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Weeds management in non-cropped areas: A Review

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ABSTRACT

Weeds are plants that are not desirable in a particular place, time and area. There are around 250,000 plant species on the planet, with about 3% or 8000 species, acting as weeds. Of those most of the area known species infest non-cropped areas. Weed flora, including annual, biennial and perennial grasses, sedges, and broad-leaf weeds, infest non-cropped regions. Wastelands (48%) have the most species followed by cultivated fields (20%), roadsides (14%), and forests (8%). Weeds in non-cropped areas decrease the land value; Aquatic weeds can obstruct navigation and devastate fisheries. The major aquatic weeds such as water hyacinth and Salvinia, and others such as *Alternanthera philoxiroides* have recently gained prominence. *Cannabis sativa* (Marijuana/Indian hemp), *Parthenium hysterophorus* (canary grass), and *Verbesina encelioides* (Golden Crown beard) infest non-cropped areas and roadsides Effective Management of weeds is necessary to reduce the harmful impacts of weeds. Hand hoeing, soil solarization, deadly wilting with high heat, burning or chemical attack with herbicides are some of the methods used. Paraquat @ 2.2 L acre^{-1}, 2, 4-D @ 1.0 kg *a.i* ha^{-1}, and glyphosate @ 3.0 L ha^{-1} are non-selective herbicides which are used to control weeds of non-cropped areas. different methods by which weeds can be managed are given in this review.

Key words: *Weeds, Non-cropped areas, Perennial, Aquatic weeds, Soil solarization, Glyphosate.*

Introduction

India has 70.0 million hectares of non-cropped area that are heavily infested with perennial and annual monocot and dicot weeds (Agricultural Statistics, 2007-08). Weed species in non-cropped areas are much more complex as compared to the in cropped area. Very little attention is paid to controlling weeds in non-cropped areas (Kewat *et al.*, 2008). In Punjab *Cannabis sativa* (Marijuana/Indian hemp), *Parthenium hysterophorus* (canary grass), *and Verbesina encelioides* (Golden Crown beard) infest non-cropped areas and roadsides. *Parthenium hysterophorus* (canary grass) is a noxious weed which mostly germinates in non- cropped areas and it is difficult to control as its growth rate is fast, high reproductive potential and intrusion *via* allelopathy are the major factors accountable for its widespread invasion in wastelands and non-cropped areas as well as cultivated fields (Kohli *et al.*, 2006 and Sushilkumar, 2014). *Verbesina encelioides* (golden crown beard) is a major roadside weed particularly in South West Punjab districts including Ferozepur, Fazilka, Bathinda, Barnala and Sangrur (Goyal *et al.* 2019). They cause poisoning in livestock as it contains chemical named galegine. *Cannabis sativa* (Indian hemp) is another weed initiated along roadsides and non- cropped areas of Punjab. *Cannabis sativa* can cause short-term memory loss in humans Kaur *et al.* (2015). When left unmanaged, it can reduce crop yields by 40 to 97%. *Lantana camara* is an important weed of agro and forest ecosystems, where it forms dense thickets that livestock cannot penetrate (Rai, 2015). The leaves are toxic when ingested by most domestic livestock or native mammals, although toxicity varies greatly between strains.

In Australia like other countries, plant invasion has been associated with the extinction of several valuable endemic plant species such as *Lantana camara* (Gooden *et al.*, 2009) Khan *et al.*(2012). Kohli *et al.*, 2006 reported that it can seriously impact on agriculture, the environment, biodiversity, and human and animal health, and contribute to social and economic instability. Management of weeds infesting roadsides or field boundaries is vital to prevent their invasion into croplands.

Manual and chemical methods are very effective in managing the growth of P*arthenium* in cropped fields, but these methods are not economically viable options in waste and range lands and also lead to dermatitis problems when we advocate manual removal. An integrated approach is recommended to effectively eradicate this weed (Thakur *et al.*, 1992). The most important component of mechanical removal is part of an integrated strategy. Herbicide application followed by weed removal followed by the release of bio-control agents. However, there is a pressing need to progress biological agents that are effective in managing the *lantana*. Furthermore, the creation of useful Technology can assist with its economic application in the fight against this poisonous weed. Weed management in non-cropped areas is an essential component of sustainable land management practices. Weeds are not only unsightly but can also pose a threat to biodiversity, wildlife habitats, and ecosystems by altering the structure, composition and function of the native vegetation. Effective weed management helps to maintain the health and integrity of non-cropped areas, preserving the long-term ecological balance and supporting the provision of ecosystem services.

