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Knowledge of Cassava Pest Management: The Case of Farmer Training on Integrated Management of Millipede Infestation in Outbreak Areas in Western Region, Ghana

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Authors' contributions

This work was carried out in collaboration between all authors. Authors IA and KOF designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors MBM and MOA managed the analyses of the study. Authors KOF and EAM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Millipede infestation has been identified as a major contributing factor to low root yield of cassava and other root and tuber crops. Lack of knowledge in managing millipedes contributed significantly to reduction in cassava production. To address this challenge was to enhance the knowledge base of cassava farmers and extension agents. Integrated millipede management

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strategy training was thus organized for stakeholders in the Identified hot spots area.
Place and Duration of Study: Identified hot spots namely Nsuopun (Amenfi East), Tebe (Prestea-Huni Valley) and Krakye Akuraa (Wassa East) in the Western region of Ghana, between June 2012 and July 2014.
Methodology: All together 100 participants took part in the training. This included 62 male farmers, 28 female farmers and 10 male extension agents aged between 22 and 68 years with varied educational background. Among the topics treated during integrated management strategies training included promotion of tolerant cassava varieties and good farm sanitation. Training involved lectures, focus group discussion, field visits and evaluation.
Results: As a result of the training, 83% of the farmers who benefited from the training adopted the technology. Over 93% of the farmers expressed satisfaction with the intervention strategies. 30% of farmers who adopted technology transferred technology to their peers.
Conclusion: The training significantly increased level of knowledge of farmers and improved the measures employed to manage the millipede menace.

Keywords: Millipede; cassava; integrated management; farmer; knowledge.

ABBREVIATIONS

AEAs : Agricultural Extension Agents
GDP : Gross Domestic Product
RELC : Research Extension-Farmer Linkage Committee

1. INTRODUCTION

Cassava, *Manihot esculenta* Crantz (Euphorbiaceae) provides food security for small to medium scale farmers in Africa and other tropical countries. It is ranked the fourth most important source of carbohydrates for human consumption, after rice, sugar, and maize [1]. Its starchy root is a substantial portion of the diet for nearly 600 million people worldwide [2]. It is a primary food source for more than 250 million Africans [3]. In Ghana, cassava is produced as food, industrial and in most recent as a cash crop. It contributes 22% of GDP and has per capita consumption of 159 kg [4]. Despite its importance, not much is realized by farmers in terms of yield due to constraints to production. Among the numerous constraints that affect productivity of cassava in Ghana include poor soils, diseases and arthropod damage.

Millipedes (Diplopoda: Arthropoda) are useful as scavengers. Generally, their role is a beneficial one in helping to break down dead plant matter. However, when conditions are favourable they develop high populations and invade farms and dwellings. Millipedes will also feed on overripe fruit in contact with the soil such as strawberries, tomatoes, or melons that have developed cracks. They also seriously damage root and tuber crops especially cassava.

The Research Extension-Farmer Linkage Committee (RELC) report of 2010-2011 identified Millipede infestation as a major contributing factor to low root yield of cassava and other root and tuber crops in some Districts of the Western Region. The pest status and hot spots of these Diplopods have been established [5]. Millipedes affect the planted cuttings and quality of the tuberous roots of cassava. The economically damaging infestations occur on the cuttings, the basic units of propagation (Fig. 1) which could lead to total crop loss (Fig. 2) and the tuberous roots in the form of penetration (Fig. 3) and consumption leading to root rot (Fig. 4). This renders the roots unfit for human consumption and consequently loss in value [6].

Until recently, outbreaks of millipedes as pests have not been persistent and therefore full blown effect was not felt. With recent outbreaks, however, the effect was enormous leading to significant reduction of cassava production but there was inadequate information with regard to the management of millipedes. For this reason, farmers and extension agents in the hot spots zone did not know how to sustainably manage the arthropods. It was therefore, very important to organize the training to build their capacities to manage it. Stewart and colleagues [7] observed that efforts to support smallholder farmers through training have the potential to improve rural livelihoods. Such efforts therefore require effective means of providing the knowledge and skill so that recipients will hear, see and practice what they are taught. Farmer training program was therefore designed to equip them to become independent, confident and take expert decisions [8]. Because local training materials were not available, it became imperative to develop resource materials on integrated millipede management strategies to suit prevailing conditions at hot spot areas, to be used by both farmers and extension agents.

