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The Exploration of Indigenous Knowledge on Management of Magonono in Enhancing the Production of Crops in Thulamela Municipality

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Introduction

Many flowering and fruit bearing plants are attacked by *Magonono* which feed mainly on flowers, with almost all flowering plants coming under attack, including roses and hibiscus as well as the flowers of vegetables like sunflower, sorghum, sweet potatoes, mangoes, beans, apples, pumpkin, alfalfa, beet, potato and tomato. Rose blooms can be partially or completely destroyed. *Magonono* also feed on the blossoms and fruit of stone-fruit and citrus and the aerial parts of green beans, especially the flowers, again causing considerable damage. At times, they cause lesions on fruit such as peaches as well as tomatoes when they are ripening, and sometimes the complete fruit is eaten. High numbers of *Magonono* can easily destroy a crop or reduce yields. *Magonono* can also cause lesions to fruit making it unmarketable. Special attention should be given to crops during flowering stage because it determines and affects the yield of the crop. During reproductive stages, there are lots of insects that linger around the beans because they are attracted by the flowers. Categories of these insects are pollinators such as bees and pests that feed on these flowers resulting to reduced production of the dry beans. *Magonono* are often known for their gregarious behaviour when attacking crops which can be catastrophic (Helm, 1992).

Harris (1941) avers that *Magonono,* commonly known as the Blister Beetles or Cape Mounted Rifle (CMR) beetles, were derived from South Africa where they were partly named after the old Cape Mounted Rifle brigade who had uniforms with similar black and yellow bands. These *Magonono* are known for their slow, buzzing or coloured brightly with yellow and black bands across the elytra announcing their toxicity to would-be predators (Bologma et al., 2001). There are many species of *Magonono*, some are fairly large with already over fifty species named and probably many not yet described (Bologma & Pinto, 2001). Most adult *Magonono* prefer different plant families such as sunflowers, beans, apples and potatoes by feeding on nectar of flowers, pollen, and sometimes entire flowers.

Many biopesticides including the Spinosad, an OMRI-listed biopesticide that kills within 24 to 48 hours, have been mentioned to control *Magonono,* however, none has been mentioned to use *Magonono* to control the *Magonono*. Once *Magonono* are well-established, they are almost impossible to eradicate completely, even if chemical or other toxic sprays are used (Kinney et al., 2006). Different methods such as hand picking

have been used to control *Magonono* in the fields. According to Stone (2007), indigenous knowledge refers to what indigenous people know and do, and what they have known and done for generations, as well as practices that have evolved through trial and error and proved flexible enough to cope with change. Indigenous practices play a vital role in sustainable agriculture. It has advantages over outside knowledge as it is cost effective and readily available. Indigenous knowledge systems and technologies are found to be socially desirable, economically affordable, sustainable and involve minimum risk to rural farmers and products.

In many cases, traditional knowledge has been orally passed for generations from one person to another and this can be expressed through stories, songs, art and even laws. It has been suggest that "indigenous knowledge is frequently charged with being methodically wide….unproven populist or politically naive; and that it generates findings that are too complicated to be of practical use to policy makers". Often, western science and indigenous knowledge are seen as two different competing knowledge systems, characterized by a binary divide. Indigenous knowledge therefore, becomes something much driven by the pragmatic, utilitarian and everyday demands of life. Indigenous knowledge is thus, dynamic and creative and experimental, constantly incorporating outside influences and inside innovations to meet new conditions.

Insect pests cause heavy losses to crops, hence, curative control measures are practiced to protect the crops. Amongst them, chemical fertilisers are applied, but they are dangerous and affect non-target organisms and the environment. The traditional pest control practice plays an important role in the management of agriculture and it is an inevitable practice for sustainable agriculture. The proper control of pests minimizes economic losses and damage to the environment. The traditional system of pest management is an economic and environmental friendly approach as chemical pesticides have adverse effects on biotic and abiotic components of the ecosystem (Nath & Ray, 2012).

