YAM BEETLES (HETEROLIGUS SPP) CONTROL TRENDS IN NIGERIA

F. O. TOBIH.

Department of Agronomy, Delta State University,
Asaba Campus, Asaba
Email: tobih002@yahoo.com

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Abstract
Yam beetles are a perennial insect pest problem in most of the yam growing regions in Nigeria, particularly those areas found within the forest and derived savannah. The study was undertaken to assess the trends and various methods used to control the yam beetle menace. Aldrin dust an organochlorine insecticide was used widely and economically against the devastation of the beetle in the sixties and seventies until it was banned due to its persistence and residual environmental problems. Other insecticides evaluated to combat the problems were Furadan, Carbofuran and Chlorphyriphos which gave relatively satisfactory results. Cultural, resistant varieties, plastic mulch, biological agents did not give any economic control. It was suggested that more research should be focused on more environmentally safe and friendly insecticides since this is the only feasible option to control this pest for now.

Keywords: Yam beetle, control, insecticides, damage, yam tuber.

Introduction

Yam (Genius: *Dioscorea*) is a major staple food crops feeding an estimated 60 million people in the region stretching from Ivory Coast to Cameroon, an area commonly referred to as yam zone of West Africa (IITA, 1998; Okwor and Asiedu 1995; Ekpe *et al.*, 2005). In Nigeria, most of the production is in the Northern rainforest and Southern Guinea Savannah zones (Wood, *et al*., 1980). The crop is also cultivated in other parts of the World like India, Asia, South America, Caribbean, etc. with world production exceeding 30 million metric tonnes per annum (Okonkwo, 1985, FAO, 1994; 1998). Due to its significance in rural economies, in the 1850s, it was reported that yams were one of the chief articles of trade, "the staff of life" and the staple food of the population between the forest and savannah transitional zone (Agboola, 1979). The economic importance of yam is largely due to the tuberous underground stem, which may weigh 15 – 20kg (Timothy and Bassey, 2009; Ukpabi and Okoli, 2002). It was reported that between 1.5 – 2 million hectares of land are put to yams production annually with bulk production coming from the Southern part of Nigeria (Enwezor *et al*, 1989), the largest world producer (31.5 million tonnes annually (CBN, 2003) and the largest consumer of the produce (Ezulike *et al*, 2006).

One major constraint to optimum yam production is the damage inflicted on yams by the yam tuber beetles *Heteroligus* spp (Taylor, 1964, Onwueme, 1978, Tobih *et al.*, 2007). The genus was reported to be a very serious insect pest of yam in riverine areas particularly in the rainforest zones up to the savannah regions along the Benue-Niger Rivers and tributaries (McNamara and Acholo, 1995). The beetles cause untold losses and drastic reduction in the yields and market values of yams (Taylor, 1971; Wood *et*

al., 1980; Tobih, *et al.*, 2009). Adult beetles feed on tubers making large hemi-semi hemispherical holes (1 - 2 cm) on the tuber prior to harvest resulting in low market value and a predisposition to bacterial and fungal attack in storage.

The review study was undertaken primarily to evaluate the control measures taken so far in Nigeria, their level of effectiveness and recommend appropriate control strategies for yam beetles decimation in Nigeria. Early studies in yam cropping system indicated loss due to yam beetle attack ranging from 22-74% and recently 31-57% in some part of Delta State Nigeria was reported (Taylor, 1964; Tobih *et al*., 2007).

Damage Caused by Yam Beetle

The economic importance achieved by the yam beetles in the early twenties in the yam growing regions in Nigeria and the concern over the losses due to damages caused to yam tubers, is exemplified by the quotation from a petition addressed to the Government by the people of Afikpo Division in Eastern Nigeria now Cross River State in 1952: "About two years ago, we noticed certain insects beetles, Ebe (local name for the beetle). They attacked almost every yam in a bed and in some cases the yams were useless to us. The yams destroyed this year have caused almost without exaggeration, a great dearth (famine) in the land. It is a threat to us and we do not know what may happen in the next few months". The alarm and devastation was not limited to the people of Afikpo alone but were equally experienced in the yam growing areas of Benin (Edo), Warri, Asaba (Delta), Onitsha (Anambra), Lokoja (Kogi), Rivers, Benue and Adamawa Provinces currently Edo and Ondo, Delta, Anambra, Kogi, Rivers, Benue, Adamawa and Yobe States respectively (Taylor, 1964; Tobih *et al*., 2007; Okoroafor, *et al*., 2007).