Fig. 1. Damaged sprouting buds on cutting

Fig. 2. Newly established cassava field destroyed by millipedes

Fig. 3. Millipede boring into cassava root

Fig. 4. Millipede damage in root tubers

2. MATERIALS AND METHODS

2.1 Area of Study

The study was carried out in communities identified as hot spot areas in south western part of Ghana during persistent millipede outbreaks in 2012 and 2013. The area falls within the evergreen tropical rainforest belt with heavy rainfall between March and November with a short spell of dryness in December to February. Communities covered included Nsuopun (Amenfi East), Tebe (Prestea Huni-Valley) and Krakye Akuraa (Wassa East) Districts of the Western Region.

2.2 Training Format

Training materials was developed after assessment of ecological conditions at the hot spots by a team of research scientist. The training was modeled in the training of trainee format to facilitate widespread adoption in the various communities which could easily experience future outbreaks. The training program was organized at the district capitals of the worst affected districts in which participants, mainly farmers and extension workers were assembled from hot spot communities. Simple random sampling was used to select participating farmers. Thirty farmers were selected from each hot spot community, thus a sample size of 90 cassava farmers and 10 extension agents from the 3 districts benefited from the training. Training modules involved lectures (Fig. 5), focus group discussions (Fig. 6), visits to selected field locations for practical demonstrations and evaluation of technology adoption (Fig. 7). Emphasis was however placed on good husbandry practices rather than on chemical usage. The training also ensured participants' appreciation of practicality of the technologies

Table 1. Districts, hot spot communities, training venues, training and monitoring dates of millipede intervention strategies in the Western Region, Ghana, 2013 and 2014

District	Capital	Community	Training venue	Training date	Monitoring date
Amenfi East	Wassa Akropong	Nsuopun	Apostolic Church	20/08/13	13/05/14
Prestea Huni-Valley	Bogoso	Tebe	Bogoso Golden Hotel	21/08/13	14/05/14
Wassa East	Daboase	Krakye Akuraa	District Assembly Hall	22/08/13	15/05/14

Fig. 5. Lecture session during training of Farmers and Extension agents on integrated strategies for managing millipedes at (A) Daboase (Wassa East) and (B) Bogoso, (Prestea Huni-Valley)

Fig. 6. Focus group discussion

Fig. 7. Monitoring and evaluation session at Mensakrom, Wassa East district

since it conformed to their farming system. Additional training materials in the form of fact sheets were provided during the training sessions. The training program was regularly monitored for progress and adjustments were made as when necessary.

Follow up visits were made to participated farmer communities to monitor level of adoption of available management strategies.

2.3 Interventions Strategies

A package of six intervention strategies was introduced as the main topics for the training as outline below;

- Yard sanitation and ash barriers (Fig. 8) mixture of wood ash and water into paste restricts movement of millipedes and thereby prevent them from our farms.

- Thinly spread of farm debris (cleared weeds and other farm debris should not be heaped or gathered but spread out thinly on the farm to ensure dryness of field).
- Avoidance of farm debris heaps which serve as breeding places (Heaps of farm debris should be avoided since they serve as breeding places for millipedes).
- Ensuring adequate sunshine in crop fields by pruning and clearing weeds on regular basis
- Promotion of improved cassava varieties (Farmers were directed to free sources of improved cassava varieties).
- Chemical treatment of planting materials (e.g. Cassava cuttings) (Fig. 9) Demonstration of treatment of planting materials with insecticides.

Practicing of any four of the above package was considered adoption of the technology since It guaranteed reasonable control of millipedes.

2.4 Methods of Data Collection

A 7 months time lapse after the training was allowed for farmers to put the interventions into practice, after which the adoption rate was evaluated (Table 1). At the evaluation sessions, farmers were assembled at a central location and interviewed individually. Data were collected by the use of an interview schedule and administration of a questionnaire. The questionnaire was structured to illicit information on types of interventions, how each works and how each was implemented in their respective farms. Data thus consisted of information collected from trained participants on adoption of a package of the 6 proven intervention strategies listed above to mitigate the deleterious effect of millipedes. Farmers who practiced any four of the strategies were considered to have adopted the technology. These data gathering approaches were preferred and adopted because they allowed for direct contact with potential respondents, also explored their views and experiences of on-farm practices in the intervention zones. All farmers who participated in the training and 10 non participating farmers per hot spot community serving as a control group were interviewed. In total, 120 farmers were involved in the evaluation exercise. This comprised of 90 trained and 30 untrained. During the interview the purpose of the study was also explained to the respondents. To ensure reliable answers, questions were asked again differently to test the veracity of responses given by respondents. After the interview, 10 participated farmers were randomly selected for verification of the intervention strategies in their farms for each hot spot community. The objective of intervention strategies adoption was measured based on usage of technology and its consequent provision of evidence regarding adoption.

