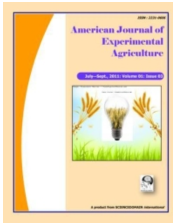

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Awareness of the Parasitic Weed *Alectra vogelii* (Benth.) Amongst Extension Officers in Three Districts in Malawi

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Authors' contributions

This work was carried out in collaboration between all authors. Author VHK conceptualized and designed the study, managed the literature searches, discussed the results and wrote manuscript. Author YLBT collected some of the data, performed the statistical analysis, wrote the study protocol and the materials and methods section of the manuscript. Author EK organized data collection and collected most of it. All authors read and approved the final manuscript.

Case Study

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ABSTRACT

Aims: To determine *awareness* of legume witchweed *A. vogelii,* relative to well known cereal witchweed *Striga sciatica* (L). Kuntze, amongst government extension officers in three districts in Malawi.
Study Design: Survey.
Place and Duration of Study: Kasungu, Mchinji, Lilongwe and Balaka districts in Malawi
Methodology: A structured questionnaire was administered to 118 extension personnel in the study areas. The data were subjected to cross tabulation in SPSS to obtain frequencies of the various study parameters.
Results: Of the 118 officers, 36% were aware *A. vogelii*, compared to 91% that were aware of *S. asiatica* while *Striga forbesii* and *S. gesneiroides* were hardly known (< 2%). Predominant source of information for *A. vogelii* was meetings (24%), followed by brochures (17%) and college (3%) while the rest were less than 2 %. For *S. asiatica* the predominant sources were meetings (55 %), brochures (32 %), college (21 %), and radio (16 %). Field days, newspapers, books, internet and projects were seldom sources (< 6%). The control measures known for both species were resistant variety, sanitation, rotation

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and manure application. Fewer personnel were aware of these as control measures for *A. vogelii* than against *S. asiatica*. Generally, supervisory staff were more aware of control measures for both species than frontline staff.

Conclusion: Results of this study have shown that little awareness exists on the parasitic weed *A. vogelii* compared to *S. asiatica.* The current extension methods involving meetings and brochures are operational at very low rates, while there is much less effort for dissemination with media and field days. Meetings are predominant means of information source, and that information flow between extension personnel in supervisory positions and frontline staff is minimum. Knowledge on control methods is poor, particularly for frontline staff.

Keywords: Alectra vogelii; witchweeds; technology transfer extension.

1. INTRODUCTION

1.1 Importance of Legumes in Malawi

In Malawi grain legumes are an important component of the daily diet, farm income and cropping systems. They compliment maize (*Zea mays* L.), the staple cereal, in that they are rich in protein, and also contribute to soil fertility improvement through biological nitrogen fixation. In the 2011/12 growing season legumes were grown on a total of 978,582 hectares, 66% of which were pulses including soybeans (*Glycine max* L.), common bean (*Phaseolus vulgaris* [L.]) and cowpeas (*Vigna unguiculata* [L.] Walp while 33% of the land had groundnuts (*Arachis hypogeal* [L].). On the other hand, maize was grown on a total of 1,497,829 hectares [1]. Thus, maize/legume systems are predominant in Malawi and offer opportunity for this compliment. The trend of direction in Integrated Soil Fertility Management (ISFM) in sub-Saharan Africa is to scale out and intensify grain legume–cereal rotations and mixed cropping systems for soil fertility improvement and income generation and to improve the protein content in the diet through the high content of essential amino acids [2-11]. In 2005/06 season the Government of Malawi introduced the Farm Input Subsidy Program (FISP) which includes grain legume seeds for ISFM in addition to improved household food security and income [12].

