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Organic Horticulture and Bioherbicides: A Review

Dr. Pramod Kumar[1], and Dr. Prafful Kumar[2]

[1, 2]Assistant Professor, Department of Agriculture, Sanskriti University, Mathura, Uttar Pradesh, India

Correspondence should be addressed to Dr.Pramod Kumar; farm.agri@sanskriti.edu.in

ABSTRACT- Weeds are one of the most problematic, time-consuming, and expensive production issues for organic horticulturists. The need for novel bioherbicides to manage weeds has increased as organic agriculture has risen in importance. Pathogens, cosmetic compounds, and natural material extracts might all be made to produce bio herbicides. Two types of infectious pathogens that can be used as bio-herbicides are dangerous fungus and microbes. Herbicidal activity has been shown in by-products of accepted birthplaces such as Dried-Distillers-Grains with Soluble(DDGS), Corn-Gluten-Meal(CGM), and Mustard-Seed-Meals(MSMs). Bioherbicide potential has also been discovered in certain essential oil extracts. The effectiveness of a bio-herbicide is the primary restraining element in its application, and it may be influenced by variables like as humidity and moisture, application technique, bioherbicide spectrum, and formulation type. In addition to effectiveness, bioherbicide usage is limited by price and worries about possible human health risks. Because incorporating bio-herbicide technology into current weed monitoring systems might well help manage resistance mechanisms, benefit from economies of scale, and increase crop yields, continued studies should concentrate on the improvement of more cost-effective and convenient bio-herbicides for pest management, as well as the efficiency of manufacturing techniques and traditional influences with the use of frontrunner bio-herbicides.

KEYWORDS- Bioherbicide, Corn Gluten Meal, Dried Distillers Grains with Soluble, Essential oil, Mustard Seed Meal.

I. INTRODUCTION

Weeds are the most expensive kind of agricultural pest, resulting in significant output loss and labor costs [1]. Agricultural-weeds may quickly establish themselves, reducing crop-plant by fighting seeking micronutrients; they can increase growth overall quality and generating compounds that inhibit crop development [2]. Annual dandelions reproduce thru all the prolific agricultural crops and proliferate in response to exposure, increased oscillations in soil temperature and rainfall [3], improved recirculation, and accelerated carbohydrate release, whereas perennial dandelions regenerate new factories from smaller pieces of roots, rhizomes, rhizomes, and other underground. With favorable climatic circumstances, a sensitive yield, or a big weed-seed-bank in the soil, severe clear issues pose a significant danger to horticulture crop output [4].

Herbicides, organic pesticides, especially pre-emergent and article, physical approaches such as handweeding and insulations, and bio-herbicides are now used in horticulture production to manage weeds [5]. Herbicides used formerly and through weed-seed-germination are known as pre-emergence herbicides. Emerging roots and/or shoots are blocked when germinating seeds come into touch with the herbicide [6]; however, without adequate contact with maturing weed seeds, pre-emergent insecticides might not have been successful. Herbicides that are applied after weeds have appeared from the loam, preferably at the seedlingstage, are known as post-emergent herbicides [7]. To guarantee that organic insecticides do not harm agriculture plants, they must always be applied prior to crop seedlings emergence or transplantation, or after existing cereal plantings have already been developed. Some of the contemporary biological herbicides included ammonia nonanoate, fatty acid oxidation, balsamic, clove oil, and D-limonene [8]. A broadcast application of acetic and clove-oil on juvenile, new success sweet corn, onion, and tuber has been studied for weed control. Glove and mulches (including weed-discs) are different physical marihuana approaches which are essential for some high-value products but are unskilled labour and night before going to bed, and costly [9]. In accumulation to the techniques mentioned overhead, domestic goat cropping has shown to be effective in controlling a variety of weed species. Complete weed control was achieved by following pre-emergent pesticide application, combining hand-weeding with spot application with post-emergent insecticides [10].

Consumer preferences, conserve natural resources, and nutrition security are all aspects to consider are all driving organic horticulture's growth in North America and Europe. Expanding organic agriculture has resulted in the development of sustenanceally enhanced food-crops with scarcer outdoor ideas and lower conservation impact [11]. Horticultural-crops, particularly berries and spuds, are important parts of a balanced diet. Organic-foods, according to some studies, contain more minerals and vitamins than conventionally produced meals, and have become more popular among consumers. The organic food and drink industry in North America was worth 35 billion-US-dollars($) in 2013, with a strong growth-rate anticipated [12]. Because the sustainable agriculture, laws regulating the procedure of products for pest, infection, and weed-control problems, organic horticulture crops might have been harder to cultivate to cultivate compared to traditionally grown crops. The horticulture

depends on sustainability due to the great expenses of pest and weed control, as well as the time and effort required to maintain the system, depending on organizational capabilities and cultural aspects, it would be more successful then classical agriculture [13].