2.5 Analysis of Data

Descriptive statistics was used to analyze data on adoption of intervention strategies (technologies). Due to the nonnumeric nature of the responses to the questions generally, percentages and averages were used to analyze farmer's knowledge, practices and adoption of the technologies.

Fig. 8. Millipede trapped in the ash barrier

Fig. 9. Chemical treatment of cuttings

3. RESULTS AND DISCUSSION

Before planning the district training programs there had been millipede outbreak in the three districts of the Western region of Ghana. None of these districts had the requisite know-how to rapidly respond to the outbreak situation. A critical gap was realized with regard to extension service delivery and policy directives. Building the capacity of resource limited cassava producers and extension agents through the transfer of knowledge on millipede management strategies have provided a partnership of local front line groups to manage the menace. Selection of farmer participants and extension agents for the millipede management training workshop from affected communities enhanced the number of trained personnel in those communities [9]. Considering the varied level of education among participants, an informal approach was adopted in which vernacular was mostly used as means of communication [10]. In addition statements were supported with illustration for a deeper understanding of the message being put across. The non-formal education approach facilitated full participation of participants as expressed by Cotlear [11]. In addition, gender and educational level barriers [12] were duly removed leading to understanding of the message and consequent high adoption of the technologies (83%). This corroborates the findings of Wilson and Gallup [13], stating that effective education contributes to farmers' understanding and help improve on their abilities. Accordingly, improving farmers' knowledge on technologies can dramatically increase their level of productivity [14]. In all 90 farmers and 10 extension agent in the affected areas participated in the training on integrated strategies for managing millipedes' infesting farms. All together, 62 males and 28 females took part in the training (Table 2). During the training more emphasis was laid on beneficiary farmers training their peers who did not get the opportunity to attend since not all farmers could be trained at a time. The selected farmers were thus to serve as trainers in their communities. The extension agents trained were also to provide backstopping on the training as well as train other farmers. As a result of the training, 83% of the farmers who benefited from the training adopted the technology (Table 3). This has contributed to increase access to tolerant varieties, sustainable management of millipedes by smallholder farmers and the decline in the spread of millipede menace to unaffected communities.

Responses of participating farmers during the monitoring and evaluation interactions were indicative of their acceptance of the technology. Impact rating of adopting the technology with regard to trained cassava farmers revealed significant reduction of millipede population, damage to crops, harvests, access to tolerant varieties and satisfaction of current practices as compared to the non participating farmers. Over 93% of the farmers who adopted the intervention strategies were satisfied with the technology and willing to transfer the technology to others. Only 7% said there was no change after adoption of the intervention strategies and therefore not satisfied with the technology. The veracity of this response need follow up to ascertain the correctness of how the strategies were carried out.

The satisfaction of intervention strategies is also amply demonstrated by the rate of transfer thus 30% of farmers who adopted technology transferred technology to their peers. Participated farmers' transfer of the technology to their peers significantly increased the number of knowledgeable stakeholders within the affected area by 25% compared to the number of farmers trained (Table 3). The peer technology transfer option duly paid off since farmer groups are targeted as an important means of increasing uptake of agricultural technologies [15].

The efficient implementation of their activities apart from solving problems will help in checking the spread of the millipede invasion into new areas. By so doing, it will contribute to reviving cassava production in areas affected by the pandemic. However, total control and prevention

Table 2. Location, number and gender of farmers and AEAs, who participated in the training, August, 2013

District	Hot spot	No. of farmers	Male	Female	AEAs
Amenfi East	Nsuopun	30	21	9	3
Prestea Huni-Valley	Tebe	30	18	12	3
Wassa East	Krakye Akuraa	30	23	7	4
Total		90	62	28	10

Table 3. Adoption and satisfaction of intervention strategies by farmers of the millipede affected areas in the Western Region, May, 2014

District	Farmers trained	Adopted technology	Satisfied	Transferred	Adoption (%)
Amenfi East	30	21	20	5	70
Prestea Huni-Valley	30	29	27	11	97
Wassa East	30	25	23	7	83
Total	90	75	70	23	83

of further spread of the millipede menace will require a strong dedication from farmers, opinion leaders and local front line members in the affected and nearby communities to sustain the research efforts in managing millipedes.

4. CONCLUSION

The study has verified that training farmers on area-wide intervention strategies allowed easy adoption and provided an appropriate medium for extending such technology to a wider community. Carrying out the training exercise have significantly increased the capacity of stakeholders across the hot spots and surrounding communities. The training format employed has contributed to better coordination and management of the millipede menace in the affected communities. Adoption of intervention strategies has tremendously increased farmer's access to improved varieties, reduced millipede damage to cassava and ultimately increased yields. Cassava cultivation in the affected communities bounced back and led to improved living standards of farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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