ASSESSMENT OF WEED MANAGEMENT STRATEGIES FOR SUCCESSFUL FARMING ACTIVITIES

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ABSTRACT

Weed is the most important biotic constraint to agricultural production in both developing and developed countries. This literature review examines weed management strategies for the economics of plants through an empirical study of farmers in Akwa Ibom State. Weed management is a comprehensive method to control and mitigate infestation in fields that incorporates diverse techniques. Management practices should be flexible and allow for adjustments to cope with changing conditions. This paper provides a comprehensive review of the concept of weed, the causes of weeds in farms, and the damages and losses caused by weeds. In conclusion, the paper noted that weeds cause economic and social harm to farmers. Improvement in tillage regimes has long been identified as an impressive weed-control measure. Harvest weed seed control and seed predation have been shown as potential tools for reducing weed emergence and seed bank reserves, and the use of herbicides has been known as one of the management strategies for weed control. One of the recommendations was that there should be awareness among farmers about the appropriate skills required to use and apply herbicides correctly to minimize damage to crops and the associated health and environmental hazards.

KEYWORD: Weed Management Strategies, Economic of Plants, Farmers and Akwa Ibom State

Introduction

It is possible to successfully control or eradicate weeds by using a range of control strategies in concert, lowering the need for herbicides alone. Programmes for integrated weed management necessitate long-term planning, an understanding of the biology and ecology of weeds, and effective weed control techniques. Weed control is currently the key to increased production in Nigeria because it is a constraint on plant productivity. The field task that requires the most labour in the cassava industry is weed management. Due to their early, slow growth after planting, plants are

typically more prone to weed infestation. Plants are vulnerable to early weed competition during the first three to four months following planting, just like many other crops grown in the tropics.

Plants known as weeds can affect farmers economically and socially under certain situations. Weeds are a result of inter-specific selection that humans have induced since they first started cultivating crops, which has had an impact on the soil and the entire habitat (Chauhan, 2022). The selection process is ongoing and is based on the farming methods used. Reduced canopy development, tuberization, tuber quantity, and weight are all effects of weed competition. It also makes the crop more vulnerable to infestations of pests and diseases. Weed competition causes a loss in tuber output that ranges from 40% in early branching types to almost 70% in late or non-branching cultivars. Crop losses of up to 100% occurred on fields where there was no weed control. One of the processes in plant production is weed management, which helps plants reach their maximum genetic potential and increases yield capacity. Hand weeding, which includes hand-pulling, hand-slashing, and hand-hoeing, is likely the oldest method of weed control. These methods have repeatedly shown to be ineffective and expensive as well. In nations with modern technology, hand pulling is only employed as a backup for more effective weed management techniques. When used properly and on time, herbicides have been shown to be inexpensive and effective at controlling weeds in cassava.

Concept of Weed

A weed is a plant out of place, a plant that interferes with human activities, a plant whose negative characteristics outweigh its positive characteristics, or a plant whose positive characteristics have not yet been discovered. While individual weeds vary greatly in their structure and function, weeds as a group tend to have a number of biological characteristics that make them very good competitors against forage crops. In the table below is a list of biological characteristics that enable weeds (and other plants that possess them) to spread rapidly into cropland and pastures. Weed is any plant that is growing in a place where a human wants a different kind of plant or no plants at all, or any plant that crowds out cultivated plants. Plants that are considered nuisances to man because they compete for resources in the same local environment as the crops we intend to grow for our own species The weed may actually indirectly help the crop by diverting pathogens that may otherwise infect it. (Biology Online, 2022). It is also a street name for marijuana. Vocabulary.com (2023). Weeds are plants that are undesirable, persistent, damaging, and interfere with the growth of other crop plants, thus affecting human activities, agriculture, natural processes, and the economy of the country.