There are no easy or conventional methods for weed management in organic gardening. To manage weeds without causing crop loss, organic farmers must use long-term strategies [14]. The foundation for effective organic weed management is a thorough knowledge of weeds and their functions environment [15]. Hand-weeding and biological approaches should indeed be employed in organic horticultural to minimize weed-induced productivity losses and preserve weed management costs low. Because synthetic herbicides are prohibited in organic horticulture due to the risk of uncleanness of produces and ordinary properties, bio-herbicides, which use natural-products, biological control is becoming more powerful with the use of preparations and normal evolutionary agents like as microbes such as bacteria [16].

II. DISCUSSION

A. Bioherbicide Approach

Living creatures such as insects, nematodes, bacteria, and fungus, as well as natural materials, have been used to create biological controls for weed management. Bioherbicides provide a long-term, low-cost, and environmentally friendly alternative to traditional weed control techniques, addressing the demand for innovative weed management tactics [17]. Classic biological control and bio-herbicide methods are the two major ways of biological weed management [18]. The traditional biological method involves introducing a natural-enemy that spreads across the target-weed's habitat. Though, after introducing the biocontrol agent to a new region, this method runs the danger of harming non-target plants. As a result of the implementation of dangerous chemicals, dangerous viruses into farming output, the traditional method is subject to stringent restrictions [19]. Organisms are being used in the bio-herbicide methodology found in the plant's native area to induce substantial weed destruction and minimize the negative effect on crop production. The traditional method relies on natural enemies' inherent ability to proliferate, while the bio-herbicide approach relies on natural enemies reproducing under controlled circumstances and then being disseminated by humans. Bio-herbicides are favored over traditional pesticides because they have a wider range of applications. The primary goal of the succeeding dialogue is to evaluate the efficacy of different bio-herbicide methods, given the growing significance of bio-herbicides in organic agriculture.

B. Pathogen-derived bioherbicides

Many microbial organisms have been investigated for their effectiveness as bio-herbicides in crop production, turf, and agroforestry systems, comprising obligate antifungal parasites, non-phytopathogenic mushrooms, compost fungal pathogens, compatible and non-pathogenic microorganisms, and nematode. DeVine was one of the first bioherbicides to be registered, containing the active component Phytophthora-palmivora, and was designed to suppress strangler-vine (Morrenia-odorata) on oranges in Florida [20], [21]. Several additional harmful fungi and bacteria were created to manage weeds during the next quarter-century. Plant diseases may cause serious harm to target weed species when used as biocontrol agents. To become marketable pathogens, they must've been industrially and their cytotoxicity tested on herbicides in a wide range of environments, followed by field performance and specificity testing. Plant pathogens exhibit a range of phytotoxins, which could also cause anything from small transcriptional modifications to mother plant death.

C. Natural Products Bioherbicides

Weed control bioherbicides have been developed from natural-source byproducts [22]. Dried Wine makers Grains with Detachable is a residue of production of bioethanol that is frequently used as animal fodder and, because of its high nutritional content, may also double as a fertilizer amendment in horticultural production technologies [23]. Using 800–1600 gm2 of the number of reported grassland sprouts, DDGS on the surface of the potting medium was decreased by 40.01%–57.3%, and the number of communal chick-weed (Stellaria-media) seedlings was reduced by 33.04%–58.55%, separately. The numeral of emergent creeping-wood-sorrel (Oxalis-corniculata) plantlets was decreased by 25.09% when DDGS was sprayed to the soil surface at 225.09 gm2. Maize-gluten-meal (CGM), a consequence of corn-wet-milling with herbicidal activity, has the potential to be utilized as a natural herbicide to control a inclusive assortment of broad-leaf and meadow species. The CGM reduced 22 germinating weed growth at concentrations of 300–1000 gm2 when administered to the surface soil in a laboratory, resulting declines in seedling establishment, spike length, and better root of black l.) belongs, creeping broadleaf weeds, ubiquitous lambs-quarters, curly docking, and purslane. The professional rapeseed oil pressing technique yields mustard seed meal (MSM), which really is a contaminant. The glucosinolates (GLS) in MSM may be degraded by enzymes to form isothiocyanates, thiocyanate, nitriles, and other chemicals. Many weed species are poisonous to these physiologically active chemicals. MSM at 113, 225, and 450 gm2 was the frequency of annual bermuda seedling was diminished by 60.98%, 86.33%, and 98.13 %, respectively, when administered to the surface soil of receptacles. The proportion of developing saplings and the fresh and dry weights of creeping wood-sorrel have both been reduced using 90.34% and 95.12%, accordingly with an MSM treatment rate of 225 gm2. MSM applied at these three rates after emergence reduced liverwort by 83 to 97 percent while having no detrimental impact on plant development. MSM's usage is restricted, however, since its infiltration rate is 10–20 times that of conventional granulated herbicide in greenhouses. Compared with the non-counterparts, MSM supplementation suppressed appearance percentages of kochia (Bassia-scoparia), widespread lambs-quarters, and barnyard-grass by 83.34%, 73.34%, and 66.56%, correspondingly.

