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Extracts from Weed Plants a Better Resource for Biopesticides Formulation: A Review

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ABSTRACT

Till a few decades ago, chemical pesticides proved to be a boon in reviving our country from the food crisis, but we soon came to know that these chemicals also have side effects, which is causing great harm to the living being and environment. To avoid these side effects the best substitutes are biopesticides, but the use of biopesticides is much less as compared to chemical pesticides. There are many reason for this, one of the main reason is the lack of their resources, so it is necessary that new resources of the biopesticides should be discovered. For this review article we have collected research papers from 2010 to 2022. All these research papers collected are based on antimicrobial activities, chemical analysis etc. of weed plants extracts. We have tabulated some important information related to the weed plants used in these research articles. All research papers gathered from the authentic sources. Through this review article, we want to highlight “Weed Plants” as a resource for biopesticides formulation. After reviewing all the selected research articles, it comes to the fore that weed plants have the potential to be a good source for biopesticides formulation in future.

Key words: Antimicrobial activity, Biopesticides, Chemical pesticides, Plant pathogen, Weed plants.

Time from 1960s, to 1980s it was a very precious and important time for India because this was a time when Green revolution started in India for overcome the problem of food crises (Chakravarti, 1973). It had the first time when India used Science technology in field of agriculture. This scientific interventions were related with improved seed Varieties, irrigation and the extended use of fertilizers and Chemical pesticides for food self-sufficiency. Extended use of chemical fertilizers and pesticides increased the productivity. But at the time of late 80s we realized that these all chemical which increased the productivity and controlled the plant pathogen they all are creating environmental and health hazard (Pingali, 2012).

The extreme use of these all synthetic pesticides leads to build up a large amount of deposits in the nature, thereby causing a considerable environmental health hazard due to uptake and accumulation of these toxic compounds in the food chain, pollution of drinking water, land degradation, biodiversity loss, environmental pollution and health risk to humans (Sharma and Bala, 2011). Our agricultural products always threatened from many pathogen and it creates much losses in agricultural sector and affect our economy because agriculture sector is the one of the important part of our economy.

After knowing that synthetic pesticides is very harmful for environment, it was very clear that we have to investigate some new alternatives which is ecofriendly and discover some new natural resource which act as good option for controlling plant pathogen. Biopesticides is the best solution of these problem, now Biopesticides have emerged as a good ecofriendly substitute. But the use of Biopesticides is still less than, that of chemical pesticides, an important reason for which is the lack of resource. Through this review, has to bring to the fore the positive aspects of the special category of plant “Weed Plants” which know so far as a problematic plants in agriculture sector and weed plants have to be identified as new resource of biopesticides.

There for main purpose of this review to throw light on positive characteristics of weed plants and discussed the different *in vitro* antimicrobial activities of weed plants, so that weed plants can emerge as a good source of biopesticides.

Biopesticides: Friend of nature

After knowing the detrimental effect of synthetic pesticides, development and awareness has noticed in area of food safety, management of plant pathogen by ecofriendly method, organic farming, finding resources for biopesticides and biopesticides formulation *etc*. In last few decades increased interest, observed in different aspects of biopesticides researches. And science and technology got positive result in these area because of their safe status they are easily decomposed, nature friendly and non-phytotoxic.

In contrary to synthetics, biopesticides have emerged as a green tool in the era of sustainable agriculture. These

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are the most likely alternatives to some of the most problematic chemical pesticides currently in use. Biopesticides offer solutions to concerns such as pest resistance, public health issues and detrimental effects on the surrounding environment, this greener approach is struggling for its place in established conventional chemical pesticide market (Mishra *et al*.,2020). Biopesticides those natural product which controlling plant pathogens with natural method without disturbing the nature. Basically biopesticides are obtained from natural resources like microbes based - living organism used as biopesticides Ex. *Bacillus thuringensis*, Trichoderma, NPV and byproduct based - byproducts of plants and microbes Ex. Plant extract, latex, resin, pheromones *etc*.

