

Consequences of Application of Biological Control in Agricultural Pest Management and its Effects on Native Ecosystem

Muhammed Shittu LAWAL Ph.D

Department of Forestry and Nature Conservation, College of Agriculture, Animal science and Veterinary Medicine, Butare University of Rwanda
daprx1@gmail.com

ABSTRACT

From agricultural perspectives use of biocontrol in any ecosystem has been enthusiastically championed as the credible and effective strategies that increase food production for global demand, this is however half truth because information on its ecological impacts is not adequately covered. Thus, this work brings forth the environmental hazards of biological control on ecosystem. For this research, extensive literatures on biocontrol and agricultural yield, workshop and conference reports were diligently read. In addition, comprehensive literatures materials on impacts of biological control in native ecosystem were consulted. Biological pesticides are parasitic and invasive in nature this has lead to dominancy and distortion of ecosystem chain in some cases because of their possible spread and recorded attack on non-target ecosystem species. Furthermore, some biological controls are insects, virus, bacteria and plant. Biological control could be invasive and become threats to native wildlife. Also, there are incidences when biocontrol endangered some established plant and wild animals' thus distorting ecosystem. In addition, biological controls with increase population compete with native species for environmental nutrients and resources for survival. A lot of ecological damages such as distortion of food web and nutrients cycles, parasitism and pathogenicity have been noticed where biological control was applied. For these reasons, the potential benefits that will arise from genuine ecological concerns in the development and use of biological control cannot be overemphasized with involvement of diverse interest holders. Finally, series of biocontrol experimental tests should be carried out in different regions of the world in other to gather more diverse data and information on possible biocontrol activities in different parts of the world before ratification for use. The assumed success of biological control in agricultural yield would be nothing compared to ecological impeding catastrophes likely to occur in nearest future because of multiple distortion of ecosystem.

Keyword: Ecosystem, Biological Pest control, Increased Agricultural production

INTRODUCTION

The recorded history of biological control may be considered as dating from Egyptian records of 4,000 years ago, where domestic cats were depicted as useful in rodent control (ANBP, 2010). Biological control is a method of controlling pests that relies on predation, parasitism, herbivory and other natural mechanisms and can be an important component of integrated pest management programs (Hoy, 1994). Bio-control use gain international popularity with the work of Paul H. DeBach an entomologist (*DeBach, 1964*). Identification of both the pest and known associated natural enemies is the first step in a biological control effort. There are many cases when associated natural enemies go outside their target to affect non-target species members of ecosystem. Furthermore, biological pest control application is gradually gaining more spread despite its dire

ecological threats. Besides, the international community is not given adequate attention to ecological dangers attached with biological pest control. In spite of environmental hazards, many entomology and allied research stations in advanced countries are working tirelessly to discover and produce more biological pest for agricultural use. In addition, more than one biological control is in existence. This include: Predator control, parasitic control and predator-parasitoid control. Also, there are insect and weed biological controls (University of California, 2018). All these have different ways they alter or interfere with natural ecosystem set up. Many native ecosystems have gotten one exotic species or the other from application of biological pest control. Besides this, there are three classes of pest control strategies: importation, augmentation and conservation (*Cornell University, 2016*).

LIST OF EARLY INTERNATIONAL SHIPMENT OF BIOLOGICAL PEST CONTROL

Year	Shipment	Type	From	To	Target
1873	<i>Tyroglyphus phylloxera</i>	Predator	USA	France	Grapevine phylloxera
1882	<i>Trichogramma minutum</i>	Parasitoidal	USA	Canada	Currant Worm
1884	<i>Cotesia glomerata</i>	Parasitoidal	USA	Europe	White butterfly
1888	<i>Rodolia cardinalis</i>	Insect	Australia	California	Cottony cushion scale

Source: (Adapted from https://en.wikipedia.org/wiki/Biological_pest_control 2018)

The high environmental dangers inherent in synthetic pesticide leads to consideration of

biological pest control systems (Lynch, 1998). However, the adoption of biological pest control is generating series of global

ecological concerns. The general perception of users of biological control pest management is that it is nature friendly and boosts food production. However, most users have little or no understanding of its ecological consequences. Messing *et al.*, (2006) stated that biological pest control regulation and adoption techniques by users may be ineffective. It is on this premise that this research work is carried out to establish the ecological implications of biocontrol agents on ecosystem.

Argument of Proponents of Biological Control Against Ecosystem Consideration

Economic reason is the strongest point put forward by proponents of biocontrol over other factors. For instance, Australian government justify use of biocontrol in a series of cost-benefit analysis with economic interpretation that state that on every dollar spent in application of biocontrol the reward is \$23 agricultural production profit. Also, another point raised by the same government is that elimination of rabbit in agriculture production yielded a gain of \$70 billion (Brian *et al.*, 2013).

Secondly, another supporting point put up by developers of biological control is that it is more environmental friendly and a lasting credible alternative to chemical pesticide that

have devastating effects on ecosystems. The under listed were summarized as general benefits of biocontrol use:

1. Firstly, biological control is a very specific strategy. The vast majority of the time, whatever predator is introduced will only control the population of the pest they are meant to target, making it a green alternative to chemical or mechanical control methods. For example, whereas weed killing chemicals can also destroy fruit-bearing plants, biological control allows the fruit to be left uninterrupted while the weeds are destroyed.
2. Furthermore, natural enemies introduced to the environment are capable of sustaining themselves, often by reducing whatever pest population they are supposed to manage. This means that after the initial introduction, very little effort is required to keep the system running fluidly. It also means that biological control can be kept in place for a much longer time than other methods of pest control.
3. Biological control can be cost effective in the long run. Although it

may cost a bit to introduce a new species to an environment, it's a tactic that only needs to be applied once due to its self-perpetuating nature.