The objectives of weed management in non-cropped areas include controlling the spread of invasive species, reducing weed populations, and restoring native vegetation. To achieve these objectives, various management strategies have been developed, including mechanical, cultural, biological, and chemical methods. These methods can be used singly or in combination, depending on the particular weed problem, the environmental conditions, and the desired outcome.

Mechanical methods of weed management involve the physical removal of weeds by hand, machine or animal grazing. This approach is often the most cost-effective and efficient method for controlling weeds in non-cropped areas, particularly in areas with low weed densities. However, mechanical methods may not be feasible in areas with dense weed populations, steep slopes, or rough terrain.

Cultural methods of weed management include the modification of the growing conditions to reduce the competitiveness of weeds, such as changes in soil moisture, nutrient levels, and light conditions. These methods are most effective in combination with other methods, such as mechanical or chemical control.

Biological methods of weed management involve the use of natural enemies of weeds, such as insect pests, pathogens or grazing animals. These methods are usually long-term, relying on the build-up of populations of natural enemies over time. However, they are not always effective and can be unpredictable, as the natural enemies may not always be present in the right numbers or at the right times to control the weeds.

Chemical methods of weed management involve the use of herbicides to control weed populations. Chemical methods can be effective, but they can also have negative impacts on non-target species and the environment, and require careful selection and application to minimize these impacts.

Management of weeds in non-cropped areas by different methods Biological method

Herbicide usage and mechanical control methods haven't had any discernible success.

Exotic natural insect enemies, especially from Tropical America, have been tried as biocontrol agents, but they haven't shown to be very effective. It is well known that the majority of insects that are effective biocontrol agents in laboratory simulations and to severely harm weeds have fared horribly in real-world settings. In the following days, field-based, intense research on biocontrol agents should be conducted.

Parthenium can be managed effectively by the biological method by using *Zygogramma bicolorata*. *Zygogramma bicolorata* is a useful Leaf eater, both adults and larvae, devour leaves. The beginning Larvae feed on terminal and auxiliary buds at this stage. As the leaf blades expand, continue to the next step. A high insect density within 4–6 weeks, one adult per plant- induced leaf skeletonization.

However, the plants are living, and when the conditions are right, dampness is present (Jayanth, 1987).

Tejeonemia scrupulosa Stal. is the *lantana* lace bug (Hemiptera: Tingidae) This bug feeds on the lantana's young, sensitive leaves, causing full defoliation and a temporary retreat of the weed to newer locations (Thakur *et al.,* 1992).

Nanjapa *et al.,* (2005) revealed that the Tingid bug, *Leptobyrsa decora* feed on mature and hard *lantana* leaves and can flourish in the shady moist forest canopy. This bug was discovered to feed on teak and to complete its life cycles consecutively for two generations on teak leaves under hunger storage conditions.

Nanjapa *et al.* (2005) reported that the *Lantana* seed fly, *Ophlomyia Jantanae* help in preventing seeds from being dispersed by birds by making the berries unappealing to them.

Nanjapa *et al.* (2005) reported that *Lantana* fruit borer, *Eplnotia Jantanae* larvae of the lantana fruit borer were discovered to bore lantana berries and receptacles. Continuous boring by the larvae hollows out the berries, which later they use as shelter.

Chemical method

Kewat *et al.* (2008) revealed that the application of combi (mixture of glyphosate 35% + 2,4-D 35%) at a higher rate (2.5 kg/ha) during the noon hours reduced the density, dry weight, shoot and root length of *Brachiaria mutica* (Paragrass) by 14.52, 15.88, 31.93, and 43.90%, respectively, when compared to glyphosate (7.43, 4.87, 22.33, and 29.26%) at the same rate (2.5 kg/ha) and time of application.

Khan *et al.* (2012) reported that Glyphosate and metribuzin were the most effective parthenium weed control treatments, with 91% and 75% mortality at 4 WAT, respectively. At 4 WAT, trisulfuron + terbutryn, bromoxynil+MCPA, and atrazine+s-metolachlor provided 50- 61.5% control. Weed mortality was 36.5, 41, and 43% with atrazine, s-metolachlor, and 2,4-D, respectively. This highlights the need of testing new herbicide formulations and the combination of effective and efficient herbicides under non-cropped conditions, economic management of these weeds is possible. a broad-spectrum herbicide called Indaziflam being a member of the alkylamine chemical class kills weeds by limiting biosynthesis of the cellulose of susceptible plants.

