AN ANALYSIS OF WEED MANAGEMENT IN INDIA

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ABSTRACT

Weeds are the most significant impediment to the development of long-term crop production. Weeds control the majority of crop production practices and cause huge losses (37%) as a result of their interference. Farmers use a variety of methods to manage weeds in various crops/cropping systems, the most common of which is the use of herbicides, which is currently at the top of the list due to labor shortages. Environmental, social, and economic concerns about global competition, production costs, soil erosion, environmental pollution, and concerns about the quality of rural life are all raising questions about the systems' long-term viability. The central thesis in new weed management paradigms will be to improve crop competitiveness through preventive methods, cultural practices, mechanical methods, plant breeding, biotechnology, biological control, and crop diversification. Integration of the aforementioned techniques will be critical for long-term weed control that maintains or improves crop productivity, profitability, and environmental quality. The goal of this review is to make it easier to develop environmentally friendly alternative weed management methods that will support crop production systems that use less tillage, herbicide, and other inputs. To achieve this goal, crop ecology research and the development of ecologically based weed management technologies must be dramatically expanded. Adoption of sustainable agricultural practices reduces the intensity of soil manipulation, making it more difficult for weed seeds to germinate, as well as reducing organic matter depletion and soil erosion. As a result, sustainable approaches to weed and soil management may be an option for ensuring long-term crop production.

KEYWORDS: *Agriculture, Food, Management, Plant, Weed.*

1. INTRODUCTION

As the world's population grows, the food demands imposed on agricultural production systems will put existing agricultural methods to the test. Furthermore, sufficient food production in the future can only be accomplished by using sustainable growing methods that limit environmental damage and resource conservation while maintaining high yield and profitability in cropping systems. This article demonstrates how certain unique characteristics of sustainable agriculture point to the necessity for an effective weed management strategy. It's critical to have a long-range plan in place to assist anticipate and prevent future weed issues. Maintaining agricultural production requires effective weed control. Weeds may decrease agricultural production and quality by competing for light, water, space, and nutrients, resulting in billions of dollars in yearly crop losses. Weeds are almost difficult to eradicate from any particular field due to their capacity to survive and spread via repeated reproduction and dispersion of latent seeds/ vegetative propagules.

The fact that herbicides account for the vast majority of pesticides used in agriculture, far outnumbering inputs for all other major insect groups, demonstrates the significance of weed control to successful cropping. The effectiveness and long-term viability of our weed control methods has a significant impact on the success and viability of agriculture as a whole. Weeds are a significant restriction in agricultural production systems because they operate at the same tropic level as the crop, capturing a portion of the available resources required for plant development. Allowing weeds to grow unchecked will, sooner or later, result in significant agricultural output losses and higher production costs. Weed management by hand is labour demanding, limiting the producing area. Due to a dwindling labour force as a result of male population outmigration, it has become more difficult to recruit labour for weeding and other agricultural tasks in many rural Indian villages. As a consequence, agricultural activities are often pushed back, and labour expenses have risen. For sustained crop production, the scenario necessitates labour-saving weed control techniques. Depending on the weed type and crop weed competition, it can reduce yield by up to 96.5 percent, and some researchers have reported total crop failures[1].

Crop rotation, tillage, and seed washing have been used to control weeds in agriculture from the dawn of agriculture until the advent of herbicides. In the decades after World War II, the increasing availability and acceptance of extremely powerful and selective synthetic herbicides shifted weed researchers' and managers' attention away from nonchemical weed control. Weeds were not considered components of agro-ecosystems in this setting, thus sustainability problems were easily overlooked, and preventative or suppressive weed management methods were dismissed. Weeds have become a significant issue due to a lack of study on various weed management alternatives, especially when chemical weed control has been avoided. Herbicidal control was one of the main catalysts for the intensification of agricultural production systems in the 1940s, which was marked by a massive rise in labour productivity, but the excessive dependence on chemical weed control is today deemed undesirable. For starters, a high level of dependence indicates widespread usage of chemicals that may have severe consequences for food safety, public health, and the environment. Second, agricultural systems that are solely focused on herbicide control are becoming more susceptible, since herbicide resistance is often resulting in circumstances where chemical control of a portion of the weed population is no longer possible.