But still the use of biopesticides is less than chemical pesticides. Biopesticides represent only 2. 89% of the overall pesticide market in India and is expected to increase drastically in coming years. In India, so far only 12 types of biopesticides have been registered under the Insecticide Act, 1968. Neem based pesticides, *Bacillus thuringensis,* NPV and Trichoderma are the major biopesticides produced and used in India. Whereas more than 190 synthetics are registered for use as chemical pesticides. Most of the biopesticides find use in public health, except a few that are used in agriculture (Kandpal, 2014).

Use of biopesticides have many advantages which will give benefits to our society. Biopesticides are generally less lethal than synthetic pesticides. Biopesticides usually effect only on the target microbes and closely related organisms, in compare to wide range, conventional pesticides that may affect organisms as different as birds, insects and mammals. Biopesticides often are work in very small amounts and biodegradable, resulting in lesser exposures and largely avoiding the pollution and other environmental problems initiated by conventional pesticides. Biopesticides easily decomposed than synthetic pesticides so food products are fully organic and safe for health.

From long time in India many plants were used for controlling harmful microbes, some examples like neem, tulsi, turmeric, cloves *etc*. for many reasons. Like these so many plants found in our surrounding wildly shows antimicrobial activity and they all are used in our daily life, for many reason directly or indirectly. Plants can be a prominent natural source of biopesticides. By many studies it proved that plants have good antimicrobial activity. We should use this quality of plants for save our environment from hazardable chemicals.

Weed plants: A better resource for biopesticides

We all are directly and indirectly connected with plant Kingdome actually we should said that without plant living organism unable to survive single one minute because a precious gift which gifted to us from plant that is lifesaving gas 'Oxygen'. But apart from this many benefits we are getting from plants in different form. First of all medicinal plant give us different type of aayurvedic medicine which is famous all over the world. Second is spices yielding plant... aroma of these spices have been always attracting people. Apart from this timber yielding plants, agriculture sector, ornamental plants, fiber yielding plants *etc*.

Reason of above discussion is that, plants categories which are discussed in above they already have their economic value, they have been get their place in commercial market and human being also know the importance of these plants. on the other hand a group of plants which have been always neglected and these plants have been always pointed as a problematic plants, their economic importance not very clear, they are known as "Weed Plants".

There are approximately 250,000 species of plants worldwide of those, about 3% or 8000 species behave as weeds. Foremost most common feature which are famous about weed is that weeds are troublesome in many ways. Primarily, they reduce crop yield by competing for water, light, soil nutrients and space. Other problems associated with weeds in agriculture include, reduced crop quality by contaminating the commodity. Interference with harvest. Serve as hosts for crop diseases or provide shelter for insects. Production of chemical substances which are toxic to crop plants (allelopathy), animals, or humans.

Advantages of weeds

Apart from the negative impacts of weeds, the weed plants actually have some benefits. Some attributes include along with weed plants are follows:

- Few weeds are eatable and have healing properties (Naveen *et al*. (2013).
- Good source for compost, because they are rich in different types of micro and macro elements.
- Home for many living being.
- One of the important feature of weeds is that they have the quality of stabilizing nutrient in soil, that beneficial for other crops.
- They play important in decrease soil, wind and water erosion.
- Some weeds make good healthy fodder for animals.
- Used for beautification at home environment.
- Weeds also used as 'Trap crops' to manage nematode.
- Preparation of the land for other desired crops.

Unique feature of weed plant

Weed plants have some unique feature, which help them to survive in poorest condition where other ones are not capable to survive. They do not need any special soil condition or richness of nutrients to thrive. Some special feature, which help them to survive in adverse condition like, strong root system, ability of resprout easily, tiny and copious seeds easily pollinated by different medium, seed dormancy, long term survival of buried seed, adaptation for spread, presence of vegetative reproductive structure, ability to occupy site disturbed by human activities.

