Parthenium hysterophorus

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Parthenium hysterophorus, also known as carrot top, white top weed, and fever few is a fairly new invasive weed but has quickly become one of the worst weeds to tropical areas(CABI 2015). In Ethiopia it is known as Farmasissa which means "sign your land away" (IAPPS 2016). Originally from Central America, Parthenium has been seen to cause major problems in India and Southeast Asia, Australia, and East Africa. In 2015, Parthenium is said to have invaded roughly 34 countries globally (Strathie 2015). A fast growing highly reproductive invasive species, Parthenium has become a hazard to farmland, rangeland, as well as animal and human health. Parthenium is an annual weed that can grow from germination to flowering in 4-6 weeks (Kaur 2014). Flowering can persist for 6-8 months (CABI 2015). Parthenium is also highly allelopathic which means that it leaches certain chemicals into the soil through the roots and different plant parts that inhibit the germination and growth of other surrounding plants. Starting out as a rosette, Parthenium spreads like a carpet, smothering the ground using allelopathy to push out other plants before growing upwards. A deep taproot, shown to reach 2m deep allows the plant to be drought tolerant (Kaur 2014). Parthenium produces many small white flowers. Each plant produces between 15,000-25,000 seeds and each seed remains viable for approximately 10 years (Muasum 2013). Seeds are small, and are spread by wind, water. Seeds are also spread by human and animal interaction by sticking to clothing or in treads of shoes and tires or on the hides of animals. Due to its allopathic abilities as well as quick reproduction, Parthenium is highly invasive especially in disturbed sites such as roadsides as well as in overgrazed pastureland and eroded areas.

Parthenium hysterophorus growing outside of Arusha, Tanzania
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Parthenium in Farmland

Parthenium has had major impacts on farmland. Farmers, who already spend much of their time weeding, may find themselves working even more in hopes of controlling Parthenium within their fields. In Australia, Parthenium invaded 14.25 million hectares of farmland by 2007 and In India; it has been

shown to impact yields by up to 40%. In Ethiopia, sorghum yields have been impacted between 40-97% if not managed (Kaur 2014). Pollen from Parthenium, which is also allelopathic, has a negative impact on fruit and seed set after landing on different crops such as Maize. In India, fruit set impacts have caused a 40% impact on maize yields (CABI 2015). Chemicals exuded by Parthenium not only inhibit germination and growth of surrounding plants but also inhibits nitrogen fixing and nitrifying bacteria impacting legume nodules (Kaur 2014).

Parthenium in Rangeland and Natural Ecosystems

In the area of rangeland and natural ecosystems, Parthenium is the most concerning. It has the ability to outcompete favorable grasses and forages greatly reducing the carrying capacity or the amount of animals the land is able to support. In Australia, Parthenium has invaded 170,00km^2 prime grazing land by 2014 causing an economic loss of $16.8 million per year (Kaur 2014). Parthenium has been established in the Serengeti National Park and has the potential to greatly impact grazing migrations of wildlife (IUCN 2011). The large amount of animals that migrate through these areas leave the land disturbed for parts of the year which increases the vulnerability of invasion of weeds such as Parthenium. Once introduced, the monoculture stands of weeds such as Parthenium will reduce access to important forage grasses important to both livestock and wildlife which has the potential to effect grazing patterns. Large monoculture stands of weeds such as Parthenium also decrease diversity within ecosystems pushing out important native species. Dr. Arnie Witt with CABI was quoted in a news article saying that, “although the weed may look benign to most people, it probably posed one of the most serious threats to the ecosystem…research suggests that conditions in the Maasai Mara are highly suitable for this weed so we should all be concerned” (Ng’etich 2011).

Parthenium hysterophorus at a glance

- Grows quickly, can reach maturity in just 4 weeks and produce 15,000 to 25,000 seeds per plant
- Is allelopathic, exudes chemicals into the ground inhibiting growth of surrounding plants including favorable crops and forage grasses
- Toxic to animals, causes skin dermatitis and sores in mouth, too much in diet may lead to death
    - Taints the meat and milk of livestock reducing price
- Long term exposure may cause allergies including hay fever, bronchitis, and skin dermatitis in Humans
- Be aware and proactive
    - Uproot plants before flowering
    - Use good sanitation on farm and clean tire wheels and shoes to prevent spread
    - Herbicides can be used in small amounts

Cows grazing among Parthenium in Arusha, Tanzania
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Parthenium on Human and Animal Health

Within the pollen and the tricomes, Parthenium contains Parthenin, the same compound that is toxic to plants. This compound when exposed to the skin or breathed into the lungs overtime can have negative effects on both humans and animals (Goodall 2010). Cases of dermatitis, asthma, and bronchitis due to the chemicals in the pollen and plant matter have been reported in humans (Kaur 2014). When consumed by livestock, lesion in the mouth and excessive salivation has occurred. Consumption also causes tainted meat and milk which can lower the value of livestock. A diet consisting of between 10-50% Parthenium can cause death in cattle. Most livestock avoid Parthenium but will consume if forced (Kaur 2014, CABI 2015).

