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Investigating the Bio-controlling efficacy of Amravati's aromatic flora against *fusarium* wilt pathogen

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ABSTRACT: The growing environmental and health risks linked to synthetic pesticides highlight an urgent need for sustainable crop protection methods. This study explores native plant alternatives available in Amravati district, Maharashtra. We evaluated the bio-controlling capacity of aqueous extracts derived from ten common aromatic herbaceous weeds, such as *Parthenium hysterophorus*, *Lantana camara*, and *Calotropis gigantea*, against the pervasive phytopathogen *Fusarium oxysporum*. Extracts were prepared at a 10% (w/v) concentration and tested using both in vitro poisoned food techniques and in vivo pot studies involving infected tomato plants. *P. hysterophorus* and *L. camara* extracts proved most effective in laboratory tests, inhibiting fungal mycelial growth by 78.4% and 72.1%, respectively. A composite bio-spray formulated from these potent extracts was highly effective in the greenhouse, reducing disease severity by 65% in tomato plants—closely approaching the 85% efficacy of the commercial fungicide Mancozeb, but without harmful phytotoxicity. Our findings confirm the significant potential of these underutilized local weeds as effective, eco-friendly biocontrol agents, offering a sustainable alternative for integrated pest management in agriculture.

KEYWORDS *Local Aromatic Plant, Herbaceous weeds, Bio-Controlling Plants, Fusarium oxysporum, Fungal Infections on Crop Plants, Amravati Herb.*Numbers, Set, Possible Susets, Square Root Mean

I. INTRODUCTION

Several Modern agricultures, while achieving remarkable productivity, has become heavily reliant on synthetic chemical pesticides. This dependency has led to a cascade of negative consequences, including soil and water contamination, harm to non-target organisms, development of pesticide-resistant pathogens, and significant risks to human health [1]. The accumulation of pesticide residues in the food chain is a global concern, prompting a paradigm shift towards more sustainable and ecologically sound agricultural practices.

In this context, biopesticides derived from natural sources, particularly plants, have emerged as a promising alternative. Botanical pesticides are generally target-specific, biodegradable, less prone to inducing resistance, and have minimal impact on the ecosystem [2]. Weeds, often considered a nuisance in agriculture, represent a vast, untapped reservoir of bioactive compounds (allelochemicals) such as alkaloids, tannins, terpenoids, and flavonoids, which have evolved as natural defence mechanisms against herbivores and pathogens [3].

The Amravati district in the Vidarbha region of Maharashtra, India, is characterized by extensive agricultural activity alongside significant patches of barren and wastelands. These areas host a prolific growth of various aromatic weeds. Harnessing these locally abundant, zero-cost resources for pest control could provide a dual benefit: managing weed proliferation and offering farmers an affordable, effective, and environmentally benign tool for crop protection. This project focuses on to identify common aromatic weeds in the Amravati district with potential pesticidal properties.

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II. REVIEW OF LITERATURE

The search for alternatives to synthetic pesticides is well-documented. Govindachari *et al.* (1998) highlighted the potent antifeedant and insecticidal properties of azadirachtin from the neem tree (*Azadirachta indica*), which set a precedent for botanical pesticide research in India [4]. However, research has since expanded to include a wider array of plants, including many common weeds.

Several studies have confirmed the antimicrobial and insecticidal potential of weeds targeted in this project. For instance, the allelochemical 'parthenin' found in *Parthenium hysterophorus* has demonstrated strong fungicidal, insecticidal, and herbicidal properties [5]. Similarly, extracts from *Lantana camara*, containing pentacyclic triterpenoids known as lantana denes, have been shown to be effective against a range of agricultural pests and fungal pathogens [6]. Research by Singh and Singh (2017) demonstrated that aqueous extracts of *Calotropis gigantea* possess significant nematocidal and fungicidal activity, attributed to the presence of cardiac glycosides [7].

The methodology for extracting and applying these botanical compounds is a critical factor in their efficacy. While solvent-based extractions often yield higher concentrations of active compounds, aqueous extractions are more practical, cost-effective, and safer for on-farm preparation by farmers [2]. The effectiveness of aqueous extracts of plants like *Datura stramonium* and *Argemone mexicana* against fungal pathogens such as *Fusarium* and *Alternaria* species has been established in various lab-based studies [8]. However, there is a significant gap between laboratory findings and field application. Many studies stop at *in vitro* screening, and there is a lack of comprehensive research that follows through to *in vivo* testing, comparison with conventional chemicals, and formulation of a practical, broad-spectrum product from a composite of local weeds. This project aims to bridge that gap within the specific agro-ecological context of the Amravati district.

