

Farmers' awareness level on the effect of parthenium weed (*Parthenium hysterophorus* L.) on agricultural production and its control in Nyando division, Kenya

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IAS – Invasive Alien Species

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Abstract

Parthenium hysterophorus L. is an Invasive Alien Species (IAS) that poses threat to agricultural production. The aim of this study was to assess the

level of awareness of the effect of parthenium weed on agricultural production and ways through which parthenium is controlled in Nyando division. The research was carried by interviewing 120 farm household heads using purposive sampling technique. This study established that majority of the respondents were unaware that parthenium interfered with milk production (95.0 %), livestock health (78.4 %) and crop yield (53.3 %). On the other hand, 63.3 % respondents were aware that parthenium lowered pasture availability. Physical methods (98.3 %) were majorly used to control parthenium as compared to chemical (1.7 %). This study established that, the ill-effects of parthenium weed on agricultural production were not directly associated to parthenium invasion. Therefore this research recommends that awareness creation campaigns on the adverse effects of parthenium weed on agricultural production and its control should be undertaken urgently. Similarly, integrated control methods should be adopted for effective management of parthenium weed.

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1. Introduction

1.1 Back ground of the study

Parthenium weed (*Parthenium hysterophorus* L.) commonly known as feverfew is an Invasive Alien Species (IAS) of the Asteraceae family. It is an annual herb native to Central and South America believed to have originated from the Gulf of Mexico. It has spread rapidly and extensively throughout the world since 1970s and is now considered a weed of global significance occurring as an alien invader in

over 20 countries in Africa, Asia and Australia (McConnachie et al., 2011). In Kenya, parthenium was first reported as a problematic weed in coffee plantations around Nairobi areas in 1975 (Njoroge, 1986). In 2010, the weed was declared a noxious weed in Kenya under the Suppression of Noxious Weed Act (Cap. 325) (GOK, 2010). The overall impact of parthenium weed on agricultural production systems is multifaceted and therefore difficult

to quantify losses (Evan, 1997). Apart from direct competition for nutrients, water and sunlight, the allelopathic effects of parthenium weed on other plants is an important biological characteristic for its success and aggressiveness (Kanchan and Jayachandra, 1980).

Parthenium weed produces enormous number of weeds with a single plant capable of producing 100,000 seeds. The seeds can remain viable for between 4-6 years thus building an enormous seed bank estimated at 200,000 seed per m². This explains its potential build-up of persistent soil seed bank and the difficulty in its eradication (Mahadevappa, 1997; Navie et al., 1996; Prasanta et al., 2005). Apart from its high invasion rate and difficulty in its eradication, parthenium exhibit allelopathic effects which are exhibited through the inhibition of germination and growth of pasture grasses, legumes, cereals, vegetables, other weeds species and trees (Evans, 1997; Belz et al., 2007; Navie et al., 1996). These adverse effects consequently affect crop yield, for instance, in India, parthenium was reported to reduce crop yields by 40 % (Khosla and Sobti, 1981). Similarly, Ethiopia experienced between 40 % and 97 % grain yield decline in sorghum when parthenium was left uncontrolled throughout the season (Tamado et al., 2002). On the other hand, parthenium weed affects livestock production by interfering with grazing land, animal health, milk and meat quality, marketing of pasture seed and grains (Evans, 1997). Studies on the toxicity of parthenium to cattle and buffaloes showed that a significant amount of parthenium (10-50 %) in diet is capable of killing animals within 30 days (Narasimhan et al., 1977).

1.2 Statement of the problem

Parthenium is a highly poisonous and an aggressive weed posing serious threat to crops, human beings and livestock and has been ranked as one of the most dreaded weeds of the world (Singla, 1992). Despite the high threats posed by parthenium weed to agricultural production, its eradication is hampered by the production of enormous number of seeds which remain viable for up to 4 years plus its preference to a wide range of ecological conditions (Navie et al., 1996). In agricultural systems, parthenium negatively affects both livestock and crop production. Parthenium is reported to lower the quality and quantity of livestock products by interfering with pasture availability as well as livestock health (Ahmed et al., 1988; Tudor et al., 1982).

Therefore, this research sought to generate information on farmers' level of awareness on the effect of parthenium weed on agricultural production and its control in Nyando division.

1.3 Objective of research

The study aims at assessing the effect of parthenium weed on agricultural production and ascertaining the control measures used against parthenium weed in Nyando division.

1.4 Justification of research

This research was important in that it sought to investigate whether farmers were aware of the adverse effects of parthenium weed on agricultural production. This is because parthenium is reported to adversely affect agricultural production in other parts of the world where it has invaded. It is important to note that no documented study had been carried out in the study area or in any part of the country. The results of this study will be useful to policy makers in making informed decision in an effort to control parthenium.