Controlling Parthenium

Control of *Parthenium hysterophorus* has proven to be a challenge and many have faced the problem with not a lot of overall success. As is the case in every situation, prevention and early detection rapid response are the most effective at keeping Parthenium from invading. Parthenium invades areas that are eroded or disturbed so if good land management practices are in place, Parthenium is less likely to invade a site. Practicing good sanitation reduces the spread of weed seed. This is done through avoiding walking, driving, or working in infested areas. If interaction with infested areas occurs, shoes, tires, machinery etc. should be cleaned to remove weed seed lodged in shoes, tire treads, caught on clothing, etc. Many invasive plant species are spread during road construction, therefore weeds should be removed before moving soil/ gravel/ supplies from one site to another and good sanitation of equipment should be practiced. If Parthenium is detected early on when still in the juvenile stage, it can be plowed as long as seed is planted directly after to outcompete any young Parthenium plants that may return. Plants may also be uprooted as long as the plant has not flowered. If the plant has flowered, uprooting the plant will only cause further infestation through the spread of seed. Manual removal can be labor intensive and one should wear long sleeves and gloves when removing Parthenium to avoid developing an allergy to the invasive species. Burning has also been used to remove Parthenium with varied results. Burning can use large quantities of fuel and can endanger other wanted plants. If burning is used, the burned land should be planted or the native grasses should be allowed to return fully before grazing to avoid reinvasion of the Parthenium or other weeds. The use of chemical herbicides to control Parthenium has been used as well with varied success but should be used with caution. A common salt mixture of 10-20% concentration has been found effective as a foliar spray (Kaur 2014).Work has been done looking at using other plants to out-compete Parthenium or to create foliar sprays from other vegetation to control Parthenium. Butterfly pea, purple pigeon grass, buffel grass, and kangaroo grass have all shown to be potentially useful in outcompeting Parthenium. A 49.41% decrease in seed germination of Parthenium was achieved through an application of a leaf leachate of Amaranthus virdis (Muasum 2013). Merigold, specifically Tagetes erectus L. was studied as a potential herbicide against Parthenium and was found to be effective as a foliar spay to inhibit germination and growth. The study shows that by adding plant residue of *Tagetes erectus* to the soil reduced plant biomass by 90-97%. Marigold was also found to be a strong competitor when growing next to Parthenium. (Shafique 2011).

One of the most effective resources for control of Parthenium is biocontrol which is being heavily researched in Ethiopia. Both a beetle that feeds on the weed *Zygogramma bicolorata*, as well as the stem-boring weevil, *Listeronotus* setosipennis are under quarantine for testing to insure they will only attack Parthenium and make a good biocontrol (Mersie 2010). International Association for the Plant Protection Sciences (IAPPS) now is in phase 4 of their project which includes the raising and releasing of Zygogramma which have both been approved in Ethiopia as well as research in quarantine on Smicronyx, a seed-eating weevil (IAPPS 2016).Even though biocontrol is cost effective, only a small number of countries including Australia, India, South Africa, Ethiopia, and Tanzania have considered biocontrol agents as a form of management(Strathie 2015).

In order to most effectively control *Parthenium hysterophorus* as with any significant weed management strategy, a mixture of tactics or Intergraded Pest Management or IPM is necessary. IPM encourages use of two or more different approaches to prevention and removal of a weed.

Alternate uses of Parthenium

Parthenium has the potential of being controlled by being used for positive uses. Within biogas, Parthenium when added at 10% with cattle manure was shown to produce 60-70% CH^4 (Saini et.al. 2014). It has also been researched as an addition to compost. When added before flowering to avoid spreading seed, Parthenium made for a great addition to compost. Allelochemicals present within the beginning stages of the compost process are greatly reduced once the compost is ready to use. The remaining allelochemicals may help reduce the germination of other weeds (Saini et. al 2014). Additionally, Parthenium may be useful as an addition to vermicomposting. Parthenium leachates have been proven to be effective on controlling different insects and funguses as well as on weed germination and growth. Flowers and leaves have been found to have the highest amounts of allelochemicals and therefore should be used in controlling weeds (Saini et. al 2014). Sprays created from Parthenium leachates may have important implications especially as an herbicide on small scale farms where use of chemicals can be costly both financially and for the environment. Other beneficial uses for Parthenium include a bioadsorpant, a phytoextractant, bioethanol production, corrosion inhibitor, as well as in dye degradation (Saini et. al. 2014).

Parthenium hysterophorus is a serious invasive plant species that needs attention. It has potential to have great negative impacts agricultural lands, grazing lands, wildlife, as well as human and animal health. Parthenium is a hard invasive plant to control due to its allelopathic and fast growing prolific nature. Even though, attention is needed to manage and control this invasive species as it has potential to adversely affect not only the physical environment but also the economic environment. Early detection and rapid response are needed in order to effective control.

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