III. MATERIAL AND METHODS

Suppose, 3.1. Study Area and Plant Collection

Fresh plant materials of ten common aromatic weeds were collected from various barren lands and roadsides in Amravati district, Maharashtra (20.9374° N, 77.7796° E) during the post-monsoon season. The plants were identified and authenticated at the Department of Botany, Sant Gadge Baba Amravati University. The collected plant parts were washed thoroughly with tap water, followed by distilled water, to remove any debris.

3.2. Preparation of Aqueous Bio-extract

The washed plant materials (leaves and soft stems) were shade-dried for 10-15 days until brittle. The dried materials were then ground into a fine powder using an electric grinder. For each weed species, a 10% (w/v) aqueous extract was prepared by soaking 100g of powder in 1000 ml of sterile distilled water. The mixture was kept in a shaker for 24 hours at room temperature. The extract was then filtered through a double-layered muslin cloth, followed by Whatman No. 1 filter paper. This stock solution was stored at 4°C for further use.

3.3. Test Pathogen and Host Plant

A virulent strain of the phytopathogenic fungus *Fusarium oxysporum* f. sp. *lycopersici*, a causal agent of wilt in tomato, was procured from the National Fungal Culture Collection of India (NFCCI), Pune. The culture was maintained on Potato Dextrose Agar (PDA) medium. Certified seeds of a wilt-susceptible tomato variety (*Solanum lycopersicum* cv. Pusa Ruby) were used for the *in vivo* study.

3.4. *In Vitro* Antifungal Assay

The antifungal activity of the ten weed extracts was evaluated using the poisoned food technique [8]. Required quantities of each stock extract were mixed with molten PDA medium to achieve a final concentration of 10%. The medium was poured into sterile Petri plates. A 5 mm disc of a 7-day-old culture of *F. oxysporum* was placed at the centre of each plate. A control plate was prepared with PDA medium without any extract. The plates were incubated at 28±2°C for 7 days. The radial growth of the fungal colony was measured, and the percentage of mycelial growth inhibition (MGI) was calculated using the formula: MGI (%) = [(C-T)/C] × 100, where C is the colony diameter in the control plate and T is the colony diameter in the treated plate.

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3.5. *In Vivo* Pot Experiment

A pot experiment was conducted in a randomized block design. Tomato seedlings were raised in sterile soil. After 30 days, the soil in each pot was inoculated with a spore suspension of *F. oxysporum* ($1x10^6$ spores/ml), except for the healthy control group. A composite bio-spray was formulated by mixing the three most effective extracts from the *in vitro* assay (*P. hysterophorus*, *L. camara*, and *C. gigantea*) in equal proportions. The treatments were as follows:

Table 1: List of Aromatic Weeds Collected from Amravati District for the Study.

Sr. No.	Scientific Name	Common Name	Family	Part Used
1	*Parthenium hysterophorus*	Congress Grass	Asteraceae	Leaf & Stem
2	*Lantana camara*	Ghaneri	Verbenaceae	Leaf
3	*Ageratum conyzoides*	Goat Weed	Asteraceae	Leaf & Stem
4	*Calotropis gigantea*	Crown Flower / Rui	Apocynaceae	Leaf
5	*Datura stramonium*	Jimsonweed / Dhatura	Solanaceae	Leaf
6	*Argemone mexicana*	Mexican Prickly Poppy	Papaveraceae	Whole Plant
7	*Cassia tora*	Sickle Senna	Fabaceae	Leaf
8	*Tridax procumbens*	Coatbuttons	Asteraceae	Whole Plant
9	*Eclipta alba*	False Daisy / Bhringraj	Asteraceae	Whole Plant
10	*Hyptis suaveolens*	Pignut	Lamiaceae	Leaf

The sprays were applied foliar and as a soil drench one week after pathogen inoculation and repeated every 15 days. Disease severity was recorded using a 0-5 scale, and the Percent Disease Index (PDI) was calculated. Plant height and final fruit yield were also recorded at the end of the experiment (90 days after transplanting).

IV. OBSERVATIONS

The study involved systematic collection and screening of local weeds, followed by controlled experiments. The key observations are presented in the following tables.