Early Research/Work on Yam Beetles

Yam beetle decimation and problems was recognized, widespread and its importance and significance motivated Golding (1928) and Lean (1928-29) to carry out some preliminary studies on the control. Due to the urgency needed to address the beetle damage problem, certain 'off-the-cuff' recommendations for control were made. These included the use of repellents like kerosene, naphthalene and some available cultural methods but they all proved infective. The solution to the problem posed by the yam beetles was found when Aldrin 2.5D was discovered in the early sixties. It was reported to give acceptable control against the beetles. Unfortunately, in the recent times, Aldrin 2.5D and related organochlorine insecticides were banned because of their persistence and biomagnifications properties. The development caused serious reversion in the control of these beetles, devastating yam tubers in many yam growing regions in Nigeria.

Consequently, several organochlorine insecticides such as Agrocide, Aldrin, Chlordane, Dieldrin and Endrine were evaluated either as seed dressing or spray on yam heaps, but Aldrin 2.5D applied as seed dressing to yam setts proved the most effective, satisfactory and economic in the control of the beetles resulting in up to 70% reduction in damage and increased tuber yield by 20-70% on late planted yams (Taylor, 1964). This was however not very effective on the early planted yams because the treated setts had rotted before the entry of the beetles into the yam heaps, leaving the unprotected new tubers and tuber initials to serious damage by the yam beetles. Jerath (1967) however revealed that the menace of the beetle can be effectively controlled in the early planted yams (November) by applying Aldrin 2.5D, Teoldrin and Lindane around the plant 4 months after planting. This ensured that the insecticides will still be at full strength when the yam beetles enter the yam heaps. According to PANS, (1978)

Endosulfan 5D (Thiodan) was equally effective and so recommended for yam beetles control.

The fears expressed in the use of organochlorine insecticide in controlling pests of roots and tuber crops especially in the yam beetle saga were their persistence and biomagnifications properties. These were however allayed when Taylor (1969) reported that peeled aldrin-treated yams (pulp) and not the peels from aldrin-treated yams were totally safe for human and animal consumption. Due to the hue and cry generally expressed over the use of Aldrin 2.5D and the subsequent banning of the insecticides, many organophosphates and carbamates were evaluated for possible substitute for organochlorines. At Bori, in River State, Sumithion 2.5D and Pronet 40 SD were identified. The results obtained indicated the insecticides exerting controlling effects on yam beetles as Aldrin 2.5D when applied at tuber initiation (Emehute, *et al*, 1991). Carbofuran (2, 3, dihydro-2, 2-dimethyl-7-benzafuranyl methylcarbamate) has been documented as an effective substitute to Aldrin dust for the control of yam beetle menace (Umeozor, 1998). Desirable properties of carbofuran include low contamination on application, rapid metabolization and excretion by vertebrate and invertebrate with very negligible bio-accumulation in the food chain. Carcinogenecity, mutagenecity and tetratogenecity test were all found to be negative.

To this end, new trends and challenges in Agricultural research are involved in the development of new cultivars, agro technical systems, approaches for control measures of insect pests and diseases. the global focus in production emphasises how external input and sustainable agriculture (LEISA), based mainly on inputs from farmer's farms to ensure access and control to protection strategies that will guide long term sustainability.

Different Control Measures Used

Various control methods were employed to combat the problems of yam beetles attack. This included cultural, chemical, biological, resistance varieties and integrated pest management.

Cultural Method

Different cultural practices were used to combat the menace of yam beetle damage. Gregory (1960) showed that yam vines act as signal posts to the flying beetles, and that yam heaps stand a greater chance of being attacked when the vines are 4 feet or more in length. It was also reported that yams planted on the flat attracted higher beetles attack than those on small heaps/hills simply because those on flats attained a 4-foot stage earlier than those on heaps and ridges which invariably exposed them to beetle attack for a longer periods. Manipulation of planting dates is another cultural practices adopted to limit the damage of these beetles. It was reported that yam planted between March and June showed varied degree of beetle damage in Benin area. The attack rate is usually lower on late planted yam (June/July) or those planted towards the tail end of the yam beetle migration period, this was corroborated by Tobih *et al.* (2011) who reported 'severe' and 'very severe' damages for the early planted yams (March-May) while the June and July plantings had 'mild' and 'moderate' damages in Oshimili Areas of Delta State. The yield were however higher in the early plantings than late ones. It was therefore recommended that yam setts/minisetts producers should do their plantings in June and early July to enhance good quality tubers which are relatively free from beetle attacks.