1.2 Scope of Witchweed Problem in Malawi

Most grain legume crops, however, are prone to attack by parasitic weed species, including *Alectra vogelii* Benth and *Striga gesnerioides*, both of the family Orobanchaceae, which mainly attack groundnuts, cowpeas, soybeans and bambara nuts (*Vigna subterranean* (L.) Verd. [13-16]. Serious infestation causes stunted crop growth, wilting and yield loss. In Tanzania yield losses of up to 50% have been reported [17] and in Kenya a total crop loss was reported [18]. Yield losses of 80 – 100% were reported on cowpeas in Botswana [19]. In soybeans, yield loss due to *A. vogelii* was estimated at 70-90 % [20]. For farmers to effectively adopt any effective control measure, extension workers require knowledge on the existence of the weed, its biology and its management. An integrated control approach utilizing several measures is considered as the best approach for control of witchweeds, as no single method may provide complete control [21-22]. In light infestations, uprooting before flowering and timely destruction through drying in a pit and burning is recommended [21]. Hygiene during harvest to avoid weed seeds in grain reduces further spread of the weed [21]. Other control measures include use of catch crops and trap crops [21-22]. Catch crops are susceptible species which are ploughed in or harvested after parasite attachment but before emergence and seed production. On the other hand trap crops are plants that are not hosts to *Alectra* but do stimulate germination of the *Alectra* seed. These measures result in depletion of the seeds in the soil. Important trap crops for *A. vogelii* include sorghum (*Sorghum bicolor* [L.] Moench), maize, pearl millet (*Pennisetum glaucum* [L.] R.Br), cotton (*Gossypium hirsutum* L.), sunflower (*Helianthus annuus* L.), dolichos beans (*Lablab purpureus* [L.] Sweet), [23] and guar bean (*Cyamopsis tetragonoloba* [L.] Taub). Little has been done in establishment of *Alectra* resistant varieties in legumes in Malawi. However, in cowpeas a resistant variety, Mkanakaufiti (IT99K-494-6) has been released in Malawi and is recommended for growing in hot-spot areas [24]. Crop rotation using *Alectra* immune legumes such as pigeon peas (*Cajanus cajan* [L.]), dolichos beans and non-susceptible crops can reduce *Alectra* seed bank in soil. In Malawi the parasitic weed has been reported in Lilongwe and Kasungu plains and parts of the southern region [25-26]. It has also been seen in Mzimba in northern Malawi by the authors of this article in the course of their studies. Interestingly, it was not reported by [27] in their book on 'Common Weeds of Malawi.

1.3 Justification and Objectives

While a lot of research and outreach has been undertaken on *Striga asiatica*, a parasitic weed of cereals [28,21,13,22;29-30], relatively much less has been done on *A. vogelii*. For example, there was training on biology and control of parasitic weeds for all divisional crops officers in 1997 [31]. A cowpea project at Bunda College supported by McKnight Foundation grant no. 06-741 distributed posters on *A. vogelii* biology and control to various extension offices in all ADDs in the country in 2009. A leaflet was further distributed carrying information on a newly released *A. vogelli* resistant cowpea variety, Mkanakaufiti (IT 99-494-6 ex IITA) to all District Agriculture Development Officers (DADOs) in March 2011. As efforts to popularize legumes are intensified, the incidence of *A. vogelii* appears to be on the increase. In the course of conducting research activities supported by the McKnight Foundation project numbers 06-741 and 10-236, we have noted that many extension officers were unaware of *A. vogelii* and its control, even though the parasite was widely manifested in farmers' fields within their working areas. This study was therefore conducted to determine the awareness of the parasitic legume witchweed *A. vogelii*, relative to *S. asiatica*, amongst extension officers in three districts in Malawi.

2. METHODOLOGIES

2.1 Background to the Survey Area and Respondents

Using a simple questionnaire, a survey was conducted from March 2012 to June 2012 in selected districts of Lilongwe, Mchinji, Kasungu and Balaka, in central and southern Malawi. The survey was conducted amongst extension personnel. The extension staff belonged to different categories in the organizational structure of extension service in Malawi. The structure starts from national level (Ministry of Agriculture)→Agricultural Development Division (ADD) → District Agriculture Development Office (DADO) → Extension planning Area (EPA) → Section. The frontline staff are in charge of a section within the EPA. The EPA is headed by agricultural extension development coordinator AEDC while the section is headed by an agricultural extension development officer, AEDO. There are subject matter specialists at the national, ADD, DADO levels (1). A total of 118 staff responded. There were 86 responding officers hailing from 23 EPA's in Lilongwe DADO, in Lilongwe ADD, 7 from Rivirivi EPA in Balaka district, Machinga ADD, and 25 from 9 EPAs in Kasungu and Mchinji districts (combined) in Kasungu ADD. Of these EPAs five were involved in activities connected to *A. vogelii* coordinated by the authors. In all cases the questionnaire was administered just before commencement of a meeting or field event.