The crops are severely affected by a number of insect pests, amongst them are *Magonono* which are the most damaging and major pests (Visser, 2009). There are numerous insecticides that can be used to control insects in all developmental forms such as ovicides and larvicides (Helm, 1992). However, most controls for feed and grass crops, including spraying, cannot entirely eliminate the insects or the threat they pose, instead they only decrease the spread of the beetles in the fields.

Recently, it is believed that the use of insecticides is one of the major factors behind the agricultural productivity in the 21st Century. However, some insecticides kill or harm other creatures in addition to those they are intended to kill such as birds that may be poisoned when they feed on food that was recently sprayed with these chemicals. Sprayed insecticides may drift from the area in which they were applied into wildlife, especially when sprayed aerially (Shokrzadeh and Saravi, 2011). Insecticides may also lead to a decline in pollinators by killing bees that are meant for cross – pollination and this will result in a reduction of crop yields. Hence, all insects have the potential to significantly alter ecosystems as many are toxic to humans and others are concentrated in food chain. Therefore, it is necessary to balance agricultural needs with the environmental and health issues when using insecticides.

The use of biological pest control has recently been brought back in vogue to reduce the effort of broad spectrum toxins added because they have little effect on other organisms and they are considered more environmental friendly than the synthetic pesticides. Various plants have been used as indigenous insecticides for centuries as there are farmers who have reported successfully using spray of crudely fermented alcohol, tobacco, *Musudzungwane* and pyrethrum as effective insecticides (Helm, 1992). *Magonono* causes heavy damage on flowers (during flowering stage) and on fruits in Thulamela municipality where local farmers are practicing the management process of this pest in their own way. Considering the importance of farmers' indigenous knowledge based practices in pest management, the present paper explored the indigenous knowledge on management of *Magonono* to enhance the production of crops in Thulamela municipality.

Methodology

The current study used Google scholarly database to acquired knowledge wherein key words such as indigenous knowledge, insecticides and manage were used for the research. Other key words used interchangeably for obtaining clear knowledge included "traditional knowledge", "pesticides" and "control". The research was conducted to allow researcher to learn about indigenous knowledge in management of Magonono to enhance crop production at Thulamela Municipality.

After looking at the literature, the researcher identified the information gap regarding the *Magogono* biopesticide and felt it imperative and above all, necessarily important and justified to report on establishing the Indigenous Knowledge on management of *Magonono* in enhancing the production of crops in Thulamela municipality.

Results and Discussions

3.1. Description of Magonono

Magonono, commonly known as the Blister Beetles or Cape Mounted Rifle (CMR) beetles, have approximately 2500 species, divided among 120 genera and four subfamilies (Bologna & Pinto 2001). The larger *Magonono* are common in Africa including South Africa, Zambia, Zimbwabwe as well as in parts of the world such as India, America, France, and many more. *Magonono h*ave their distinctive yellow and black, red and black, orange and black colour collaboration (Figure 1). These *Magonono* have been well researched especially in health for their healing, zoologically for their habitat, and agriculturally as pests (Bologna & Pinto, 2002).

Magonono are plant eating and favours the flowers of beans of all kinds, sweet potatoes, sunflowers, beans, apples and potatoes and particularly a small mauve convolvulus-like weed of sorghum heads as soon as grain begins to set (Harris, 1941). *Magonono* visit flowers to feed on nectar, pollen, and sometimes entire flowers.

Figure 1: Various pictures of *Magonono* from different locations/ countries (Bologma *et al.* 2001).

3.2. Conventional/ Synthetic pesticides

Destructive activities of numerous pests including fungi, weeds and insects are faced by Agriculture from time to time, sometimes leading to

drastic decreases in yields and quantities (Chandler et al., 2011). There are many pests affecting crops such as thrips, common bean weevil, blister beetles and many more (Figure 2). These pests occur naturally while others are introduced (with other pests species being non-native) either naturally or accidentally in various areas of the world which are highly aggressive, however, controlling these pests is challenging worldwide, hence the use of pesticides.