Finally, the growing popularity of organic agriculture necessitates the development of new weed-control strategies. As a consequence, a variety of paths have emerged, the first of which is a more efficient use of herbicides. This approach may be applied via advancements in application technology, factor adjusted doses, and patch spraying, all of which increase herbicide efficiency and save time. A second approach is to place a greater emphasis on curative control technologies such as cultural, biological, and mechanical weed control. Any change or alteration to the general management of the crop or cropping systems that contributes to the regulation of weed populations and minimizes the negative effect of weeds on crop production is known as preventive and cultural control. Because biological control alternatives are limited, a full dependence on mechanical or agronomical control is undesirable, and herbicidal control is banned in organic agriculture, cultural control seems to be especially important. Despite the availability of a wide range of cultural control methods, weeds are still cited as the primary productivity barrier in sustainable agriculture. In addition, despite the aim to decrease the heavy dependence on chemical control, cultural management has yet to gain traction in traditional agriculture. Furthermore, the long-term viability of our food production systems, as well as the health and environmental implications of pesticide usage, are quickly becoming major worldwide concerns, reigniting interest in ecological weed control methods[2].

1.1 Preventive methods:

Weed prevention refers to any actions used to prevent new weeds from entering and establishing themselves in an area that has not previously been infected. This may be accomplished via the use of weed-free crop seeds, seed certification, weed regulations, and quarantine laws, among other things. Clean seed legislation, cleaning agricultural equipment and product, cleaning irrigation water, cleaning sand and gravel, and decreasing the quantity of weed seeds returned to the soil may all help to decrease weed spread within a nation. Weeds may be avoided in crop fields by using weed-free seed, avoiding using fresh or partly decomposed FYM or compost, cleaning farm equipment thoroughly before sowing, and maintaining the farm bund and irrigation/drainage channel clear of weeds[3].

1.2 Cultural methods:

By decreasing weed establishment and enabling quicker crop growth to smother weeds, cultural techniques provide crops a competitive edge against weeds. Stale seedbed techniques, crop rotation, increase the competitive ability of the crop, time of seeding and irrigation, inclusion of cover crops, and intercropping, conscious use of crop interference, use of cropping pattern, and tillage systems; employing time, method, rate of sowing, rate of fertilizer, and tillage systems; employing time, method, rate of sowing, rate of fertilizer, and tillage systems; employing time, method, rate of sowing and rate of fertilizer[4].

1.3 Stale seedbed technique:

After seedbed preparation, the field is watered and left unsown to enable weeds to sprout and be destroyed either by a non-selective herbicide or by tillage before to planting in the stale seedbed method. This method slows the emergence of weeds, delaying early crop-weed competition and reducing the weed seed bank. The success of a stale seedbed is determined by a number of variables, including seedbed preparation, emerged weed control methods, weed species, stale seedbed duration, and environmental conditions[5].

1.4 Crop rotation/crop diversification:

Through varied planting and harvest dates, rotating crops with distinct life cycles may disrupt the formation of weed crop associations, limiting weed establishment and therefore weed seed generation, mostly through smothering and allopathic effects. The weed seedbank and quantity of broadleaf weeds are reduced when wheat, maize, and soybeans are grown in rotation. Palmaris minor and other weeds were decreased in population and soil seed bank when the rice-wheat sequence was changed to rice-potato, rice-potato-wheat, or any other sequence. Weed density and weed dry matter output are reduced when the rice-wheat cropping scheme is altered. Rice-wheat-green gram sequence had the smallest population among the three weed groupings, followed by rice-wheat, rice-chickpea, and rice-pea sequences. Diversified cropping systems, the use of different grain crops, forage legumes as green manure, and livestock manure to provide organic sources of nutrients and organic matter that can reduce weeds by affecting weeds through suppression and the release of allele chemicals, or by providing substrates for other organisms that inhibit weed seedling growth and potentially influence the colonization of an area[6].