2.2 The Research Tool

The main tool was a structured questionnaire which was designed to capture the following:- respondents' designation, whether they knew *A. vogelii* and other witchweeds, if they had received any information about control of witch weeds, how they received the information and the type of information they received. The sample size was 118 across categories of staff. These categories included 66.9 % AEDOs, 19.5% AEDCs, 9.3% DADOs and other staff at district level and 4.2% ADD level staff.

2.3 Functional Background to Extension System to Malawi

The Agricultural Extension Development Officer (AEDO) is in charge of a section and interacts with farmers in their daily duties. They report to the Agricultural Extension Development Coordinator, AEDC, in their respective EPAs. At the EPA's there are fortnightly meetings during which all staff are appraised on recent developments in the EPA, including updates on new technology or simple skills and knowledge transfer sessions. Most of the staff and farmer training takes place at EPA level. Training is usually coordinated by subject matter specialists at the District, ADD or National levels. Most research and outreach projects operate at EPA levels and may disseminate information in direct or indirect ways to both staff and farmers. For this report, all staff other than AEDO have been categorised as supervisors and the AEDO as frontline staff. Further to this government extension system, there is pluralistic agricultural extension system in Malawi [32-33].

2.4 Data Analysis

The data were analysed by tabulation as percentages of frequencies using Statistics Package for Social Scientists (SPSS) 16th edition.

3. RESULTS AND DISCUSSION

3.1 Results

<u>3.1.1 Awareness of various *A vogelii*</u>

The percentages of extension personnel aware of various witchweeds are presented in Fig. 1. Of the 118 respondents, fewer extension personnel (36%) were aware of *A. vogelii* than *S. asiatica* (91%). The other two species of *S. forbesii* and *gesnerioides* were seldom known (< 2.0%).

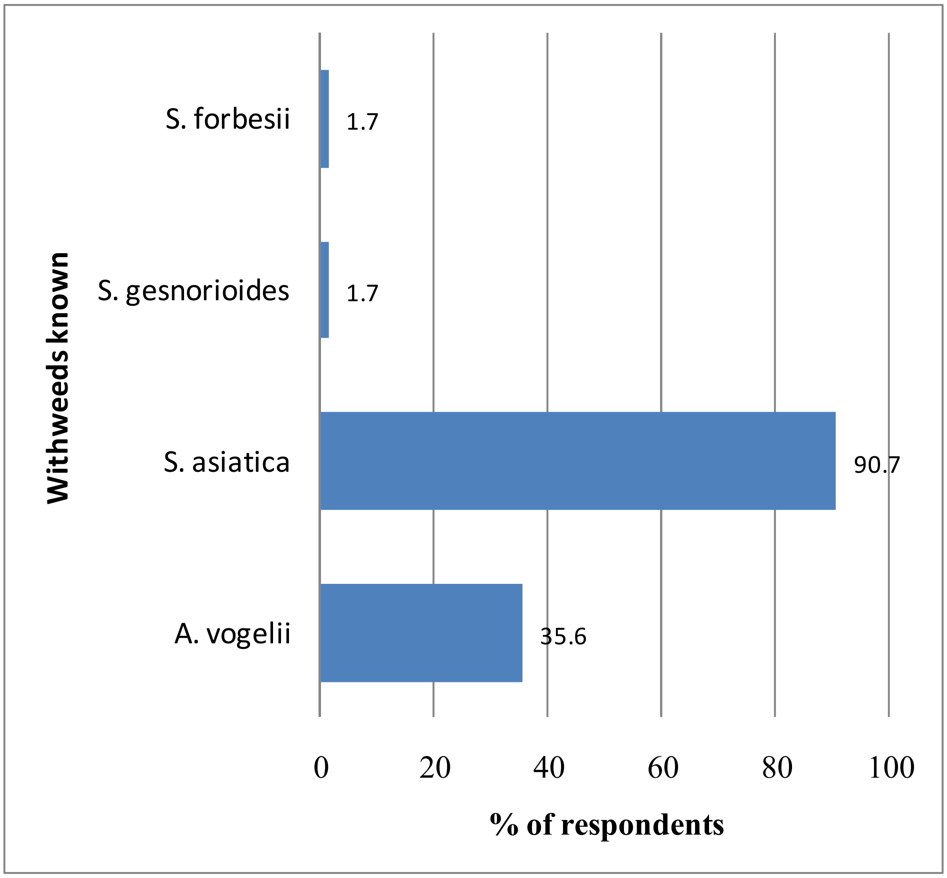

Fig. 1. Percentages of extension staff having knowledge of parasitic weeds (n=118)

