A unilateral approach using pesticides has limitations; thus a socially acceptable and economically practical approach to crop protection is needed.

What are the problems with pesticides

- Economic and energy costs
- Resistance to pesticides
- Disruption of natural control
- Target pest resurgence
- Induced secondary pest outbreaks
- Human health hazards-acute and chronic effects- user and consumer risks
- Environmental pollution and effects on wildlife
- Effects on pollination

Goals of IPM

Increase farm profitability (increase net profit)

- Prevent or avoid crop and pest problems before economic losses occur
- Eliminate crop input expenses by avoiding unnecessary management actions
- Improve the efficiency of management actions by adopting better application practices.

Improve Environmental Quality

- Judicious use of pesticides and fertilizers based on identified needs.
- Use selective chemicals or application methods where possible to reduce risk to non-target organisms.

Major underlying Principles of IPM: The management unit is the agro ecosystem and any management action may produce and undesirable effects-this notion forms the basis of the system or holistic approach to IPM.

Any Pest Exists at some Tolerable Level: This notion forms the basis of the economic injury level concept.

Natural Control Factors Regulate Pest population and are Maximized: In IPM as the primary means of management, if these strategies fail to maintain pests below economic levels, then pesticides in combination with other tactics are used as a last resort.

Less than 100% Control is desirable to Leave a Permanent pest Residue: For natural enemies and as a refuge for susceptible pests to reduce the chances of resistance development.

Vertebrate Pests

Vertebrate animals (animals with a segment spinal column or “backbone”) are divided into five cases. These are mammals, birds’ fishes, reptiles and amphibians. All vertebrae animals have the potential to become pest.

Integrate vertebrate pest management: Integrated vertebrate pest management is based on using knowledge of the habits and biology of a species to effectively reduce or eliminate the damage, caused by that species, in a manner which maximize the safety of the environment, humans and other animals. Integrated vertebrate pest management most often involves a combination of actions, many of which are directed toward preventing pest problems prevention of animal pest problems provides a long term solution, whereas control, such as killing or otherwise removing offending animals, generally provides a short term solution.

Distribution and origin of vertebrate pest species: The distribution of vertebrate pest is closely related to the environment and ecological factors, mainly climate, vegetation and the availability of their nature food (fall *et al.,*1993). Most vertebrate pest species in African are indigenous with the exception of some rat species (Rosevear, 1969). Vertebrates that dwell in dense grasses are more abundant in the rain forest. The structure of the vegetation provides fossorial (burrowing), terrestrial (land-living) and arboreal (tree-climbing) habitats for animals. All three types of habitat occur and are occupied by vertebrates in the rain forest eg rodents such as ”glass cutters”, and several mouse-like rodents, primates and ungulate. Arboreal species are few or almost absent in the savanna grassland, except in the “forest outliers “or transitional areas.

Major vertebrate pests: rodents: These include bush rat or grass cutters, rabbit’s mice etc. they can be very serious pest of stored produce; rodents are th largest, and one of the most interesting, grounds of mammals. They are important components of virtually all of the earth’s terrestrial ecosystems and are important herbivores that aerate the sol by burrowing activities and assist plant propagation by consuming and disseminating seeds. They are significant economic pests that devastate crops, garden, orchards, or landscape planting, and damage commercial forest plantation. The rodent species that infest stored foods in farm and village structures differ in the several regions of the world. The primary rodent pests are the cosmopolitan, commensally rodents, of which the roof rat (*Rattus rattus)*, also known as the black or ship rat, is the major rat species found in food storage facilities, followed closely by the abundant and ubiquitous house mouse (*Mus musculus).* Since the mouse consumes far less food daily, it may be of lesser importance that the rat species in terms of overall amounts of food lost. The Norway rat (*Rattus norvegicus),* also known as the sewer, barn, or brown rat, is not as common and widely distributed as the roof rat, but is a formidable pest of food stores in many temperate areas of the world.

Birds: Birds and mammals are warm blooded thus; their activities are not limited by low or high weather to the same extent as insects and other invertebrates. Hence, they are highly destructive all the time of the year. They are among the most mobile creature that existed; their powerful flight is must superior to insect flight and most purposeful (Fall, *et al*., 1993).