On other hand we saw that, weed plants are not general affected by plant pathogens and animal not prefer to eat such plant because of unpleasant in taste and smell. These

unpleasant taste and smell of weed plants is because of different type of chemical which they produced own self. Some of the chemical are toxic for insect and pest. These byproduct make good defense system in weed plants for their enemies. These all properties of weed plants are shown in Fig 1. These powerful quality and their wildness make them unique because of that in last few decades it remarked that investigators are taking attention in weed plant. Many weed plants was examined for antimicrobial activity, chemical composition, mode of defense mechanism and many are under investigation they all are showing positive results. In next section we discussed the related works which admit that weed plant has better possibility as a good resource of botanical pesticides.

Antimicrobial activity of extract of weed plants

To protect the environment from these detrimental chemical pesticides it necessary to adopt some new ecofriendly methods and chemical substance like 'Biopesticides'. Weed plants are a unique type of plant category which survive in unfavorable conditions and protect itself by their own defense system. In this section we are discussing about different investigation and studies which done on weed plants which supported that weed plants are a 'significant resources' for botanical biopesticides because weed plants are rich in bioactive and antioxidant compounds.

Usually plants produce different type of secondary metabolites, most of which belong different chemical group like phenols, Terpinoids, essential oils, alkaloids, polypeptides many more. These substance responsible for special character like special odors, pigment and flavor in plant. But in other hand these secondary metabolites help plant in self-defense from predators such as microorganism, insects and herbivorous. Nevertheless the quantity of these secondary metabolites in different plants is vary. Plants which rich in these substance they are capable in protect themself against predators. Weed plants are one of them, we always observed that weed plants not affected by predators, on other hand crop plants which are very susceptible for plant pathogen. In weed plants level of these secondary metabolites is higher than crop plants due to this reason, they have an unpleasant taste and odors which protect them from predators.

Rao *et al*., (2010) Investigated the antibacterial and antifungal activity of *Euphorbia hirta* L. against five pathogenic bacteria and four pathogenic fungus. *E*. *hirta* one of the important weed plant of our surrounding. In this study leaves of *E*. *hirta* have been collected in different seasons, from January to December. After that leaves were washed, dried under shade and use for extraction by maceration with the help of solvent Methenol. In this investigation researcher observed that leaves collected during mid August to December end showed significant antimicrobial effect compared to other extracts.

Naveen *et al*., (2013) studied three non-economic weed plants grow in waste land which are very commonly found

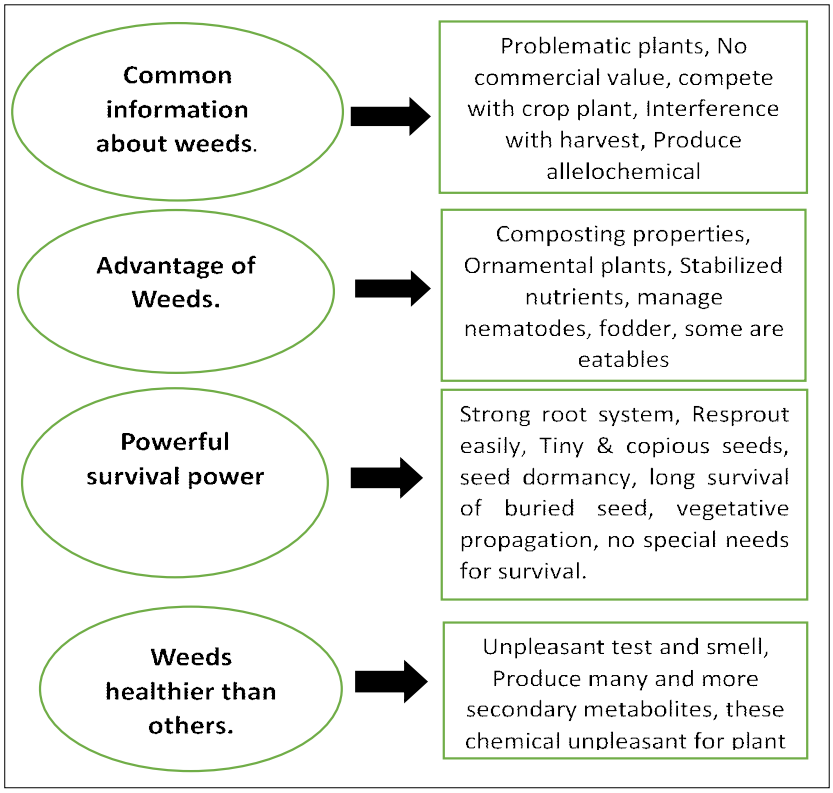

Fig 1: Schematic diagram showing important feature of 'Weed Plants'.