4. Lastly, most important of all, it's effective. Whatever pest population you want to control will no doubt be controlled. Because the predator introduced will be naturally inclined to target the pests, very often you'll see the pest population dwindle.

Advantages and Disadvantages of Biological control at <http://owlcation.com>

How Biocontrol Works

Biocontrol works on target species gradually thus its effects is relatively slow at the beginning. Time is however needed for a biocontrol agent to establish itself successfully before causing significant damage to its host organism (Bio Test at www.dwaf.gov.za)

. Notwithstanding, not all growth of invasive species can be curbed purely by biological control (Bio Test at www.dwaf.gov.za). Biocontrol could be in any form like insects, weed, fungi, bacteria and plant.

Ecological Impacts of Biocontrol Use

There are many documented evils of biocontrol application globally. Most of these are not discern to farmers and many non

nature conservation experts. The danger of biocontrol use started originating from the first point of its application. Irrespective of a number of notable successes, there have also been a significant number of failures in biocontrol (Clausen *et al*, 1977). Today, it has become a global alarming issue that call for urgent attention. Some of the consequences are addressed below:

1. Effects of biological pest control on non-targets species in ecosystem

Although current biocontrol programs for weeds take precautions to minimize ecological risks, little attention is paid to the potential non-target effects of introduced food subsidies on native consumers (Yvnette *et al*, 2004). Biological control can be fickle. Ultimately, you can't control whatever natural enemy you set loose in an ecosystem. Bio-control has the tendencies of attacking non-target species through prey-predator switch mechanism. Many species that are considered useful have actually been attacked by bio-control pest. Stiling (2004) affirmed that potential risk of biocontrol use on nontarget species must be critically considered before application.

2. Impacts on native ecosystem

Bio-control pest can ravage world's ecosystems by distorting critical

environmental stability. Biocontrol grows and disperse rapidly in order to catch up with their target. Their fast growth leads to their high population density and strive for survival with endemic species. In short, biocontrol can be very apt in any ecosystem, once established in any environment they tend to permanently be members of native ecological species. This has endangered some native species.

3. Biological pesticides are parasitic

Application of biocontrol in some cases has led to endangering of some endemic species of ecosystems. In Washington DC, two researches demonstrated that two gall flies: *Urophora affinis* and *Urophora quadrifasciata* introduced for biological control of spotted knapweed *Centaurea maculosa* dramatically affect the foraging ecology of the deer mouse *Peromyscus maniculatus* (Yvnette et al., 2004). Some of the biocontrol are actually parasitic in nature killing or blocking and altering the physiological system of their hosts. In some cases they have tendencies to affect any other species. At times biocontrol becomes parasite in an ecosystem.

Biocontrol themselves uses disease spreading mechanism, this feature make them very risky to some other ecosystem species. They

transmit diseases outside unwanted to species thereby creating pathogenicity.

4. Biological controls are invasive

Biological pesticides are invasive in nature this has led to dominancy and distortion of ecosystem chain in some cases because of their possible unwanted spread. In Australia (1935), an introduced biocontrol in the name of cane toads (*Rhinella marina*) targeting cane beetles (*Dermolepida albohirtum*) became nuisance by invading and distorting many Queensland ecosystems. The cane toad covers an average of 40km per year in term of spread (Shanmuganathan *et al.*, 2010). The fact that biocontrol are invasive prone them to competing with native species for environmental resources. Competition for air, soil nutrient space and water increases as the population of biocontrol does.

Consequences of biological control on food chain/web and nutrients cycle

It invariably distorts food chain/web and nutrients cycle in ecosystem. In food and nutrients cycle, each species has its niche, both diseases and non-diseases causing organisms contribute to sustained natural flow of these web and cycle. However, biocontrol disruption in density of a particular species could have direct or

indirectly food/energy cycles effects on organism that relies on the said species in an ecosystem. Also, in food chain or web a species called predator in a particular situation becomes prey for another organism, therefore, acute disturbance of a species can alter the whole lots of the natural flow of food web and energy cycle. Few target pests do survives, in spite of the application of biocontrol agent, for this reason, biocontrol agents are always around continuously interfering with food and nutrients cycles in the natural environment (Bio Test at www.dwaf.gov.za). Biocontrol application in some cases has resulted into introduction of new species to native environment with consequences disruption of natural food web.

Conclusion

The assumed success of biological control in agricultural production yield would be nothing compare to ecological impeding catastrophes likely to result in nearest future which would have multiple life threaten effects. A lot of damages such as distortion of food web and nutrients cycles in ecosystem, parasitism and competition and pathogenicity have been done to natural ecosystem where biological control was applied. In conclusion, skeletal and immediate breakthrough in the application of biological pest control cannot

justify possible global distortion of natural environment.

Recommendations

The potential benefits that will arise from genuine ecological concerns in the development and use of biological control cannot be overemphasized with involvement of diverse interest holders. With this objective in mind, there is need for strict international policies collaboration on biological control standardization, monitoring, development and use that can justifiably remove ecological threats. Finally, series of biocontrol experimental tests should be carried out in different regions of the world in other to gather more diverse data and information on possible biocontrol activities in different parts of the world before ratification for use.

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