Cultural Control of Vertebrate Pests in Nigeria

Cultural control is management tools and activities that make the crop habitat less favorable for pests to survive and cause damage (Horne, 2008). Cultural management practices may make the crop or habitat in hospitable to pests directly, for example, by planting cultivars resistant to pest feeding or rotating crops to deny overwintering pests their preferred food source. Cultural management practices an also make the habitat less hospitable to pests in an indirect manger by encouraging natural enemies (predators and parasitoids) to enhance biological control.

Cultural controls play a key role a controlled vertebrate pests; cultural controls are ways of modifying the garden environment to hamper pests' breeding feeding, and shelter habits. Cultural control practices can help reduce the need for pesticides while still maintaining a healthy garden. A healthy garden helps ensure healthy crops, and healthy crops are less susceptible to pest damage.

Cultural: This is concerned with manipulation of the environment in such a manner that it would be unfavorable for the pest thereby adversely preventing the damage or at least limiting its severity. Cultural control practices includes: selection of good site, use of clean planting materials, tillage, deep sowing, manipulation of planting and harvesting time, crop sanitation, crop rotation, intercropping, close season, planting of trap crop, mulching, irrigation, manipulation of crop spacing.

Cultural Control Methods

Sanitation: Removes existing infestation or the resources needed for a pest building (examples: cleaning grain bins and the surrounding area of infested grain and grain debris; removing manure breeding sites for filth flies; controlling weeds to minimize seed production and dispersal).

Tillage: Directly affects survival of insects that live in soil or crop debris. Indirectly it influences how attractive and suitable the environment is to insects. (example; educed tillage systems suffer more frequent and serve damage from black cutworms)

Resistant varieties: Are a low-cost highly effective control that has minimal impact on the environment. Some varieties may prevent a pest from becoming established or may kill it (Example: young corn contains a chemical that prohibits the European corn borer from growing varieties suffer less damage from the generation European corn borer if they are near faster-growing varieties). Some varieties may injury and still yield well losses from second-and third-generation European corn borer).

Crop rotation makes: It harder for a pest to know when or where a crop will appear. This strategy is very effective against pest that overwinter as eggs or larvae and against pests that have limited ability to disperse (example: crop rotation is extremely effective against corn rootworms that overwinter as eggs) crop rotation is useless against insects that disperse readily during the growing season, such as potato leafhopper, armyworms (Jahn *et al.,* 2001).

Cultural Practices

Habitant management: Breeding populations of rodent pests which can affect the next crop cycle survive non-crop periods in adjacent waste areas containing vegetation and crop residues. Simple husband vegetation such as field sanitation, clearing of farm borders and removal of potential nest sites, continuous inspection of farmers to identify and check damage and prompt harvesting can eliminate many rodent and other vertebrate pest problems.

Organized hunting and trapping for food: Farmers and hunters trap or shoot offending animals primary for food rather than to control crop pest. Hunting rats, for example by gangs of hunters and dogs, maybe employed but these are not usually effective. Small snap-traps and large leg-holding traps are uses by local farmers for killing rodents, bush fowl and larger vertebrate. Several types snares made from twine, thread, steel or aluminum wire are used to kill small rodents, squirrels, giant rats, cane rats, primates and ungulates.

Fencing of plots and snaring and / or scaring: Use of physical barriers such as 2.5cm mesh chicken wire is a preventative measure against most vertebrates including domestic animals such as goats, sheep, cattle and fowls where the fields are near settlements. Scares ("scare-crows" resembling a man) are also employed to keep away vertebrate pests.

Flushing, smoking of holes and destruction of burrows: Most fossorial rodent are flushed out of their burrows by hunters and farmer mainly for food purposes. Smoke generated from fires set at the entrance of burrows and blow into them is widely used to kill of giant rat and other mouse-like rodents. Artificial flooding of burrow with irrigation water are dam sires can also flush out rodent their burrows to be killed by dogs and hunters.

CONCLUSION

At this stage of our knowledge and the limitation impose by the sparse literature available on vertebrate pests; it is not possible to set out simple instructions for their control under different cropping patterns. More data are required on the species involved, their behavior, ecology, biology.

From the view point of predation the objective of an integrated control programme will be to increase the vulnerability of vertebrate pests.

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