Table 2: *In Vitro* Efficacy of Weed Extracts (10% Conc.) on Mycelial Growth Inhibition of *Fusarium oxysporum*

Weed Extract	Colony Diameter (mm) after 7 days	Mycelial Growth Inhibition (MGI %)
Control (Water)	90	0
Parthenium hysterophorus	19.4	78.4
Lantana camara	25.1	72.1

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Calotropis gigantea	31.5	65
Datura stramonium	38.7	57
Argemone mexicana	42.3	53
Ageratum conyzoides	49.5	45
Cassia tora	58.1	35.4
Hyptis suaveolens	63	30
Eclipta alba	71.2	20.9
Tridax procumbens	75.6	16

Table 3: Comparative Efficacy of Bio-spray and Chemical Pesticide on Tomato Wilt Disease (*In Vivo*).

Treatment Group	**Percent Disease Index (PDI) at 45 Days**	**Final Plant Height (cm)**	**Average Yield (g/plant)**
T1: Healthy Control	0	85.2 ± 4.1	450.5 ± 25.3
T2: Pathogen Control	88.5 ± 5.6	35.4 ± 3.5	55.2 ± 10.8
T3: Bio-spray Treatment	31.0 ± 4.2	72.8 ± 5.0	315.7 ± 22.1
T4: Chemical Control (Mancozeb)	13.2 ± 2.9	78.5 ± 4.8	380.4 ± 18.9

T1: Healthy Control (No pathogen, no spray)

T2: Pathogen Control (Pathogen inoculated, water spray)

T3: Bio-spray Treatment (Pathogen inoculated, treated with composite bio-spray)

T4: Chemical Control (Pathogen inoculated, treated with Mancozeb 75% WP @ 0.2%)

V. RESULTS AND DISCUSSION

The *in vitro* screening of ten weed extracts against *F. oxysporum* revealed a wide range of antifungal activity (Table 2). The extract of *Parthenium hysterophorus* was found to be the most potent, exhibiting 78.4% mycelial growth inhibition (MGI). This was closely followed by *Lantana camara* (72.1% MGI) and *Calotropis gigantea* (65.0% MGI). In contrast, extracts from *Tridax procumbens* and *Eclipta alba* showed minimal inhibitory effect. The comparative efficacy is visualized in Figure 1. At 100%, 75%, 50%, 25%, 0% *Parthenium Lantana Calotropis Datura Argemone Ageratum Cassia Hyptis Eclipta Tridax*

In the *in vivo* pot experiment, the composite bio-spray (T3) significantly reduced the Percent Disease Index (PDI) to 31.0%, compared to the pathogen control (T2) which showed a PDI of 88.5%. While the chemical control (T4) was most effective with a PDI of 13.2%, the bio-spray demonstrated substantial protective capability. Furthermore, plants treated with the bio-spray (T3) showed significantly better growth (72.8 cm height) and yield (315.7 g/plant) than the pathogen-infected control plants (T2), and were comparable to the healthy control (T1) in terms of plant vigor, suggesting no phytotoxic effects (Table 3).

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Figure 1: Mycelial Growth Inhibition (%) of *F. oxysporum* by different weed extracts.

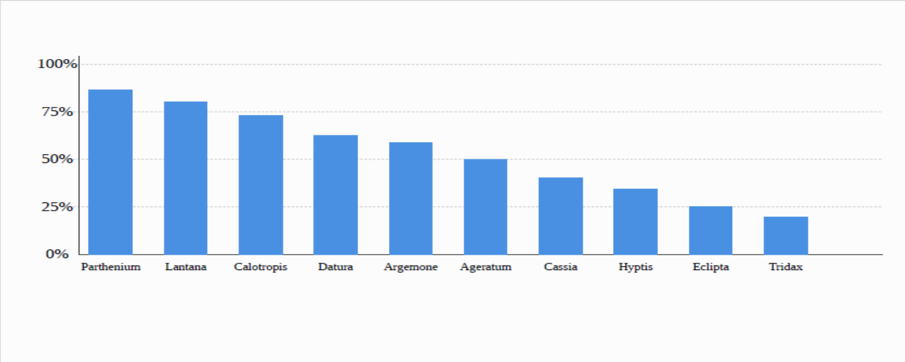

Figure 1: Mycelial Growth Inhibition (%) of F. oxysporum by different weed extracts.