The term weed is typically applied to any plant species that often becomes a pest, such as common lamb's quarters (Chenopodium album), pigweeds (Amaranthus spp.), and crab grasses (Digitaria spp.). However, weed manuals and herbicide promotional literature also list as weeds species such as clovers (Trifolium spp.), orchard grass (Dactylis glomerata), tall fescue (Festuca arundinacea), hairy vetch (Vicia villosa), and Jerusalem artichoke (Helianthus tuberosus) that many farmers value as forage, cover, or food crops when grown in the right context. Indeed, "volunteer crops" such as buckwheat (Fagopyrum esculentum), winter rye (Secale cereale), corn (Zea mays), or even forage soybeans (Glycine max) can become weeds when they self-seed and emerge in another part of the crop rotation when they are no longer wanted. Managing a weed species to protect the desired crops usually does not require exterminating that weed altogether. Based on these considerations, a weed might be defined as any plant not intentionally sown or propagated by the grower that requires management to prevent it from interfering with crop or livestock production. In this definition, a weed is a non-crop plant that can become a pest if not managed adequately.

However, its presence may not always be harmful and does not automatically warrant its immediate eradication. Weeds can perform vital ecosystem services such as protecting and restoring exposed or degraded soils. In addition, some weeds provide habitat for beneficial organisms and thereby contribute significantly to the natural and biological control of some insect pests. Certain weeds also make nutritious food or fodder. For example, a flush of common lamb's quarters coming up in a fallow bed in late spring can take up nutrients that would otherwise leach, protect the soil surface from crusting and erosion, and provide highly nutritious greens for human or livestock consumption. Managing weedy species like lamb's quarters and wild carrot can consist of letting them grow and utilizing them when and where their presence is mainly beneficial; removing them promptly when they threaten to interfere with the crop; and mowing or pulling before they can cast seed onto crop fields (EOrganic 2023).

Causes of Weeds in Farms

The problem with weeds is that they have a negative impact on the bottom line of the farming business. Quite often, growers don't have enough deeper knowledge to understand just how much it affects yields, quality, and efficiency on the whole farm. (Horticulture.org. 2022). The timing of weed-crop competition is important. Ecologists have defined a critical period of weed competition. This is the time when the weed reduces crop yield. Weeds that are removed before the critical period or that emerge after the critical period do not cause any appreciable yield loss. The exact timing of this period is not an "inherent property of the crop" and varies for different crops, for different weed species, and under different conditions such as year or location. In general, weeds should be removed at early crop growth stages. Early weed removal was found necessary to protect the field pea yield. The relative timing of crop and weed emergence is very important in determining the magnitude of yield loss from weed competition. When it comes to plant competition, generally, the first one out of the ground wins. Competition from wild oat resulted in a 17% yield loss in barley when it emerged five days before the crop, compared to a 3% yield loss when wild oat emerged five days after crop emergence. Weed size is partly a matter of timing. Weeds that emerge before the crop are generally larger and better established than those that emerge after the crop. This gives them greater access to soil and spatial resources, and thus they do more damage to crop yield. Size also varies among species. For instance, three Canada thistle plants are naturally much larger and likely to cause more yield loss than three thyme-leaved spurge plants. Size also depends on plant nutrition, disease, and pests. Some weeds may limit crop development through chemical means, or allelopathy, either while they are alive or as they decompose. Some weeds, for example, Canada thistle or quack grass, release chemicals that inhibit their neighbors. This affects their competitive relationships.

Weeds can cause problems other than crop yield loss. Some weeds are poisonous and can taint food and feed crops. For example, wild mustard seed cannot readily be removed from canola and can flavor the resulting canola oil if crushed with the crop seed. Stinkweed in feed for dairy cattle produces off-flavors in milk. Weeds that remain green at harvest, especially those with fibrous stems, can interfere with harvest. The problem varies with both the crop and the weed. A low-growing weed like wild tomato causes very little problem in a cereal crop because most of the plants are below swath height. In a crop like lentils, chickpeas, or beans, severe harvest difficulties may occur. The low cut means that wild tomatoes are harvested with the crop, and they can stain the pulse and clog the machinery. Weeds like wild buckwheat that twine through a crop can also be problematic. Weeds can harbor problem insects and crop diseases. For instance, mustard-family weeds can carry canola diseases, making rotation a less effective tool for disease management. Immature weeds can interfere with harvesting operations. Weed seeds in harvested crops cause dockage and

increase the risk of spoilage. This can reduce crop value or increase shipping costs. Weeds cause many problems. Most importantly, weeds can reduce crop yield. Weeds cause greater crop losses if they occur in large numbers, if they get a head start on the crop, if they are especially vigorous, or if they produce allelopathic substances. Other problems weeds cause include dockage, tainted products such as feed or food, increased numbers of harmful insects or diseases, and a more difficult harvest.