in Thanjavur area Tamilnadu .Name of plants is *Ipomea carnea*, *Jatropha curcas* and *Calotropis gigantea*. These weed plants investigated for their antifeedent efficiency against rice pest namely the leaf folder. According to this research paper *Ipomea carnea* showed a good antimicrobial activity against rice leaf folder and *Ipomea carnea* will be go a long way as local resource base non chemical tool in the integrated pest management.

Fontem *et al*., (2014) lead an investigation into antimicrobial activity of two weed plants *Mitracarpus villosus* (sw) and *Ageratum conyzoides* L., they used these plants for manage leaf blight disease of Taro plant, this caused by *Phytophthora colocasiae*. Weed plants screened in at full strenth concentration simultaneously positive control studied by commercial fungicides and negative control studied by simple plates which contain only PDA. Result of investigation show that weed plants extract and commercial fungicides show significant inhibition against fungal mycelium growth in comparison to negative control. And Mitracarpus villosus showed 64% more effectiveness than Ageretum conyzoides. Which showed that Mitracarpus villosus have a new chemical entity for managing Taro leaf blight.

Aderogba *et al*., (2014) carried out *in vitro* test against some selected plant pathogenic fungi .these pathogenic fungi are *Aspergillus parasiticus, Aspergillus niger, Colletotrichum gloeosporioides, Fusarium oxysporum, Penicillum expansum, penicillum janthinellum, Phytophthora nicotiana, Pythium ultimum, Trichoderma harzianum*. In these study they used invasive weed plants *Pseudogn aphalium luteoalbum*.Extract of *P.luteoalbum* show strong antifungal activity against plant pathogenic fungi. They had also identify two compound which moderately and highly active against fungi. These compound first time isolated from this plant and no cytotoxicity of these compound against Vero kidney cell was observed at highest concentration.

Waheed *et al*., (2016) worked on methanolic leaf extract of *Calotropis procera* to manage charcoal rot disease of mung. Causal organism of charcoal rot disease is *Macrophomina phaseolina*. Various concentrations of Methanolic extract of *C. procera* leaves were prepared and their *in vitro* bioactivity was examined against the test fungus. Methnolic leaf extract was taken for further fractionation.The higher concentration of methanolic leaf extract (7%) caused maximum inhibition (38%). The n-hexane fraction of methanolic leaf extract was found to be the most effective against *M. phaseolina*. Seven compounds belonging to different classes of secondery metabolites were identified in GC-MS analysis of n-hexane fraction. They concluded that Antifungal activity of *C. procera* might be due to the presence of the identified seven compounds in n-hexane fraction of methanolic leaf extract.

Karim *et al*., (2017) find that methanolic seed extracts of *Datura metel* have very effective on *Colliotricum gloeosporioides* which are causing agent of Anthracnose disease of mango. In this investigation they use different part of plant such as leaf, root and seed, for extraction. And results showed that 1.5% methanolic seed extracts showed maximum inhibition activity against fungus. Methanolic seed extracts also taken for further fractionation and various bioactive constituents were identified by GC-MS.

Ali *et al*., (2017) evaluated the antimicrobial efficacy of *Argemone mexicana,* for this investigation they used different part of plant like seed, arial part and root and they used beetles of *Tribolium castaneum* and *culex quinquefasciatus* as test organism. They find that Pet.Ether extracts of seed and Pet.Ether extract of different part of plant has showed high efficacy against *T. castaneum* and *C.quinquefasciatus* respectively.