D. Bioherbicides from Extracts

Bioherbicides may be made from extracts from natural sources. The root development of germinating weeds was reduced by five dipeptides isolated from hydrolyzed CGM. Bioactive compound formulations from the foliage of Ailanthus altissima reduced germination and early growth in Mangifera indica saltiva. Rice husk extracts were shown to have a high allelopathic potential. Increasing the quantities of warm-water-hull cuttings from certain rice-cultivars inhibited barnyardgrass germination, seedling development, and weight, according to a few studies. Everniastrum-sorocheilum, Usnea-roccellina, and Cladonia-confusa methanol extracts extracts were also shown to suppress red clover germination and root development (Trifolium-pratense). Phenolics isolated from the lichen-Cladonia-verticillaris induced alterations in the ultra-structure of lettuce seedlings' ancestries and verdures, indicating that they may be effective bioherbicides. The black-walnut (Juglans-nigra) possesses allelopathy properties, and walnut cuttings need marketed as a bio-herbicide. At a concentration of 33.3 percent, a commercial product based on black walnut extract fully prevented the horseweed (Conyza-canadensis) and bushy fleabane (Conyza-bonariensis) have both emerged, demonstrating that it is sometimes used as a postintervention bio-herbicide [24].

Essential oils are abundant in herbs, and essential oil preparations with allelopathic properties may be utilized to control weeds [25]. Essential-oils of eucalyptus (Eucalyptus spp.), Lawson-cypress (Chamaecyparis-lawsoniana), rosemary (Rosmarinus-officinalis), and white-cedar (Thuja-occidentalis) inhibited-amaranth (Amaranthus-retroflexus), factor when selecting (Portulaca-oleracea), and golden plover (Acroptilon spp. Artemisia-vulgaris, Mentha-spicata subsp. spicata, Ocimum-basilicum, Salvia-officinalis, Thymbra spicata-subsp. spicata, Thymbra-spicata subsp. spicata, Gastric mucosa spicata subsp. spicata, Thymbra spicata subsp. spicata, Thymbra spicat (Agrostemma githago, amaranth, Cardaria-draba, Chenopodium-album, Echinochloa-crus-galli, Reseda-lutea, Rumex-crispus, Trifolium-pratense). Manuka-oil, a distilled essential fatty acid from the melaleuca alternifolia tree (Leptospermum scoparium), shows significant comment effect against large broadleaf weeds seedlings (Digitaria spp.), indicating that it will be used as a bridge across organic and non-organic agricultural. The noxious plant Parthenium hysterophorus was severely harmed by volatile oils from Eucalyptus citriodora leaves. Essential-oil compounds from Origanum-syriacum, Micromeria-fruticosa, and Cymbopogon-citratus suppressed the development of wheat, Amaranthus palmeri, and Brassica-nigra embryos. Essential-oils with allelopathic actions are found in herbal ingredients such as Cymbopogon species, Lavandula occidentalis, Xanthoxylum-rhesta, Cunila-spicata, and Artemisia-spp.