1.5 Sowing/planting time:

Although sowing time is a non-monetary input, it has a significant impact on crop production. Early planting gives adapted crop cultivars a competitive advantage against weeds since the crop emerges before the weeds, depriving the weeds of adequate sunlight for emergence and development. Several studies have indicated that seeding rice after the beginning of the monsoon resulted in greater grain production and lower weed density, while late wheat planting reduced Phalaris minor infection[7].

1.6 Cultivars:

Over the last several years, the function of crop genotype in weed control has gotten a lot of attention. Competitive cultivars may reduce weed seed production, restrict future weed infestations, and provide a safe, ecologically friendly, and low-cost weed control technique. Weed suppression and weed tolerance are key characteristics to look for when identifying weed-controlling cultivars. Within a species, cultivars vary in their ability to compete with weeds. This phenomenon is caused by morphological and physiological variations between types, and it may also be influenced by external influences. Seedling emergence, canopy establishment, early fast growth, maximum number of leaves, tall stature, and more tillering capacity are all traits that cultivars with faster seedling emergence, canopy establishment, early fast growth, maximum number of leaf, tall stature, and more tillering capacity have a better competitive ability against weeds[8].

1.7 Sowing/planting methods:

Crop sowing and planting techniques have a major impact on weed population and dry weight. In wheat, zero-till and FIRB sowing produced lower weed density with higher grain yield than conventional tillage and strip till drill system over conventional ill age and flatbed system, and in lentil, zero-till and FIRB sowing produced lower weed density with higher grain yield than conventional tillage and strip till drill system over conventional ill age and flatbed system. This is due to the weed not finding favourable moisture conditions at the surface to germinate due to the avoidance of soaking the entire cultivated soil surface in bed planting. Seeds laying at lower depths did not sprout in zero till seeding by Happy Seder machine with stubble mulching, undisturbed inter row space, and it saves time and energy. In comparison to flatbed and ridge furrow techniques, the BBF method of sowing offers a favourable environment for crop growth and development while also decreasing weed population. In wheat, bidirectional sowing produces less weeds than unidirectional planting, despite the same seed rate. Transplanting under puddle conditions harmed weed growth and resulted in the lowest producer of weed dry weight compared to direct sowing with zero till drill under unpuddled wet seed bed, direct drum seeding of pre-germinated seeds under puddle conditions, unpuddled transplanting, SRI, whereas drum seeding + green manure significantly reduced weed density in direct seeded rice over drum[9].

1.8 Intercropping:

Weed management may be accomplished via intercropping. Planting a variety of plant species together improves weed management by collecting a larger proportion of available resources and boosting shade and crop competition with weeds in tighter crop spacing. Intercropping also lowers weeding costs and increases the system's overall production and monetary rewards. Intercropping, or selectively spreading several kinds of crops, such as legumes, cucurbits, and sweet potatoes, helps to create a quicker and denser ground cover, which inhibits weed development and minimizes erosion. However, due of the varying canopy coverage, this method is insufficient to guarantee effective weed management. Where intercropping offers a stronger competitive impact against weeds in light, time, or area than monocropping, evidence of improved weed suppression was quite apparent. Over solo sugarcane, sugarcane + black gram, and sugarcane + okra intercropping, sugarcane + green gram intercropping had the lowest weed dry weight and the greatest cane yield[10].

1.9 Planting pattern:

2 Planting pattern, which modifies the crop canopy structure

3 and micro climate, in combination with weed management

4 practices, may influence the weed infestation to a great extent

5 (Dwivediet al., 2012) and hypothesized that increased crop

Planting patterns, which alter crop canopy structure and microclimate, in combination with weed management practices, may have a significant impact on weed infestation. It is hypothesized that increasing crop density, reducing row spacing, and increasing spatial uniformity can improve weed suppression by improving crops' competitive ability with weeds. Competition with weeds begins sooner in a completely uniform grid design, where the distance between individual crop plants inside the row and between the rows is equal, than in a row pattern, where competition between individual crop plants is postponed as long as feasible. Due to a fast canopy closure, crop competitiveness for limited resources will increase, decreasing weed seedling development and soil weed seedbank. Bi-directional row orientation had the lowest dry matter of weeds in wheat, followed by North-South row orientation, cross sowing at 22.5x22.5 cm, and standard 22.5cm. This may be due to a superior smothering effect.