Ahmad *et al*. (2017) worked on *Euphorbia hirta* they studies, Antimicrobial activity and phytochemical screening of *E.hirta* extracts. This study revealed that many secondary metabolites like alkaloid, flavonoid, saponin, terpenoid, steroid and sterols are present in extracts. They concluded that *E.hirta* showed good antibacterial and antifungal activity due to presence of these secondary metabolites.

McPartland *et al*., (2018) conducted a review of literature about hemp (*Cannabis sativa*) as a botanical biopesticides. In this review they yielded 88 literature and organized it very effectively. After reviewing that they conclude that essential oil more effective than other form of use like companion planting, use of plant material without any extraction, aqueous extracts.in this review they also discussed mechanism of action.

Shrivastava *et al*., (2019) screened an important weed plant which found very commonly in our surrounding, name of this weed is *Euphorbia thymifolia*. They used methanolic crude extracts of *E.thymipholia* against *Abelmoschus esculentus* and *Glycine max* pest, *Earias fabia* and *Diacrisia oblique*. After all experimental process they lighted that, crude methanolic extract more effective against *Diacrisia oblique* (93.33% mortality) than *Earias fabia* (76.67% mortality). And suggested that botanical pesticides, beneficial for farmer in developing country for managing *Earias fabia* and *Diacricia oblique*.

Gaikwad *et al*., (2019) they have worked on insecticidal activity of *Cassia tora L*. against adult red cotton bug, *Dysdercus cingulatus*. Plant leaves are collected for extraction and two solvent methanol and ethyl acetate has been taken for extraction. By results we know that ethyl acetate extract shows more insecticidal activity against *Dysdercus cingulatus.*

Banaras *et al*., (2020) worked on an Allopathic weed plant *Sonchus oleraceus L*. and test organism of this investigation was *Macrophomina phaseolina* which is causal organism of charcoal rot disease in urdbean. Present study settled that application of 2.5% dry biomass of *S.oleraceous* can completely manage charcoal rot of urdbean and significantly enhance crop growth and yield.

Pathak *et al*., (2020) evaluated the antifungal activity of some selected weed plants against, fungus *Rhizoctonia solani*. For evaluated the antifungal activity of extracts they used poison food technique. Among all the plant extracts

Table 1: Antimicrobial activities of weed plants.