Some Methods of Weed Management include:

- Prevention. The most important factor in overall weed control is to prevent weeds from developing seed and perpetuating the weed problem
- Cultivation
- Cover Crops
- Mowing
- Flaming
- Hand-removal
- Mulches

Damages or Losses Caused by Weeds

- ***Reduction in crop yield***: Weeds compete for water, nutrients, and light. Being hardy and vigorous in their growth habits, they soon outgrow the crops and consume large amounts of water and nutrients, thus causing heavy losses in yield. E.g., a 40% reduction in yield of groundnut and a 66% reduction in yield of chilli The loss of N through weeds is about 150 kg/ha.
- ***Increase in the cost of cultivation***: One of the objects of tillage is to control weeds, on which 30% of expenditure is incurred, and this may increase more in heavily infested areas and also increase the cost of weed control by weeding or chemical control. Hence, reduce the margin of net profit.
- ***Quality of field produce is reduced:*** Weed seeds get harvested and threshed along with the crop produce, which lowers the quality. Such produce fetches fewer prices in the market. E.g., leafy vegetables, grain crops.
- ***Reduction in quality of livestock produce:*** Weeds impart an undesirable flavor to the milk (Ghaneri), impair the quality of the wool of sheep (Gokhuru, Aghada), and cause the death of animals due to the poisonous nature of the seed (Dhatura).
- ***Harbor insect-pests & disease pathogens:*** Weeds either give shelter to various insect pests and disease pathogens or serve as alternate hosts, thus perpetuating the menace of pests and diseases. E.g., gall fly of paddy, midge fly of jowar, leaf minor of soybean and groundnut, rust of wheat, tikka of groundnut, black rust of wheat, and Downey mildew (Saccharum spontaneum).
- ***Check the flow of water in irrigation channels:*** Weeds block drainage & check the flow of water in irrigation canals & field channels thereby increasing the seepage

losses as well as losses through over through over flowing, so reduce the irrigation efficiency.

- ***Secretions are harmful:*** Heavy growth of certain weeds like quack grass (Agropyon repens) or lavala lowers the germination & reduce the growth of many crop plants due to presence of certain phytotoxins secreted by weeds.
- ***Harmful to human beings and animals:*** Weeds cause irritation of skin allergy & poisoning to human beings, also death of castles.
- ***Cause quicker wear & tear of farm implements:*** Being hardy & deep rooted; the tillage implements get worn out early & cannot work efficiently unless they are properly sharpened or mended.
- ***Reduce value of the lands:*** Heavily infested lands with perennial weeds fetch less price as require heavy expenditure to brought under cultivation.

Weed Management Strategies and the Prospects

Weed management includes prevention, eradication, and control by regulated use, restricting invasion, suppressing growth, preventing seed production, and complete destruction. Thus, weed control is one aspect of weed management. (TNAU-2016) Weed management consists of developing a plan (weed management strategy) utilizing available tools, information, and management skills (weed management tactics) integrated into a working weed-crop management system. This working management system is then modified to reflect changing long- and short-term constraints and opportunities. A weed-crop management system is a working plan of on-farm activities consisting of a collection of interdependent, interacting tactics. A balanced weed management program includes several control tactics, including tillage, crop rotation, cultivation, cultural practices, and herbicides, thus promoting vigorous competition from the crop. "An efficient weed management system integrates preventative measures, crop rotation, soil and water management practices, cultivations, and the use of competitive crops, natural enemies, and herbicides when appropriate. Integrated systems of weed control must be compatible with the management of other pests, other practices to increase crop production, and a quality environment."

Strategy in weed management is the development of a plan utilizing weed control expectations, information, and management skills. Strategic planning involves making short-term (e.g., tillage, herbicide selection) and long-term plans (e.g., seed bank deposits, crop rotations). When tillage is either significantly reduced or eliminated, herbicides become one of the most relied-upon strategies for weed control, but they must be used in conjunction with appropriate cultural practices. There is no single "big hammer" solution to weeds; rather, a strategy involving "many little hammers," or cultural weed control practices such as cover crops, crop rotations, and tactics that improve a crop's competitive advantage, is essential to ensuring successful weed management (SARE, 2020). Switching to conservation tillage requires increased management intensity to develop an integrated weed control plan suitable for the farm.