Mostly used herbicides which are used to control weeds in non-cropped areas are glyphosate and paraquat. Another significant herbicide used for weed management in non-cropped areas is paraquat (1,1-dimethyl-4,4-bipyridinium ion). However, several studies have found that the efficiency of this herbicide has decreased as a result of the emergence of resistant weeds (Heap, 2017).

Kaur *et al.* (2020) revealed that tank pre-mix of indaziflam plus glyphosate at 70 + 1400 g/ha might provide effective weed management of *Cannabis sativa* and *Parthenium hysterophorus* in non-cropped regions for up to 60 DAS, and of *Xanthium strumarium* and *Verbesina encelioides* for even longer (120 DAS).

Kumar *et al.* (2021) revealed that weeds can be effectively controlled on non-cropped land with the application of glyphosate 41% SL @ 3.0 L ha^{-1} and 4.0 L ha^{-1}, with the least influence on the microbial community.

Allelopathy

Lantana residues are allelopathic to milkweed vine according to Achhireddy and Singh (1984). This allelopathic impact might be beneficial owing to phenolic compounds' release group p-hydroxybenzoic, syringic, ferulic, pcoumaric, m- coumaric, protocatechuic, (Jain) gentisic, vanillin, and methyl coumarin (Jain *et al.,* 1989). According to Umapathi *et al.* (2000) stated that the incorporation of lantana leaves with hand weeding provided good weed control. Allelochemicals are released by sedges. The Lantana's allelopathic effect can also be used for weed control without the use of chemicals in the crop output today (Nanjappa and Saravanane, 2003).

Lantana camara (Verbenaceae) is an allelopathic plant. Allelo chemicals are present in all parts of the shrub. When released in surrounding, these chemicals restrict the germination of other species e.g., *Lemna paucicostata, Morrenia odorata, Eichhornia crassipes, Commmelina benghalensis, Digitaria sanguinalis, Echinocloa colonum, Panicum psilopodium, Microcystis aeruginosa, Abutilon theophrasti, Lepidium virginicum, Cyclosorus dentatus, Amaranthus hybridus, Parthenium hysterophorus* (Bais *et al.*, 2006; Ambika *et al.,* 2003; Kumar *et al.,* 2011). The leaf, root and stem possess allelochemicals that suppress neighbouring plant germination and growth (Rusdy and Ako, 2017). Allelochemicals belong to a range of species, including phenolic, aromatic and alkaloid species, monoterpenes, triterpenes, sesquiterpenes, flavonoids, phenyl and iridoid ethanoid glycosides (Ved *et al.,* 2018). Such compounds display growthinhibiting effects on germination and growth of adjacent plants through fluctuating microenvironments.

Integrated weed management

Integrated weed management (IWM) is the combination of two or more weed management strategies for controlling weeds. In the integrated approach we use two or more methods like manual method combined with the cultural method. It is very effective in controlling weeds. Therefore, effective management of lantana using current approaches on a campaign basis with the active participation of the public, development departments of the government, scientists, and policymakers is a necessary for long-term weed control (Angigras and Suresh, 2003).

Manual

Parthenium weed is managed using a variety of techniques when it isn't being grown, but hand removal is most common in Pakistan. Manual and mechanical approaches, however, are ineffective at getting rid of parthenium weed (Muniappa *et al.,* 2003). Herbicides, dosage rates, and weed growth stages all affect how well weeds are controlled. According to Tamado and Milberg (2004), *Parthenium hysterophorus* was only moderately controlled by 2,4-D in grain sorghum and many applications were required. 2, 4-D should be used in combination with atrazine. In a non-cropped situation, 2,4-D, atrazine, atrazine plus 2,4-D, metribuzin, metsulfuron, chlorimuron, and glufosinate failed to control *Parthenium hysterophorus*, whereas glyphosate at 2.7 and 5.4 kg ha^{-1} provided more than 90% control when assessed 18 weeks after treatment, according to Singh *et al.* (1997). To effectively and economically manage parthenium weed in uncultivated regions, fallow fields, walkways, and along water channels without causing any residual effects, new herbicide formulations need to be investigated. The province of Khyber Pakhtunkhwa did not perform any field tests to evaluate various herbicides against parthenium due to the recent introduction of parthenium in non-cropped settings. This research aimed to determine the parthenium growth stage that was most vulnerable.