S.no.	Botanical name of weed plants	Common name of weed plants (in the order given)	Plant part used for extraction	Micro-organism used for testing	Results	Ref.
1.	*Alternanthera philoxeroides*	Alligator weed	Leaf, stem and root	Fungal spp.- *A. niger, A. flavus* and *M. phaseolina*	n-hexane Leave extract showed more antifungal activity	(Amin *et al.,* 2022)
2.	1. *Ricinus communi* 2. *Datura metel* 3. *Tridex procumbens* 4. *Solanum nigrum*	1. Castor bean, 2. Devil's trumpet/Datura 3. Coatbuttons or tridax daisy 4. Black nightshade	Leaves	Fungal spp. -*Rhizoctonia solani*	*Solanum nigrum* ethanol extracts is the best potent extract for control of root rot disease	(Pathak *et al.*, 2020)
3.	*Pseudognaph-alium luteoalbum*	Jersey cudweed	Leaves	Fungal spp.-*A. parasiticus, A. niger, C. gloeosporioides, F. oxyporium, P. expansum, P. janthinellum, Phy. nicotiyana, Pythium ultimum* and *T. harzianum*	Antifungal activity in the acetone leaf extract of *P. luteoalbum* and two antifungal compounds were isolated	(Aderogba *et al.,* 2014)
4.	*Euphorbia hirta*	Garden spurge (Dudhi)	Leaves and flower	Bacterial spp.- *S. mutant, P. mirabilis*, Clostridium, Listeria, *E.coli* and *S.aureus* Fungal spp.- *A. cuboida*, *A. fumigates* and *A. niger*	*E. hirta* shows significant antibacterial activity but plant not show any antifungal activity against selected fungal species.	(Ahmad, Singh, and Kumar, 2017)
5.	*Argemone maxicana*	Mexican poppy	Aerial part, seeds and root	Tribolium castaneum (Rust-red flour beetle) and Culex quinque fasciatus (mosquitoes)	Seeds extracts of Pet. Ether, $CHCL_3$, CH_3OH are effective against adult beetles and Pet.ether extract of seed, aerial parts and root effective against mosquito's larvae.	(Ali *et al.*, 2017)
6.	*Sonchus oleraceous*	Common milk thistle	Thoroug-hly crushed dry biomass of selected weed species was used.	*Macrophomina phaseolina* (Fungus)	Author conclude that S.oleraceous successfully manage the charcoal rot disease of urdbean.	(Banaras *et al.*, 2020)
7.	1. *Mitracarpus villosus,* 2. *Ageratum conyzoides*	1. Tropical girdlepod 2. Billy goat weed	Aques crude extract of both weed plants were used.	Taro blight disease (Fungal disease)	Both weed plants shows good efficiency but *M. villosus* fungal inhibition power better than *A. conyzoides*	(Fontem *et al.*, 2014)
8.	*Cassia tora*	Sickle senna	Leaves	*Dysdercus cingulatus* (Cotton bug)	This study confirm that Cassia tora have potential of bio-pesticides	(Gadewad *et al.*, 2019)
9.	*Datura metel*	Devil's trumpet (Datura),	Leaves, seeds and root	*Colletotrichum gloeosporioides* (Fungus)	Methanolic seed extract of D. metel highly effective against fungus	Karim, Jabin, Iqbal, Javid Bioefficacy of a common weed Datura against (2017)

Table 1: Continue...

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10. 1. *Parthenium hysterophor* 2. *Chenopodium album* 3. *Canada thistle (Cirsium arvense)* 4. *Phalaris minor*	1. Carrotgrass 2. Goosefoot 3. Canada thistle 4. Canary grass	Collected weeds were used for extraction	*Fusarium oxysporium*	*Parthenium hysterophorus* shows maximum antifungal activity	(Khan *et al.*, 2021)
11. 1. *Ipomea carnea,* 2. *Jatropha curcas,* 3. *Calotropis gigantea*	1. Morning glory/beshram 2. Physic nut (Jangali arandi) 3. Crown flower (madar)	Aerial part was used for extraction	*Cnaphalocrosis medinalis* (*leaf folder*)	This study concluded that *I.carnea* weed plant will go a long way as local resources of non-chemical IPM in rice crop.	(Naveen *et al*., 2013)
12. *Alternanthera paronychioides*	Smooth joyweed	Leaves and stem	*Staphylococcus aureus, Escherichia coli, Salmonella typhi* and *Bacillus subtillis*	*A. paronychioides* leaf and stem crude exracts had significant activity against all organism tested	(Niranjan and Prabhurajeshwar, 2021)
13. *Euphorbia hirta*	Asthma Weed	Leaves	*S. aureus, B. ceresus, S. typhi, K. pneumoniae, P. aeuroginosa, A. niger, A. Fumigatus, A. flavus* and *R. oryzae*	It was observed that the leaves collected during mid-August to December end showed significant antimicrobial effect compared to other extracts	(Rao *et al.*, 2010)
14. 1. *Quercus infectoria olivier* 2. *Chromolaen odorata* 3. *A.conyzoides* 4. *T.procumbense* 5. *Mikania micrantha* 6. *Leucas cephalotes* 7. *Oxalis acetosella* 8. *Achyranthus aspera* 9. *Eupatorium odoratum* 10. *Oxalis corniculata*	1. Aleppo oak 2. Siamweed 3. Billy goat weed 4. Coatbuttons 5. Bitter vine 6. Head Leucas (goma) 7. Wood sorrel 8. Prickly chaff flower 9. Jack in the bush 10. Creeping woodsorrel	Leaves	*Bacillus cereus, Pseudomonas aeruginosa*	All the extracts showed anti-bacterial potency against tested bacteria while Quercus infectoria Olivier inactive against *Pseudomonas aeruginosa*	(Rulhania *et al*., 2021)
15. *Euphorbia thymifolia*	Choti-dudhi	Whole plant was used for extraction	*Earias fabia* and *Diacrisia oblique* (pest)	This natural pesticide has the potential for use in agriculture	(Shrivastava and Mishra, 2019)
16. *Calotropis procera*	Giant milkweed	Leaves	*Macrophomina phaseolina*	They conclude antifungal activity of the methanolic leaf extract of C. *procera* might be due to the presence of the identified compounds in n-hexane fraction of methanolic leaf extrac	(Wahed *et al.*, 2016)