- **Herbicides**

Herbicides are used in many ornamental production areas as an economical option to control weeds. By using herbicides before weeds emerge, weed competition with the ornamental crop can be reduced. Weed management includes prevention, eradication, and control through regulated use, restricting invasion, suppressing growth, preventing seed production, and complete destruction, whether used or eliminated, resulting in higher-quality ornamental plants and lower labor costs (UC IPM, 2020). Herbicides are generally classified according to when they are used in relation to crop and weed growth stages. Replant herbicides are applied before planting. These herbicides are used before the desirable plants are present because some can control both germinating seedlings and established plants. Preemergence herbicides kill weeds at the seed germination stage. These herbicides are applied before weeds emerge. Post-emergence herbicides are applied after the weeds have emerged. Preemergence and postemergence herbicides may be applied before or after the crop is planted, depending on the crop and the herbicide selected (Chaudhary & Dhakal, 2023).

Cover Crops

There is a great deal of information available about the benefits of cover crops. In addition to reducing water runoff and erosion, increasing soil organic matter, and providing a means to sequester carbon, cover crops can also reduce weed seed germination and growth. Winter cereal crops, legumes, and brassicas are typical cover crops in the Southeast. They provide weed control through a mulch effect as well as through the release of chemicals that inhibit plant germination or growth, referred to as allelopathic compounds. Many times, a grass cover crop like rye or black oats is the best option if the primary goal is weed control. These covers produce high amounts of biomass that break down less quickly than some broadleaf cover crops, such as legumes (SARE, 2020). This helps suppress weed growth longer into the season. Since some problem weeds, such as pigweed, can easily grow under high-shade conditions, high amounts of cover crop residue are preferred to provide a barrier to weed growth.

- **Tillage**

It is one of the oldest preventive measures to avoid weed infestation. It uproots and leaves weeds exposed, taking control of weeds by burying their seeds deep enough to impede their germination and altering the soil-based growing environment. Taking an effective approach to controlling perennial weeds requires either covering them deeply in the soil or drying them out with starvation tactics. There are several methods of tillage that are applicable to pulses (Chaudhary, 2023).

The Optimal Resource Managements are Data, Information, Knowledge, Wisdom and Action.

DATA is raw numbers, facts, or similar inputs.

INFORMATION is data put in some context or usable format: herbicide labels, weed maps of a field, etc. In many simple weed management systems, the temptation is irresistible at this stage of strategic planning to jump to ACTION. I have modified Gregg's original model by calling this premature leap the "Herbicide Shunt". You have information about some aspect of weed management, for instance, the need to control cocklebur in a particular field, and some other information, like a herbicide label, and the decision is made to spray. Because this premature action is so often very successful, important planning and management planning is short-circuited by this approach.

KNOWLEDGE is information that has been placed in some framework, some organisational structure, to provide a larger view of that information. In our cocklebur example above, this might be the recognition of long-term implications of herbicide information on soil carryover, seed bank changes, economic or environmental drawbacks, or implications for other long-term aspects of the cropping system.

WISDOM is the most valuable and difficult-to-achieve aspect of weed management or resource optimisation planning. Knowledge is filtered through the sieve of management skills, experience, limitations, risks involved, and even aspects of a grower's personality and irrational beliefs. The final product is wisdom; for better or worse, in every strategy you put forward, you must know whether you lose or gain from it. When it is mandatory that you know this, you see your management system going smoothly. Always take cognizance that it is not all day that things must favour you, and then apply wisdom to be patient about it in order to succeed and sustain yourself.

ACTION is doing your actual weed management system.

Management Skills

The management skills of the individual grower include management of time, labor and information coupled with an individual growers experience, insight, training and intelligence.

LABOR is one of the least available, most expensive, resources for Iowa farmers. Most farmers hunger for ways to replace labor with information, equipment and management skills.