3.1.2 Sources of information

Table 1 shows the means of accessing information on *A. vogelii* and *S. asiatica* by the officers, broken down by category of staff (supervisors, frontline or all). For both species and all staff popular sources of information were brochures and meetings, while radio and college were important sources of knowledge for supervisory staff with respect to *S. asiatica*. In terms of source of information for *A. vogelii* for frontline staff, the most important source of information was brochures followed by meetings and college. However knowledge levels were low (5-15 %). In comparison, the predominant source of information on *A. vogelii* for supervisory staff was brochure followed by meetings. In general, more supervisory staff had access to knowledge than frontline staff. Even then, less information was on *A. vogelii* than *S. asiatica,* however, of the 39 frontline personnel, 27% were aware of *S. asiatica* from college days, compared to 10% for supervisors. Notably, of the 79 supervisory staff 44% were aware of *A. vogelii* through meetings, compared to 80% for *S. asiatica*.

Table 1. Percent of supervisory, frontline and all staff positive response to receiving information on control of *A. vogelii* and *S. asiatica* from various sources

	Alectra vogelii			*Striga asiatica*		
Information source	**All (n=118)**	**Supervisory staff (n=39)**	**Front line personnel (n=79)**	**All (n=118)**	**Supervisory staff (n=39)**	**Front line personnel (n=79)**
Brochure	23.7	41.0	15.2	32.2	43.6	27.8
Meetings	16.9	24.1	13.9	55.1	79.9	44.3
Newspapers	0.8	2.6	0	5.1	7.7	3.8
Radio	1.7	0	2.5	16.1	23.1	12.7
College	3.4	0	5.1	21.2	10.3	26.6
Field days	1.7	0	2.5	5.9	5.1	6.3
Projects	1.7	2.6	1.3	0	3.6	0
Internet	0.8	2.6	0	0.8	2.6	0
Books	0.8	2.6	0	0.8	2.6	0

3.1.3 Control measures known

The control measures for *A. vogelii* most known by all staff were crop rotation (25 %), followed by resistant variety, manures and sanitation (Table 2). However, the levels were quite low (7-25 %). Early planting, use of trap crops, were seldom known (< 1 %). General awareness of control measures for *S. asiatica* was much higher, with crop rotation as most popular (76 %), followed by manure use (59 %), sanitation (30%) and resistant variety (13 %). The others were seldom known (<2.5%). Among the supervisory staff, the commonly known methods for control of *A. vogelii* were crop rotation (36%), followed by manure use (23%), resistant variety and sanitation (8%). For frontline staff, crop rotations remained the most known method, followed by sanitation and manure, but the levels were quite low (5-19%).

3.2 DISCUSSION

3.2.1 General awareness of *A. vogelii* its control measures

The results of this study have shown that awareness of *A. vogelii* (36 %) is considerably much lower, considering the greater efforts being taken to promote legumes in Malawi [12,2]. Regarding type of information, the results indicate that officers were less knowledgeable on *A. vogelii*, compared to *S. asiatica*, an observation in line with the status quo in Malawi. Thus extension personnel at all levels are more aware of *S. asiatica* as a parasitic weed, including associated control measures compared to *A. vogelii*. This concurs with current literature which shows much research and outreach on S. asiatica compared to *A. vogelii*. There have been less circulars, seminars and conference presentation on this legume witchweed.