2. Materials and Methods

2.1 Study area

This study was carried out in Nyando division. The division lies between latitude 0°19' and 0°18' North and longitude 34°45' East and 34°85' West. It has an area of 248.2 km² and is divided into five locations namely Wawidhi, Awasi, Kakola, Kochogo, Kikolo and Onjiko (Republic of Kenya, 2008). The division receives an annual relief rainfall of between 1200 mm and 1300 mm with a mean annual temperature of 23° C and ranges between 20° C and 35° C (KOD, 2013). The main economic activities are subsistence farming, livestock keeping, fishing, rice farming, sugarcane farming and small scale trading.

2.2 Sampling procedure

This study used purposive sampling technique to select the target population. Purposive sampling is a non-probability sampling that allows the researcher to use cases that have the required information with respect to the objectives of the study. Cases of subjects that have the required characteristics are handpicked according to set criteria (Mugenda, 1999). Farm household heads whose farms lay within 100 metres on each side of Nairobi – Kisumu highway and practised both crop and animal husbandry were targeted. In addition, these farms had to be invaded by parthenium weed. Semi-structured interview schedule were used to collect primary data from the respondents.

3. Results

3.1 Farmers' level of awareness on the effect of parthenium weed on agricultural production

The level of awareness on the effect of parthenium weed on livestock health was low because 78.4 % of the respondents were unaware of its impacts on livestock health. On the other hand, 10.0 % of the respondents reported that parthenium caused coughing, diarrhoea 5.0 %, mouth ulcers 3.3 %, emaciations 2.5 % and deaths 0.8 % (Table 1).

Table 1: The effects of parthenium weed on livestock health (n = 120)

Level of awareness on the effects of parthenium weed on livestock health	No. of respondents	Farmers' awareness (%)
Coughing	12	10
Diarrhoea	6	5
Mouth ulcers	4	3.3
Death	1	0.8
Emaciation	3	2.5
Unaware	94	78.4
Total	120	100

The level of awareness of the effect of parthenium weed on livestock products was low. This is because majority of the farmers interviewed (95.0 %) did not associate parthenium weed with deteriorating quality and quantity of livestock products while 3.3 % reported that parthenium lowered milk production and 1.7 reported that it rendered milk bitter (Table 2).

Table 2: The effect of parthenium weed on milk production

Level of awareness on the effect of parthenium on milk production	No. of respondents	Farmers' awareness (%)
Lowers the quantity of milk	4	3.3
Renders milk bitter	2	1.7
Unaware	114	95
Total	120	100

The level of awareness on the effect of parthenium weed on pasture availability was high as majority of the respondents (63.3 %) reported that parthenium lowered the availability of palatable pasture species. Twenty one point seven percent reported that parthenium increased pasture availability while

15.0 % reported that parthenium had no effect on pasture (Table 3).

Table 3: The effect of parthenium weed on pasture availability

Level of awareness on the effect of parthenium on pasture availability	No. of responses	Farmers' response (%)
Increase	26	21.7
Decrease	76	63.3
Has no effect	18	15.0
Total	120	100

The level of awareness on the effect of parthenium weed on crop production was low. Majority of the farmers interviewed (53.3 %) were not aware that parthenium interfered with crop yield, 15.0 % of the respondents reported that parthenium increased crop yield while 31.7 % reported a decrease in crop yield (Table 4).

Table 4: The impact of parthenium weed on crop yield

Level of awareness on the effects of parthenium on crop yield	No. of respondents	Farmers' responses (%)
Increase	18	15.0
Decrease	38	31.7
Unaware	64	53.3
Total	120	100

The level of awareness on the crop yield most affected revealed that maize crop yield (28.3 %) was the most affected crop by parthenium invasion followed by vegetables 10.0 %, sorghum and beans 1.7 % each while 58.3 % of the respondents were unaware (Table 5).

Table 5: Crop most affected by parthenium weed

Level of awareness on the crop yield most affected	No. of responses	Farmers' responses (%)
Maize	34	28.3
Vegetables	12	10
Sorghum	2	1.7
Beans	2	1.7
Unaware	70	58.3
Total	120	100

The level of awareness on the impact of parthenium weed on labour requirement was high because majority of the respondents (75.0 %) reported that parthenium weed increased farm labour requirements while 1.7 % reported that it decreases labour requirement and 23.3 % reported that it had no effect on labour requirement (Table 6).

Table 6: Effect of parthenium weed on farm labour requirement

Effect of parthenium weed on labour requirement	No. of responders	Farmers' response (%)
Increases	90	75.0
Decreases	2	1.7
No effect	28	23.3
Total	120	100

3.2 Control of parthenium weed

It was established that majority of the farmers in Nyando division controlled parthenium weed by physical control (98.3 %) and the rest 1.7 % used chemical control (Round-up®) as shown in Table 7.