1.10 Cover crops/green manures:

Growing cover crops, have potential as an important component of a system oriented ecological weed management strategy for sustainable agriculture, because it conserve soil and moisture, enhancing soil nutrient status, total biomass production and lowering temperature within the crop canopy, suppress weed growth due to allopathic effects or by shading . Besides the allopathic effects, crop covers reduce the sunlight exposure of weeds and compete with the weeds for water, nutrient and space. Use of the cover crops and organic amendments promotes the fungal, bacterial and mycorrhizal communities that may be detrimental to weeds and beneficial for the crops. Growing of non-legume crops in the rotation as a cover crop utilize the surplus nitrogen from the soil that prevent nitrate nitrogen removal and also reduce the available nutrients for weed germination and its growth.

2. DISCUSSION

Weed management technologies can be used to control weeds in a variety of ecosystems. The available technologies must be fine-tuned to meet the specific needs of the farming community and others in their specific locations. There is a need to expand infrastructural facilities for weed control research, extension, and adoption. The need of doing need-based fundamental research on weed biology and ecology in order to develop location-specific integrated weed control methods via collaborative research with other agricultural disciplines should be highlighted. Indian scientists must collaborate more with foreign institutions and weed experts from across the globe to solve weed control issues in the face of climate change. The private sector's role in large-scale adoption of integrated weed management programs in various crops is critical. They must realize that herbicides are just one weapon in the fight against weeds, and that there are many other variables to consider when planning and implementing a weed management strategy. Small farmers in India will benefit from a system-based weed control approach that includes strong cultivars, adequate agronomy and land management, appropriate application technology, and correct herbicide rotation.

3. CONCLUSION

India's agroclimates and soil types are diverse. Different kinds of weed issues plague the vast array of agricultural and fanning systems. Weeds reduce agricultural yields by 10 to 80 percent, as well as lowering product quality and posing health and environmental risks. Agriculture, forestry, and the aquatic environment are all hampered by invasive alien plants. Problematic weeds unique to a crop (weedy rice in rice) are developing as a challenge to agriculture, impacting crop yield, product quality, and farmer revenue. Weed management in India has always relied heavily on human weeding. Increased labor scarcity and expenses, on the other hand, are pushing farmers to use labor and cost-cutting methods. Herbicides are one of them, with a 15 percent yearly growth rate. Indian farmers use integrated weed management (IWM), with different degrees of acceptance from one farm to the next. Resistance has evolved in Phalaris minor Retz as a result of continuous application of iso-proturon along with mono-cropping rotation of rice-wheat. In India's northwestern region. Conservation agriculture has been adopted as a component of IWM in the rice-wheat cropping system as a result of efforts to control herbicide resistance. Herbicide effectiveness is the focus of most weed control research in India. Herbicides, used alone or in combination, have long been considered as critical tools for controlling weeds in a variety of environments. IWM is promoted in agricultural production systems, as well as aquatic and forest environments, and comprises preventive, mechanical, cultural, chemical, and biological approaches. HR transgenic crops have the potential to enhance weed control efficiency and promote CA adoption in India, assuming that the hazards related with such crops are well investigated before to their acceptance and commercialization. Newer weed management methods must be created to account for the danger of HR weeds, as well as the recurrence and persistence of weeds, as well as the need to reduce weed control costs to increase farmer profit while preserving the environment. Understanding weed ecology and biology, as well as the use of information technology, should all be part of creating and disseminating efficient, cost-effective, and environmentally friendly IWM methods in India. This article discusses a detailed overview of weeds and weed control in India.

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