Table 2. Percent of supervisory, frontline and all staff with positive response to receiving information on control of *A. vogelii* and *S. asiatica* from various sources

	Alectra vogelii			***Striga asiatica*.**		
Control method	**All (n=118)**	**Supervisory staff (n=39)**	**Front line personnel (n=79)**	**All (n=118)**	**Supervisory staff (n=39)**	**Front line personnel (n=79)**
Resistant variety	12.7	12.8	12.6	11.9	7.7	13.9
Sanitation	6.8	7.7	6.3	29.7	38.5	25.3
Crop rotation	24.6	35.9	19	76.3	79.5	74.7
Manure application	7.2	23.1	5.1	58.5	79.5	48.1
Early planting	0.8	0	2.6	2.3	5.1	1.3
Trap crops	0	0	0	0.8	0	1.3
Striga powder	0.8	0	1.3	1.7	0	2.5
Intercropping with *Tephrosia vogelii*	0	0	0	1.7	5.1	0

Many conferences and review papers which tackled *S. asiatica* did not tackle *A. vogelii* (e.g. [34-36]. We encourage that promotion of legumes should be simultaneous to awareness of important pests and diseases. We recommend that a target of 100 % knowledge is set for methods such as sanitation, manure application and rotations as these are preventive, least-cost and may also result in overall farm productivity [37,29,13]. However, it must be acknowledged that research on control of *A. vogelii* is low, and locally verified control measures are few and that much of the knowledge on control is packaged from regional and international literatures. It is recommended that research in Malawi should be intensified to verify, adapt and package most of these rotation or manure options. In Kenya, recent research has shown that use of cattle manure at 5 and 10 t ha^{-1} reduced *A. vogelii* incidence and increased yield and yield components of some cowpea varieties, and not others [38].

Only about 13 % of all staff were aware of resistant variety as control measure for *A. vogelii*. The only legume variety with resistance to *A. vogelii* was released in 2011. Brochures on this were sent to all district agriculture offices, and it would have been expected that at least through meetings and brochures, higher levels of awareness would be recorded.

3.2 2 Sources of information

The results on sources of information concur with a previous study with *Striga* spp. on cereals by [28] who reported that extension bulletins were the most popular source at 35-66%, while other means such as posters (5-18 %), NGO's (5-13 %) or farmers and friends (12 %) were low. Meetings, field days, colleges, radios were not mentioned. The finding of this study that meetings were a predominant source of information is important in that staff meetings are routinely conducted and provide an opportunity for cost-effective technology transfer. However, the percent of positive responses to meetings is very low, particularly for *A. vogelii* information, therefore we suggest a target of 100% as ideal. The low rating of field days suggests that there are hardly attempts to mention parasitic weeds despite their widespread occurrence, particularly in Mchinji and Lilongwe districts, where this study was conducted. We recommend that stakeholders should incorporate themes on control of these parasitic weeds in their legume promotional packages as these are getting widespread and cause considerable yield loss.

3.2 3 Access to information by frontline versus supervisory staff

The supervisory staff were more knowledgeable on control measures for both *A. vogelii* and *S. asiatica*. This is expected as supervisory staff are meant to be sources of information. However, staff are not directly passing information to frontline staff, noting that only 13.9 and 44.3 % of frontline staff obtained information on *A. vogelii* or *S. asiatica* from meetings. Interestingly, a high percent of supervisory staff obtained information from meetings, suggesting technology transfer amongst supervisors does take place, but is not passed on to frontline staff. The current extension policy in Malawi provides for pluralistic extension services, allowing for more players at frontline levels [32]. With this, it is surprising that field days and projects have not been dominant sources of information. A recent report indicated that there were up to 9 and 11 agricultural extension service providers in two villages in Mchinji district [33]. Such results suggest that while extension providers exist, there is less priority on these devastating parasitic weeds.

4. CONCLUSION AND RECOMMENDATION

4.1 Conclusions

Results of this study have shown that very little awareness exist on the parasitic weed *A. vogelii* compared to *S. asiatica*. Meetings are predominant means of information source, and that information flow between extension personnel in supervisory positions and frontline staff is minimum. Knowledge on control methods is poor, particularly for frontline staff.

4.2 Recommendation

With the standing pluralistic extension policy, we remind stakeholders to incorporate dissemination of parasitic weeds in their routine meetings, field days and media dissemination efforts. We recommend that a target of 100 % knowledge is set for methods such as sanitation, manure application and rotations as these are preventive, least cost and may also result in overall increase farm productivity.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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