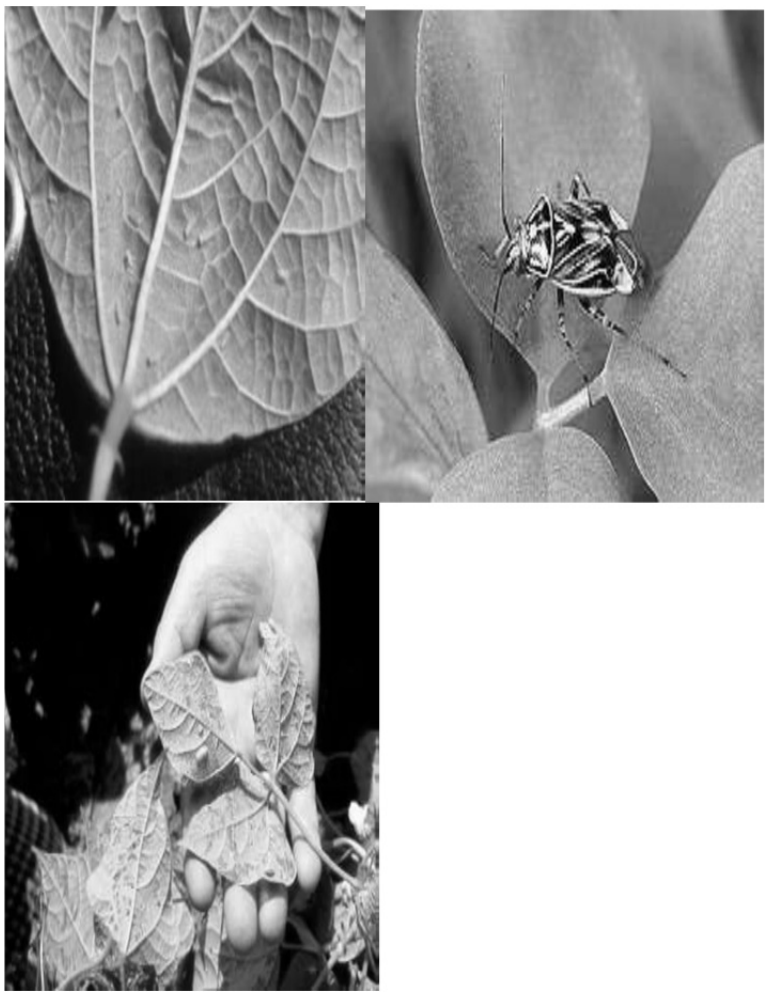

Figure 2: Examples of insects that damages the beans include leaf hoppers, plant bug, bean beetle and many more (Visser, 2009).

The most important pests of *crops*, the damage caused by these pests and possible treatment are shown in Table 1. Pesticides are chemical

compounds used to kill pests, including insects, rodents, fungi and weeds and they are used in public health to kill vectors of disease such as mosquitoes, and in agriculture, to kill pests that damage crops (Shokrzadeh and Saravi, 2011). These pesticides had made a great contribution to the battle against pests and diseases over years to control many pests in agricultural sector, however, their continuous use has raised concern in both human health and environment, resulting in development of insecticide resistance and extensive damage to the environment, pest resurgence and pest resistance to lethal effects on target organisms (Stoddard *et al.*, 2010; Abudulai *et al.*, 2001; Mnif & Ghribi, 2015). Therefore, effective methods of controlling insects have been highly required, hence, the introduction of integrated pest management system which entails cultivation practices and chemical control.

Various ways have been utilized to define Intergraded Pest Management (IPM), however, there is one widely used definition formulated by the United States Department of Agriculture in 1996 which states that IPM is "a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health and environmental risks" (Stoddard *et al.*, 2010). In the definition, it is shown that the word "pests" includes diseases and weeds as well as animals. Other IPM key aspects include understanding the biology of the pest for modelling and predicting outbreaks as well as the concept of threshold of damage which is economically worthwhile for application of control methods. Therefore, an ecofriendly alternative is required to generate higher quality and greater quantity of agricultural products. Hence, an urgent need has risen for the development of biopesticides for effective control of agricultural pests without causing serious damage to the ecological chain or worsening environmental pollution.