TIME is experienced differently when you are rushed than when you have less to do:

Concepts of Weed Management System

Weed management is a comprehensive method to control and mitigate infestation in fields that incorporates diverse techniques. Management practises should be flexible and allow for adjustments to cope with changing conditions. Recognise limitations and anticipate changing conditions, such as emerging seasonal weather conditions (e.g., rain, no rain, hail).

Nowadays, most farmers rely on herbicides. However, sustainable agriculture and organic farming require a profound reconsideration of the approach as chemical residues harm both humans and nature, and many herbs develop resistance to chemical substances. In this regard, alternative and integral weed management plans are the most beneficial option with a view to the future. This management method aims to avoid contamination of the planting material and cultivated areas. (EOS Data Analytics, Inc., 2022). We are reviewing some potential nonconventional weed management strategies for modern agriculture that are viable, feasible, and efficient. Improvement in tillage regimes has long been identified as an impressive weed-control measure. Harvest weed seed control and seed predation have been shown to be potential tools for reducing weed emergence and seed bank reserves.

Development in the field of allelopathy for weed management has led to new techniques for weed control. The remarkable role of biotechnological advancements in developing herbicide-resistant crops, bioherbicides, and harnessing the allelopathic potential of crops is also worth mentioning in a modern weed management programme. Thermal weed management has also been observed as a useful technique, especially in conservation agriculture systems. Last, precision weed management has been elaborated with sufficient details. The role of remote sensing, modelling, and robotics as integral parts of precision weed management has been highlighted in a realistic manner.

All these strategies are viable for today's agriculture; however, site-specific selection and the use of the right combinations will be the keys to success. No single strategy is perfect, and therefore an integrated approach may provide better results. Future research is needed to explore the potential of these strategies and optimise them on a technological and cultural basis. The adoption of such methods may improve the efficiency of cropping systems under sustainable and conservation practises (Ali A. Bajwa, Gulshan Mahajan, and Bhagirath S. Chauhan).

Concept of Economics of Plants

The economic value of plants is defined as those plants utilised either directly or indirectly for the benefit of man. Indirect usage includes the needs of man's livestock and the maintenance of the environment; the benefits may be domestic, commercial, environmental, or aesthetic. Plants provide food directly, of course, and also feed livestock that is then consumed itself. In addition, plants provide the raw materials for many types of pharmaceuticals, as well as tobacco, coffee, alcohol, and other drugs. Economic botany bridges the gap between pure and applied botany by focusing on the uses of plants by people. Economic botany documents the rich relationship that has always existed between plants and people around the world, encompassing the past, present, and potential uses of plants. Economic botany intersects many fields, including established disciplines such as agronomy, anthropology, archaeology, chemistry, economics, ethnobotany, ethnology, forestry, genetic resources, geography, geology, horticulture, medicine, microbiology, nutrition, pharmacognosy, and pharmacology. (Ramón-Laca, 2013) This link between botany and anthropology explores the ways humans use plants for food, medicine, and commerce. Economic botany sometimes focuses on the processes as well as the products involved in plant cultivation. Scientists ask questions about how knowledge of useful plants is acquired and transmitted between groups. In the South American Andes, potatoes are a staple of many indigenous diets.

Challenges of Weed Management Strategies

The current global population of 7.7 billion is expected to reach over 9 billion by 2050. To feed this population, world food production will need to be increased by 70 to 100% (www.fao.org). There are several biotic and abiotic constraints to crop production, in addition to socioeconomic and crop management-related issues (Ghersa, 2013). Weeds are the most important biotic constraints to agricultural production in both developing and developed countries. In general, weeds present the highest potential yield loss to crops, along with pathogens (fungi, bacteria, etc.) and animal pests (insects, rodents, nematodes, mites, birds, etc.), which are of less concern (Oerke, 2006). Weeds compete with crops for sunlight, water, nutrients, and space. In addition, they harbour insects and pathogens that attack crop plants. Furthermore, they destroy native habitats, threatening native plants and animals. Yield losses in crops due to weeds depend on several factors, such as weed emergence time, weed density, type of weeds, crops, etc. Left uncontrolled, weeds can result in 100% yield loss. In developing countries, where farm sizes are small, weeds are removed manually. This practise is becoming less common as a result of the urbanisation of labour migrating to cities and rising wage costs in agriculture. Hand weeding is being replaced by herbicide use. In developed countries, herbicides are already widely used to control weeds. However, overreliance on herbicides with similar modes of action has resulted in the evolution of herbicide-resistant weeds. At present, more than 500 unique cases of herbicide-resistant weeds have been reported globally (Heap, 2019). The maximum numbers of herbicide-resistant weed species reported in different crops are in the order of: wheat >maize >rice (Oryza sativa L.) >soybean >spring barley (Hordeum vulgare L.) >canola (Brassicanapus L.) >cotton (Gossypium hirsutum L.) (Heap, 2019). New herbicides with different modes of action are needed to manage herbicide-resistant weeds;