ethanol extracts of *Solanum nigram* exposed highest fungi toxicity (88%) followed by *Tridex* procumbence and *Dhatura metel* (85% and 80%respectively) ethanol extracts of *Ricinus communis* showed moderate fungi toxicity (65%). According to the results these four weeds hold ability to develop a ecofriendly antifungal product.

A review has presented by Sin *et al*., (2021). In this review they discussed about, allelochemicals secreted by plants and the information on weeds species with nematocidal potential was given.

khan *et al*., (2021) worked on antifungal activity of extracts of some selected weed plants such as *Parthenium hysterophorus, Chenopodium album, Canada thistle and Phalaris minor*, against *Fusarium oxysporum*, this is a pathogenic fungus create much losses in cotton. In this investigation weed extracts applied, in three different concentration by food poisoning method and weed extracts applied with *Trichoderma harzianum*, in both condition *P. hysterophorus* shows effective results.

Rulhania *et al*., (2021) worked on some common weed plants such as *Quercus infectoria Olivier*, *Chromolaena* odorata (L.), *Ageratum conyzoides, Tridex procumbens, Mikania micrantha, Leucas cephalotes, Oxalis acetosella, Achyranthes aspera, Eupatorium odoratum, Oxalis corniculeta Linn*. All the weed plants tested for antibacterial activity against two bacteria *Bacillus cereus* (gram negative) and *Pseudomonas aeruginosa (*gram positive). All weed plant showed good potency against both bacteria.

Niranjan *et al*., (2021) evaluated the bioactive chemical constituents and *in vitro* antimicrobial activity of *Alternanthera paronychioides* by agar disk diffusion method. Results shows that, minimum inhibitory concentration(MIC) of the crude extracts of *Alternanthera paronychioides* were determine for various organism which ranged between 5.0 to 37.0 mg/ml and *Alternanthera paronychioides* leaf and stem crude extracts had proven significant activity against all test organism.

Amin *et al*., (2022) investigated the ecofriendly natural fungicidal activity of leaf, stem and root of *Alternanthera philoxeroides* (alligator weed).The extraction completed with help of four different solvent, methanol, n-hexane, chloroform and ethyl acetate. They found that n-hexane fraction of plant extracts exhibited highest antifungal activity and they concluded that *Alternanthera philoxeroides* has antifungal constituents that can be isolated and identified to be used as natural ecofriendly fungicides in future.

All the above manuscript show the quality of weed plants being a good source of biopesticides. In this manuscript selected studies from 2010 to 2022 have been put in one place and weed plants, which were selected for these studies, have been shown in Table 1 by listing the antimicrobial activities and their various information.

CONCLUSION

On appraising all the above literature, it is understood that weed plants, which all know as a challenging part in the field of agri-business, have a good side. Weed plants substantiated that they are a better source of botanical pesticides, as this plant category is commonly, dominantly and easily available in the crop fields and from place to place. It is problematical for crop to be overriding, but if we use their huge number as a resources for ecofriendly and biodegradable 'Biopesticides', then it will be advantageous for the environment and human being. Consequently it is necessary now, to explore locally available weed plants and practice them for various type of analysis, such as chemical constituents of weed plants, antimicrobial activity and preparing formulation from weed plants *etc*.

Conflict of interest: None.

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