Table 1: The most important pests or crops, the damage caused by these pests and possible treatment as shown in the following table

Insects	Damage	Treatment
Black bean aphid Groundnut aphid	Vectors of various viruses	Apply suitable insecticide
Tobacco whitefly	Potential vector of bean golden mosaic virus	No insecticide currently registered
Tobacco leafhopper	Suck sap from leaves	No treatment necessary
Bean seed maggot	Maggots attack cotyledons, mine into stems below soil level and pupate	Control with a seed dressing insecticide
Bean stem maggot	Maggots mine into stems and pupate	No insecticide currently registered
Spotted maize Beetle	Beetles feed on pollen, destroy flowers	No insecticide currently registered Apply suitable Insecticide
CMR beetle Black maize beetle	Damage stems on or beneath soil surface	Apply suitable Insecticide
	Feed on young leaves, petals and pollen	Apply suitable Insecticide
Bean bug	Suck sap from leaves, stems and pods—cause wilting of developing pods	No insecticide currently registered
Tip wilter		No insecticide currently registered
Green vegetable bug	Suck sap from stems—cause wilting and dying of tips of shoots	No insecticide currently registered
	Suck sap from pods—cause browning of seeds inside	No insecticide currently registered
Common cutworm	Damage stems on or beneath soil surface	Apply suitable Insecticide

3.3. Biopesticides

Biopesticides are recently receiving abundant attention in integrated pest management programs as a means to reduce the amount of synthetic chemical products being used to control plant pests and diseases as well as protecting stored products (Mnif & Ghribi, 2015). There are many definitions of biopesticides, however, according to the Organisation for Economic Co-operation and Development of 2009, biopesticides are defined as mass- produced agent manufactured from a living micro-organism or a natural product and sold for the control of plant pests. Even though biopesticides are derived from different natural resources, they are categorised under three main types, namely: micro-organisms, biochemical and semi-chemicals where they are classified as microbial pesticides, botanical pesticides, zooid pesticides and genetically modified plants (Chandler *et al.,* 2011).

Due to their benefits such as low residue, high performance, fewer toxic side effects and good compatibility with the environment; biopesticides are swiftly preferred to control pests since they have an advantage of higher selectivity and non- target biological safety (Cheng *et al*, 2010). Biopesticides are currently trending in the global pesticide industry as compared to their chemical counterparts. Worldwide weeds, pathogens and pestiferous insects are biologically controlled by microbial pesticides derived from bacteria, fungi, oomcytes, viruses and protozoa as indicated by Nawaz *et al.* (2016) (see Table 2). In crops, bacterial biopesticides claim 74% of the market; fungal biopesticides 10%; viral biopesticides 5%; predator biopesticides about 8% and other biopesticides 3% (Thakore, 2006). However, only a few insects have been developed as biological agents which is a core of interest of the current study at Thulamela Municipality.

Table 2: Some important biopesticides list and their references (Nawaz *et al.*, 2016)

Target insect	Common name
Entomopathogenic viruses	
Helicoverpa zea: corn earworm, tomato fruitworm, tobacco budworm, *Helioth virescens*	Corn earworm NPV (HezeSNPV)
Helicoverpa armigera, cotton bollworm, pod borer	Cotton bollworm NPV (HearNPV)
Plutella xylostella	Diamond back moth GV
*Anticarsia gemmatal*s	elvetbean caterpillar, NPV (AngeMNPV)
Noctuidae	Alfalfa looper NPV (AucaMNPV)
Buzura suppressaria	Tea moth (BuzuNPV)
Entomopathogenic bacteria	
Lepidoptera	*Bacillus thuringiensis* subspecies kurstakia
Lepidoptera	*B. thuringiensis* sub-species aizawaia
Coleoptera: Scarabaeidae	*B. thuringiensis* sub-species japonensis
Coleoptera: Scarabaeidae, *Popillia japonica*	*Paenibacillus popilliae*
Entomopathogenic fungi	
Hemiptera	*Aschersonia aleyrodis*
Coleoptera (Scarabaeidae)	*Beauveria brongniartii*
Hemiptera, Thysanoptera	*Conidiobolus thromboides* Acari
Hemiptera	*Lecanicillium longisporum*
Coleoptera, Diptera, Hemiptera, Isoptera	*Metarhizium anisopliae sensu* lato
Lepidoptera	*Nomuraea rileyi*