By using electricity

Lehnhoff *et al.* (2022) stated that pre-emergent weed control experiment demonstrated that electricity has a great ability to suppress weed development, with treated plots having a mean weed cover of 4% after 4 months compared to 94% in control plots. Finally, it was demonstrated that electricity was completely successful in preventing *Convolvulus arvensis* from climbing poles. Our findings suggest that electricity is a feasible alternative to manual, mechanical, or chemical approaches for small tree removal, pre-emergent weed control in xeriscaping, and climbing weed avoidance.

Foliar application of table salt solution

With the use of a watering can, a 15% table salt solution was made and sprayed on all the plants in the designated area. Throughout the experiment, this therapy was administered three times, two weeks apart. Mekonnen (2017) and Kaur *et al.* (2018) both discuss using a salt solution to control parthenium weed. A 15% table salt solution proved successful in treating parthenium weed, and the salt solution caused the parthenium plants to fully wilt and die. Previous research also suggested that spraying table salt solution at a concentration of 15-20% efficiently suppressed parthenium weed in uncultivated regions, open wastelands along railroad tracks, and by the sides of roadways (Mekonnen, 2017). Because salt is accessible and inexpensive, its use in Uganda for parthenium weed control is appropriate, application does not pose health dangers and does not call for special expertise. However, the salt solution did not eradicate other weed species including milkweed, star grass, or Wandering Jew, making salt treatment a less effective method of managing parthenium weed in farmed areas.

Hand pulling

When there is a desire for minimal disturbance and there aren't enough parthenium plants, are too few, are too close to the crop stand, or are dispersed to warrant the use of other, more expensive techniques, hand pulling is an effective option (Onwueme and Sinha, 1991). The control of parthenium weeds by hand worked well. Farmers frequently utilise manual uprooting to manage partheniums. To stop further spread, hand pulling should be done before flowering and seed germination. The possibility of developing contact dermatitis is the drawback of hand pulling, though (Kaur *et al.,* 2014). To minimise allergic responses, personal protective equipment must be used together with extreme caution when hand-pulling parthenium weed. Hand pulling has additional drawbacks due to its arduous nature and the possibility that not all of the root system may be removed if the soil is dry. However, new plants can develop from these roots. To prevent regrowth after the removal of parthenium plants, the entire root system must be eliminated. (Abdulkerim-Ute and Legesse, 2016).

Mulching

Natukunda *et al.* (2020) stated that mulching effectively reduced parthenium plant populations throughout the trial, with only a few plants emerging on the last sample day in regions with thinner mulch. Mulching is therefore effective for reducing parthenium weed, but more mulch should be placed regularly to maintain thickness and prevent weed emergence on thinner regions following decomposition. Mulching inhibits weed development by acting as a physical barrier to weed emergence and blocking direct sunlight.

Slashing

Slashing was an effective way to get rid of parthenium weeds and other weeds. Our findings are consistent with those of Onwueme and Sinha (1991), who claimed that slashing inhibits the growth of new plants by starving the subterranean sections and preventing the majority of weeds from producing seeds. Slashing was not a particularly effective control strategy in our study since the roots left behind from the cutting also grew into new plants. After the trial, oxalis, pigweed, and Malvaceae species were among the additional weed species found in the slashed area.

Hand hoeing

Parthenium and other weed species could be effectively controlled by hand hoeing. In addition to hurting weeds, hand hoeing has a significant impact on the variety, abundance, distribution, dormancy, and vitality of weed species (Ross and Lembi, 1985). Because hoes are inexpensive, accessible, and easy to use, they are a suitable method of parthenium management for Ugandan farmers. Similarly, to this, Tamado and Milberg (2004) observed that manual hoeing was successful in Eastern Ethiopian smallholder agricultural systems for reducing parthenium weed. In the hand-hoed area, parthenium weed coexisted alongside blackjack, milkweed, sodom apple, Wandering Jew, star grass, oxalis, and members of the Malvaceae family.

Conclusion

In conclusion, effective weed management in non-cropped areas requires an integrated approach, combining multiple management strategies to achieve the desired outcome. Management plans should be tailored to the specific weed problem, taking into account the environmental conditions, the available resources, and the desired outcome. Effective weed management helps to maintain the health and integrity of non-cropped areas, preserving the long-term ecological balance and supporting the provision of ecosystem services.

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