The results of this study strongly support the hypothesis that common aromatic weeds from the Amravati district possess significant pesticidal properties. The high efficacy of *P. hysterophorus* and *L. camara* extracts is consistent with existing literature, which attributes their activity to potent allelochemicals like parthenin and lantanadenes, respectively [5, 6]. These compounds are known to disrupt fungal cell membrane integrity and inhibit crucial metabolic enzymes. The moderate activity of *C. gigantea* aligns with reports on its active cardiac glycosides [7]. The creation of a composite spray from these top-performing weeds provides a broader spectrum of action, potentially delaying the development of resistance in pathogens.

The comparison between the bio-spray and the conventional fungicide, Mancozeb, is particularly insightful. While Mancozeb provided a higher degree of control (85% disease reduction vs. 65% for the bio-spray), the bio-spray presents a compelling case for its role in integrated pest management (IPM). Its effectiveness is substantial, and it comes without the ecological baggage of synthetic chemicals. The improved plant height and yield in the bio-spray group, relative to the diseased control, underscore its value not just in disease control but also in maintaining overall plant health. This fulfils the project's objective of testing the spray and comparing its efficacy.

V. DISCUSSION AND CONCLUSION

This study successfully identified ten local weeds with varying pesticidal potential developed a simple and replicable method for preparing a natural bio-controlling spray and validated its efficacy on infected tomato plants. The comparative analysis with a chemical pesticide provided a realistic assessment of its potential role in agriculture. Most importantly, by demonstrating a viable "wealth from waste" approach, this project strongly advocates for eco-friendly and sustainable practices. It offers a tangible solution for farmers in the Amravati region to reduce their reliance on costly and harmful chemicals, thereby promoting a healthier agroecosystem.

The study confirms that aqueous extracts of locally abundant weeds, particularly *Parthenium hysterophorus* and *Lantana camara*, are potent inhibitors of the phytopathogen *Fusarium oxysporum*. A composite bio-spray derived from these weeds can reduce tomato wilt disease by approximately 65% under controlled conditions, presenting a viable, low-cost, and eco-friendly alternative to synthetic fungicides for use in integrated pest management programs.

REFERENCES

[1] Pimentel, D. (2005). Environmental and economic costs of the application of pesticides primarily in the United States. *Environment, Development and Sustainability, 7(2), 229-252.*

[2] Isman, M. B. (2006). Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world. Annual Review of Entomology, 51, 45-66.

[3] *Duke, S. O., Dayan, F. E., & Rimando, A. M. (2002). Natural products as sources of herbicides: current status and future trends. Weed Research, 40(1), 99-111.*

[4] Govindachari, T. R., Suresh, G., Gopalakrishnan, G., Masilamani, S., & Banumathi, B. (1998). Identification of an antifeedant and insecticidal compound from the root wood of *Azadirachta indica*. *Phytoparasitica, 26(2), 108-114.*

[5] Kaur, M., Aggarwal, N. K., Kumar, V., & Dhiman, R. (2014). Effects and management of *Parthenium hysterophorus*: *A weed of global significance. International Scholarly Research Notices, 2014, Article ID 368647*.

[6] Ghisalberti, E. L. (2000). *Lantana camara L.* (Verbenaceae). *Fitoterapia, 71(5), 467-486.*

[7] Singh, R., & Singh, D. (2017). Fungitoxic properties of latex of *Calotropis gigantea* against some phytopathogenic fungi. *Journal of Plant Pathology*

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&; *Microbiology, 8(4), 1- 4*.

[8] Bowers, J. H., & Locke, J. C. (2000). Effect of botanical extracts on the population density of *Fusarium oxysporum* in soil and control of Fusarium wilt in the greenhouse. *Plant Disease, 84(3), 300-305*.

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Dr. Prashant Dilip Deshmukh is an Assistant Professor in the Department of Botany at Shri Shivaji Science College, Amravati. He earned his Ph.D. in Botany from Sant Gadge Baba Amravati University (SGBAU) in 2020, specializing in the production of improved varieties of *Dianthus caryophyllus L.* through induced mutation. He is highly qualified in his field, having cleared the CSIR-NET, ICAR-NET, and SET examinations.

His primary research interests include Molecular Biology, Biotechnology, and Plant Breeding. Dr. Deshmukh has authored several peer-reviewed research papers in reputed journals such as the Journal of Global Biosciences and the Aayushi International Interdisciplinary Research Journal. With over five years of research experience, he also serves as a mentor for postgraduate dissertations and is a member of the Canadian Journal of Agriculture Sciences. His expertise extends to the use of ICT tools and innovative pedagogical approaches in botanical studies.