3.4. Indigenous knowledge on the use of biomaterials for pest management

> A lot of research has been conducted which indicated that emerging farmers in rural areas use traditional methods to protect field crops. For example, canola oil and baking soda have pesticidal applications and are considered biopesticides. However, it has been gathered by researchers that farmers' indigenous knowledge was pivotal to the success of any pest control and has shifted the focus and approach of research on biopesticides (Nawaz *et al.*, 2016).

There is a lot of information on literature regarding the indigenous knowledge and the use of biopesticides to document the type of biological material used, crop product, insect pest targeted, mode of application, key results and major conclusions (Table 3). Literature

indicates that there has been a reasonable degree of success on the use of botanical materials by indigenous people for protection of crops in the field.

Less information is available on the biopesticide developed from the *Magonono* as a pest management on crops. However, Harris, 1941 asserts that *Magonono* were collected in jars, gourds or bags before being killed by dipping them for half a minute in boiling water in cotton bags, spread out to dry in a thin layer in the sun for at least four days. Due to the smell, the drying process was carried out away from the offices and dwellings where the *Magonono* would be stored in clean bags in dry place for research. The methodology used by Harris in collecting, drying as well as the observation on the smell of *Magonono* concurs with the methodology of farmers on the development of the biopesticide, therefore it is important for the current study to look into the indigenous methodology used on the biopesticide developed from *Magonono*.

Even though farmers used their indigenous knowledge to control pests for generations, not much has been researched and applied. In order to formulate effective biopesticides and thus improve food security and alleviate poverty in Mbahela village, the indigenous knowledge base on insect pest management needs to be researched and used as a starting point for production and formulation of an effective indigenous biopesticide. In this regard, this study will investigate the indigenous knowledge on management of *Magonono* in enhancing the production of crops in Thulamela municipality.

3.5. Equipment for Application of Biopesticide

Various types of biopesticide application systems are needed to meet the individual application requirements of commercially available biopesticides since there are many varieties of products involved (Gan-Mor *et al*., 2014). Commercial use of low-toxicity biopesticides has been accomplished by means of very uniform spraying which might increase its uniformity by the use of improved systems such as air-assisted spraying in conjunction with electrostatic technologies (Figure 3). Many biopesticide products that exhibit good control capabilities in laboratories or small-scale tests have not successfully been scaled up for full-scale field uses since there have been no special equipment designed for their application. Furthermore, indigenous biopesticides such as neem, tobacco, and many more developed by subsistence farmers have

no equipment developed for them to be applied simply on different crops. Therefore, farmers use their indigenous ways to apply the biopesticide (Figure 4). However, the questions that arise are: Is the methodology effective? Is the methodology sustainable? Does the methodology affect the environment?

Figure 3: Conventional equipment used to apply biopesticides on different crops (Bozdogan *et al*, 2017).

Figure 4: Indigenous equipment used to apply *Magonono* biopesticide

Table 3: Indigenous Knowledge and the use of biomaterials in crop protection (Moshi & Matoju, 2017)