however, no major mode of action has been introduced in the past three decades (Duke, 2012). These issues suggest the need to develop different weed management options and consider the potential for integrating them. These concerns have also encouraged weed scientists around the world to develop ecologically-based weed management tools (Chauhan and Gill, 2014); to develop effective and sustainable weed management tactics, knowledge of weed biology and ecology is very important (Chauhan and Johnson, 2010). A recent review highlighted and prioritised current use and research. (Chauhanet et al., 2017).

Effect of Weed Management Strategies for Economics of Plants

Weeds pose a serious problem for crop production. Because of ignorance and financial constraints, many farmers do not remove them from their fields, which adversely affects their crop yield and quality of harvest. This consequently increases production costs and results in economic losses. Weed science is the science of understanding the problem and saving crops from its adverse effects. And this is only possible through the development and acquisition of techniques and their practises. Weeds are companions of crop plants. Weeds and crop plants: Both extract moisture and mineral nutrients from the same soil, take CO2 and light for photosynthesis from the same atmosphere, and accommodate their buildup within the same space. As both live in the same biosphere, they compete for nutrients, and as a result, the growth of crops is affected. Weeds are a universal problem, with degrees of infestation varying from crop to crop.

Negative/harmful effects of weed:

1. Weeds compete with the crop plant for light, nutrients, water, space and other growth requirements and reduce the crop yield.
2. Increase the cost of production by increasing the cost of labour.
3. Reduce the quality of crop products.
4. Exude inhibitors from the roots reduce the growth of the crop plants (allelopathy).
5. Serve as alternate hosts for insects and pathogens.
6. Reduce the efficiency of farm implements.
7. Harbour birds and rodents.
8. Reduce the sales value of the land.
9. Reduce fertility status of the soil.
10. Limit the choice of crop for a land. Some crops may not complete effectively against heavy weed growth and some weeds are parasite on crops.

Positive/Beneficial effects of weeds:

1. Add organic matter to the soil when incorporate into the soil.
2. Increase soil fertility when incorporated.
3. Induce soil formation by rapid weathering.

4. Improve soil structure spreading of weed roots change the soil structure and improve the physical condition of soil due to proper percolation water logging will be prevented.

5. Serve as food (Bothua, Shaknotey, & Amrul etc.), feed (Durba, Mutha, Chapra etc.) and medicine (Thankuni, Durba etc).

6. Serve as raw materials for public utilities as fuel, fencing and roofing materials.

7. Help in controlling soil erosion.

8. Serve as water purifier. E.g. Water hyacinth.

9. Serve as a source of genetic materials.

10. Some weeds can be used as indicators of air pollution. E.g. Wild mustard is an extremely sensitive indicator of NH3, NO2 present in air.

Conclusion

The study concludes that weeds cause economic and social harm to farmers. They have a negative impact on farming businesses; they cause crop yield loss, reduction in quality livestock produce, reduction in quality produce, increase the cost of cultivation, and reduce the value of land. Improvement in tillage regimes has long been identified as an impressive weed-control measure. Harvest weed seed control and seed predation have been shown as potential tools for reducing weed emergence and seed bank reserves, and the use of herbicides has been known as one of the management strategies for weed control.

Recommendations

1. There should be awareness among farmers of the appropriate skills required to use and apply herbicides correctly to minimise damage to crops and the associated health and environmental hazards.

2. To encourage farmers to remain in production, there should be policy advocacy for the intensification of extension education for farmers.

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