Different plant materials (leaves) *Azadirachta indica, Cymbopogon citratus, Thevetia peruviana, Ocimum viride, Cassia spp, Chromolaena odorta,* and *Jathropha curcas*

were used as mulch to evaluate their effects on beetle damage on yam tubers. Result obtained indicated that the plant materials applied caused varied significant differences in the feeding activities of the beetle across planting locations and seasons. *Cymbopogon citratus* and *Ocimum viride* were reported to be good *repellent/antifeedant* botanicals to the beetle among the reported ones with significant higher tuber yields and less beetle damages than others evaluated. However, none of the botanicals evaluated caused beetle mortality (Tobih, 2011). Another report on the use of plastic mulch to control yam tuber beetle showed that the mulch (plastic) had positive impact on tuber yield with percentage yield increase over control ranged from 23% - 66%. However, the result observed that these plastic mulches were not effective against the beetle devastation but offered some protection. According to Okoroafor et al, (2007) the efficacies of husk of powder from *Parkia biglobosa* plant, seed and leaf powder from *Azardirachta indica, A.* Juss were evaluated for possible yam tuber protection against *H. meles* damage in the soil during tuber sprouting and tuber initiation to harvests. The results obtained indicated significant reduction in the number depth and diameter of feeding holes caused by the beetles compared to untreated control.

The use of various varieties and cultivars of yam to assess their resistance to yam beetle attack was reported by Tobih *et al.* (2009). It was reported that of all the eight cultivars of yam evaluated only *Dioscorea dumetorum* and *D. cayanensis* showed some degree of resistance and tolerance to the beetle with 'mild' damage irrespective of time and location. It was however attributed partly to the bitter taste and alkaloid properties in *D. duemtorum* while the late tuber initiation in *D. cayanensis* could be the reason for its tolerance. The susceptible tuber attacked ranged from 97% to 80% while the tolerant cultivars (*D. dumetorum* and *D. cayanensis*) attacked ranged from 20% - 29% respectively according to the report.

Chemical control

Attempts to control yam beetles using chemicals came as a result of pressure from farmers who wanted immediate solution to yam beetle destructive and devastating problems. As Taylor (1964) declared, "since farmers wanted an immediate solution and not willing to wait for research results (bionomic studies), certain 'off-the-cuff' recommendation for the control had to be made". Repellents like kerosene and naphthalene were used unsuccessfully in a dare attempt to find a quick control against the ravaging beetles (Taylor, 1964). However, rewarding insecticidal trials dated back in 1953 was found when insecticidal dusts was rubbed unto yam setts and knocking off excess before planting resulted in economic control (Jerath, 1967).

Field assessment of yam beetle damage on some cultivars in Benue state, indicated that all varieties of yam evaluated were significantly damaged by yam beetle but *Bioscorea ritundata cv Tamengyo* is considered promising in managing yam beetle damage in resource poor farmers fields (Okoraofor, *et al*., 2007)

Recently, three insecticides, carbofuran, chlorpyriphos and endosulfan were evaluated for the control of yam beetle in Asaba, Delta State, Nigeria. The result obtained showed that the insecticides were very effective against the beetle infestation. There were significant increases in the tuber yields, drastic reduction in the beetle feeding index like feeding holes, depth and diameter of feeding holes while percentage yield increase over the control was reported to range between 23% to 68% (Tobih *et al.*, 2007).

Biological Control

This is the least researched area probably due to difficulties in identifying proper and effective biological agents to control the yam beetles or the fact that the beetles do not lend themselves easily to biological control principle and practices. Researchers may not have been able to explore this area effectively for proper and safe management of the pests. Nonetheless, some members of Tachinidae and Calliphoridae were reported to be parasiting larvae of yam beetle (Jerath 1967; Taylor, 1964). Some Sarcophagidae was also bred by Taylor from yam beetles but the parasites were not reckoned as important in the control of yam beetles. Farmers in beetle endemic areas have found some rodents such as (Ground squirrel) in the predation of yam beetles. Generally, the role of the parasites and predators in the control of yam beetles has not contributed significantly in the control of yam beetles.

Conclusion

For now, the only effective and feasible control method for the beetle control is the use of insecticides. Concerted research efforts should be made to evaluate some more environmentally safe, friendly and biodegradable pesticides for field application to replace banned Aldrin dusts and related organochlorines to enhance quality yield of tubers and good market values of the produce. Studies on Sterile Insect Technique (SIT) and the use of isotopes and irradiation and tight devices to trap the beetles during their immigration could be pursued with vigour to provide a method for lasting control. Light trapping holds good prospects since the beetles are usually attracted in their hundreds and thousands to electric light sources in houses close to their migration pathways.

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