E. Factors Affecting the Efficiency of Bio-herbicide

Bioherbicide effectiveness is the primary limiting-factor in their usage, which is frequently related to environmental variables. Because of numerous foliar and stem-fungal diseases' humidity requirement for establishment and propagation used for weed control, specific formulations have been developed to guarantee the efficacy of agents used in the field. Some viruses need a lengthy dew period to infect the targeting weeds' aerial surfaces Numerous invertebrates have a short shelf life and are not well adapted to long-term-storage [26]. Due to poor performance and inconsistency in effectiveness under various climatic circumstances, Xanthomonas, a pathogen that causes bacteriological wither of annual-bluegrass, was not commercially marketed. Pathogens which attack wildflowers may be regulated by the amounts of soil moisture content. A jute cloth was employed to cover land areas injected with a Sclerotinia minimal granular large - scale implementation to manage weeds, white buttercup (Trifolium-repens), buckhorn-plantain (Plantago-major), broadleaf-plantain (Plantago-major), ground-ivy (Glechoma-hederacea), and prostrate-knotweed (Polygonum-aviculare). In the absence of water, the influence of condensation was modified by increasing an inversion oil emulsified to Colletotrichum-truncatum microconidia suspension, which resulting in 100.34% suppression of hemp sesbania (Sesbania-exaltata) in the greenhouse and 95.50% administration in the outdoors. Phoma macrostoma has been approved as a bioherbicide for the management of broadleaved weed species, and nitrogen fertilizer addition improved its effectiveness against dandelion by 10–20 percent [27].

The biocontrol agent's effectiveness should be addressed while applying the bioherbicide, with special emphasis paid to bouquet dewdrop-size, preservation, and dispersion, the proportion of spraying that is administered, and even the machinery that is used. The frequency and strength of treatment are essential factors to consider when deciding the amount of bioherbicide to use. Spray-droplet permanence is determined by the weed's surface morphology and form, its biotypes, adjuvants used in the treatments, travel-speed, and droplet size. Scentless chrysanthemum was controlled more efficiently by Colletrotrichum-truncatum with reduced droplet-sizes (Matricaria-perforata). The employment of bio-herbicides with different nozzles impacted the incidence and severity and advancement on water-hemp. Improvements such as dual nozzles spray nozzles including the use of pressurized air so instead of CO2 to prevent acidosis of the dissolution medium may have had an advantage on bio-herbicide effectiveness [28].

Other variables, such as the bioherbicide's range, whether wide or specialized to certain species, the kind of composition but whether or not it incorporates microorganisms that synthesize amino acids, may all have a major impact on effectiveness. Broad-spectrum bioherbicides may have varying efficacies depending on the area. By mixing Alternaria-crassa with fruit-pectin and plant-filtrates, the variety of Alternaria-crassa was extended. Coalescing several pathogens is another way to extend the range of bioherbicides. Weeds including pigweed, sicklepod, and showy crotolaria were successfully controlled by combining Alternaria-cassiae, Phomospsis-amaranthicola, and Colletotrichum-dematium. Chandramohan et al. also discovered that a combination of three diseases, Drechslera-gigantia, Exserohilum-longirostratum, and Exserohilum-rostratum, inhibited the development of seven-weeds in Florida-orange-orchards [29]. Surfactant addition to bacterial pathogen aqueous solutions has been investigated to aid

bacteria in effectively invading plant leaves and expanding their host range. The use of emulsions, organosilicone-surfactants, and hydrophilic-polymers in increasing the effectiveness of biotic-agents and affluence of submission has benefits and drawbacks. Emulsions may enhance weed control effectiveness and consistency by predisposing wildflowers to a bio-herbicide agent. Organo-silicone-surfactants, such as Sil-wet L-77, allow bacteria and tiny spores to enter weed tissues directly. Hydrophilic polymers, which include a wide range of ordinary and manmade polymers, have varying degrees of water-holding capacity. Bioherbicide products, on the other hand, are more costly due to formulations including pricey ingredients. Furthermore, several of the components utilized in these formulations are hazardous to human health. A high concentration of amino-acid-residues has the potential to halt crop growth. As a result, adopting mycotoxins that produce large amounts of amino acids is gaining some traction as a homemade bong method. F. oxysporum f. genotypes that excrete pyruvate dehydrogenase restricted Cannabis-sativa by 70.34%–90.32%, comparing to 25.56% in a homozygous recessive isolation.

III. CONCLUSION

As a short-term remedy, chemical pesticides may be used to keep weeds from invading new regions. However, the use of broad-spectrum chemical herbicides has led in a decrease in natural enemy biodiversity, a weed epidemic, the development of herbicide-resistant weeds, and food and environment pollution. To reduce weed issues in sustainable agriculture and to create sustainable ecosystems, biological agents should be incorporated into weed management systems for long-term control. Because there are few efficient bioherbicides, including biological controls into existing weed management methods may be a viable organic horticulture option. In organic horticulture, bioherbicide technology may be utilized as part of an herbicide resistance can be minimized, operating costs will be reduced, and crop yield can be boosted using a weed management control plan. Spite of extensive attempt to create bio-herbicides, only a very few were licensed for use. Research should focus on developing highly cost-effective and efficient bio-herbicides, as well as maximizing their use in agricultural systems.

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