Table 7: Control of parthenium weed

Parthenium control method	No. of respondents	Farmers' response (%)
Physical	118	98.3
Chemical	2	1.7
Total	120	100

4. Discussion

4.1 Farmers' level of awareness on the effect of parthenium weed on agricultural production

This research results agrees with the results of various studies on the effect of parthenium weed on agricultural production. For instance, studies on the effects of parthenium weed on livestock health have shown that parthenium is harmful to livestock health (Evans, 1997). According Narasimhan et al. (1977), a significant amount of parthenium (10–50 %) in the diet killed animals within 30 days while Ahmed et al. (1988) reported that livestock got emaciated when they were fed on fodder containing parthenium. Parthenium has been reported to interfere with the quality of milk and meat when eaten by livestock (Tudor et al., 1982). Previous studies have shown that parthenium weed produces allelochemicals which inhibit the germination and growth of pasture grasses, legumes, cereals, vegetables and other weed species (Evans, 1997; Navie et al., 1996). In a study carried out in North-Eastern Ethiopia on the impacts of parthenium weed infestation on grazing land showed a negative relationship between above ground species diversity and evenness with parthenium abundance (Nigatu et al., 2010). In a survey carried out on beef producers in heavily infested areas in Central Queensland, parthenium dominated grazing land resulting in weed monoculture and this reduced stocking rates up to 80 % (McFadyen, 1992). It can therefore be argued that parthenium pose threats to the future of livestock products in

terms of pasture availability. On the other hand, respondents who reported that parthenium increased pasture availability may be a misconception that parthenium is a palatable pasture species an indicator of low awareness levels on the dangers posed by parthenium weed to livestock production. Farmers who reported that parthenium increased yields seem not to be aware the negative effects it had on crop yields. This is because the weed competes with crops for nutrients, water and sunlight as well as its allelopathic effects which inhibit the germination and growth of a wide variety of crops including pasture grasses, cereals and vegetables (Evans, 1997; Navie et al., 1996) which consequently decrease yields. According to Kapoor et al. (2012), parthenium aqueous leaves extract decreased seed germination, growth and biomass of mustard and maize while (Kumar and Kumar, 2010) reported that the burning of parthenium weed decreased the germination and growth of *Phaseolus mungo*. The results from the current study agrees with the reports by GISP (2007) and UNEP (2007) which reported that IAS affected the productive capacity of land and increased agricultural labour time which negatively impacted on human well-being by threatening the availability of food as well as reducing the time people have for recreation and other non-work activities. These consequently contribute to social instability and economic hardship by straining sustainable development, economic growth, poverty alleviation and food security (GISP, 2007; UNEP, 2007).

4.2 Control of parthenium weed

Physical control methods used included uprooting, weeding and slashing. These processes were reported to be tedious and labour intensive because parthenium sprouts after a short period of time. According to Dhileepan (2001), integrated control methods are need to full eradicate parthenium weed due to its wide range of habitats, strong reproductive and regenerative capacity, persistent seed bank and allelopathic properties which makes its management difficult.

Conclusion

This research established that the level of awareness on the adverse effects of parthenium weed on agricultural production in Nyando division is low. Due to lack of awareness of its invasive nature, the weed has spread rapidly and extensively negatively

impacting on agricultural production in the study area and across the country. Despite the weed being gazetted as a noxious weed in 2010 by the Ministry of Agriculture, little has been done towards its management and creation of awareness in the study area. This calls the need to sensitize the residents of Nyando division of the potential dangers posed by parthenium weed at large. It is evident that not unless the effects of parthenium weed on agriculture are mitigated, the weed will continue to be a major setback to agricultural production in the study area. On the control of parthenium weed, it was established that physical control was majorly used to control parthenium weed in the study area. According studies on the control of parthenium, the used of physical control methods are not effective because the weed produces enormous number of seeds and has a rapid growth rate. Unless integrated control methods are put in place coupled with creation of awareness the war against parthenium will not be won and the ill-effects of parthenium weed on agricultural production are going to be felt across the country.

Recommendations

- i. This study established that the level of awareness of the effect of parthenium weed on agricultural production was low yet parthenium is rapidly spreading in the area. Therefore, the government should urgently facilitate parthenium sensitization efforts in order to create parthenium awareness not only for the study area but also in the entire country.
- ii. Physical control methods were established to be used to control parthenium weed in Nyando division. Therefore, the government should urgently invest in research to explore other control methods for the total eradication of this noxious weed as single method is not sufficient.

Research Highlights

This research revealed that majority of the farmers were not aware of the adverse effects of parthenium weed on agricultural production and therefore there is need to create awareness in order to empower them in the mitigation of these ill-effects of parthenium weed.

Limitations

This research was limited by the fact that some effects that were associated with

parthenium weed may be caused by other extraneous factors. This was tackled by thorough probing to ensure that respondents were aware of what they were reporting. Observation and some evidence were required in some cases so as to ascertain the responses on the effects of parthenium weed on agricultural production.

Funding and Policy Aspects

Funds are required for the dispensation of the research findings in the study area and other parts of the country where the weed has invaded. The government should plan on how to create awareness on the adverse effects of parthenium weed on agricultural production and initiate control measures in the affected areas.

Authors Contribution and Competing Interests

The first author conceptualized and designed the research, collected data and wrote the draft. The second and third authors reviewed the final write-up. There is no competing interest.

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