Type of biomaterial	Product	Targeted insect pest	Mode of application	Key results	Major conclusions	Reference
Fish bean	Tomatoes, cotton and watermelon	Field pests on tomatoes	Leaves grounded and soaked in water for a given time and the filtrate sprayed to crops	The solution was effective both as pesticide and as fungicide	Bio-safety and quality studies are required for quality assessment of resulting product for human consumption/ health.	Mihale *et al.*, 2009; Goufo *et al.*, 2010
Cow dung, Wood ash	Cereals and pulses	Storage pests	Plastered on the outside of storage container or mixed with the grains	The dung acts as a repellent and Ash significantly reduced the number of damaged grains	The practices are reported as being cost effective and environmentally safe	Mihale *et al.*, 2009; Mehta *et al.,* 2012
Kitchen ash	Maize	Storage pests	The ash is mixed with the grains	Maize grains were protected against storage pests	Reduction of or killing of insect pests could be through blockage of insects spiracles.	Kaliba *et al.,* 1998
Wood	Pigean pea	Insect	Mixed	Used by	Seeds were	Minja *et*

ash/Chilies		pests	with the grain stored for food or seed	45% farmers	protected against insect pests	*al.,* 1999
Neem kernels, Rubber hedge leaves and seeds	Cabbage and Rice	Rice beetles and Caterpillars	Cut in pieces and soaked in water, then sprayed	Works against both pests	Effective than Neem kernels	Berger, 1994

Table 4: Biopesticides research activities (Moshi & Matoju, 2017)

Source of pesticidal material	Product or crop	Target pest	Main results/conclusions/lessons	Reference
Worm seed and *Khakhi weed*	Beans	*Seed beetle*	Powdered or whole leaves of worm seed were the most effective, with 100% mortality of adult insects in less than 3 days. K*hakhi weed* applied as a powder also increased mortality and reduced oviposition and progeny production significantly.	Paul *et al.*, 2009
Rubber hedge and Tree marigold	Beans	Pests of common beans	Application of *rubber hedge* leaf extract showed improved grain yield and quality when used appropriately. It is touted as a pest control and soil enrichment agent	Mkenda *et al.*, 2014
Bitter tea, Musudzungwane, and *tree marigold*	Leaves	Legume insect pests	Review on the use of extracts from these plants proposed that it is a promising strategy in controlling legume pests in the field and storage at a reasonable cost.	Mwanauta *et al.,* 2014
Oils from sesame, palm and maize	Bean	Bean weevil	Castor and palm oils resulted in effective protection comparable to that of malathion. It is possible to use castor or palm oils to protect common bean against *bean weavil* infestations with no effect on seed germination capability. It is cheap and can be obtained locally	Mushoboyzy *et al.,* 2009

Rubber hedge, tobacco, cow dung, Neem and Black pepper	Cowpea	Cowpea weevil	Leaf powders of *rubber hedge* tobacco snuff and combination of Neem and rubber hedge were effective in preserving stored grain of cowpeas	Reuben and Rhodes, 2006 Mkenda *et al.*, 2015b

Conclusion

Tomatoes, apples, sweet potato, dry beans, sunflower, sorghum and mangoes are most important cash crops as well as exportable commodities. Farmers may use biopesticides to perceive as effective pesticides. Biopesticides are considered environmentally safe, selective, biodegradble, economical and renewable alternatives to use in crops. Biopesticides are natural plant products and maybe grown by farmers with minimum costs and extracted by indigenous methods. Approximately plant species have been reported to possess' pest control properties. Botanicals such as neem, ghora-neem, mahogoni, karanja, adathoda, sweet flag, tobacco, derris, Annona, smart weed, bar weed, datura, sunflower, lantana, marigold and many more can be grown and also be used as an alternative to chemical pesticides. These botanical extracts can be used to manage pests such as red spider mite, aphids, thrips, jassid, flush-worm, termites, nematodes however there is no information on Magonono as botanical pesticide on various crops. Magonono biopesticide should also be given an opportunity as a biopesticide. Then pest control on crops at Thulamela Municipality should be looked at in order to enhance crop productivity and food security. The use of Magonono biopesticede should be incorporated in the pest management of crops which will be helpful for producing Magonono free crops. This will be helpful in minimizing the undesirable side effects of synthetic pesticides and ultimately environmental pollution will be minimized. The successful exploitation of the Magonono harvesting will require significant monitoring as well as appropriate research to identify ways and methods to avoid extinction of the Magonono.

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