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From the Desk of the Founder



At **Digital Agri News**, we understand that farming is not just a profession — it's a way of life. It is the heartbeat of our economy, the foundation of our food security, and the lifeline of millions of families. With this in mind, our mission is simple yet powerful: to bring timely, accurate, and actionable agricultural news right to your fingertips.



From market trends and crop prices to climate alerts and weather updates, from emerging technologies and sustainable practices to policy reforms and government schemes, we cover everything that matters to the agricultural community. Our goal is to empower you with knowledge that helps you make better decisions — in the field, in the marketplace, and for the future. We also believe in celebrating the spirit of farming. Through farmer success stories, expert interviews, and global agri innovations, we highlight the resilience and creativity that keep agriculture thriving even in challenging times. Every story we share is a step toward building a stronger, more connected, and more informed agri-ecosystem.

At Digital Agri News, we go beyond headlines — we provide insights, analysis, and solutions that matter. By bridging the gap between technology and tradition, policy and practice, local needs and global opportunities, we strive to create a platform where every voice in agriculture is heard and valued.

Thank you for trusting us as your partner in this evolving journey. Together, let's cultivate awareness, embrace innovation, and nurture a sustainable future for generations to come.

Dr. Mukesh Narwal

Warm Regards

Dr. Mukesh Narwal

Founder, Digital Agri News

From the Desk of the Chief Editor



Dear Readers,

Greetings to all the esteemed readers of **Digital Agri News Magazine**.

We are pleased to present **Volume 02, Issue 09**, featuring informative articles on sustainable agriculture, integrated weed management, and the role of spices in human health and nutrition.

This issue highlights the **Role of Agronomy in Sustainable Agriculture**, emphasizing soil health, efficient water and nutrient management, climate-smart practices, and modern technologies such as precision farming, remote sensing, and drones to enhance agricultural productivity while conserving natural resources.

Another key article explores **Integrated Weed Management (IWM)**, demonstrating how cultural, mechanical, biological, and chemical methods can be combined for effective weed control, reduced herbicide dependence, and sustainable crop production.

The issue also examines **Spices and Immunity**, discussing the potential health benefits of turmeric, ginger, chilli, black pepper, and garlic.

At **Digital Agri News**, we remain committed to connecting scientific knowledge with practical applications for a healthier and more sustainable future.

Dr. Ankit Saini

Warm Regards

Editor-in-Chief

Digital Agri News Magazine



DR. ANKIT SAINI

*Assistant Professor and Head
Department of Agronomy*

Dr. KSG Akal College of Agriculture
Eternal university Baru Sahib Sirmour
HP

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Assistant Professor,
Joy university, Raja Nagar,
Vadakangulam, Near Kanyakumari,
Tirunelveli Dist. – 627116 Tamil Nadu



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Centre for Protected Cultivation Technology
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Project associate -I
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Technology of Jammu , Rs Pura

ROLE OF AGRONOMY IN SUS- TAINABLE AGRICULTURE



**LAKITA TANWAR¹, PRIYANKA¹ AND CHINMAYA SA-
HOO²**

Role of Agronomy in Sustainable Agriculture

Lakita Tanwar¹, Priyanka¹ and Chinmaya Sahoo²

¹Dr. Khem Singh Gill Akal College of Agriculture, Eternal University, Himachal Pradesh, Baru Sahib Sirmaur-173101, India

²Department of Agronomy, Post Graduate College of Agriculture, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar- 848125

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Abstract

Agronomy plays a crucial role in advancing sustainable agriculture by integrating scientific principles with practical field management to ensure long-term productivity, resource conservation, and environmental health. As global challenges such as climate change, soil degradation, water scarcity, and population growth intensify, the need for sustainable agricultural systems becomes increasingly urgent. Agronomy provides the knowledge and tools necessary to optimize crop production while minimizing negative ecological impacts. This includes improving soil fertility, promoting efficient water management, utilizing climate-smart practices, and integrating modern technologies. The discipline emphasizes a holistic approach that supports biodiversity, reduces chemical dependency, and improves resilience to environmental stresses. By adopting sustainable agronomic strategies, farmers can enhance productivity, maintain ecosystem balance, and secure global food systems for future generations. This article explores the multi-dimensional role of agronomy in fostering sustainable agriculture, focusing on scientific methods, practical applications, and long-term benefits for both society and the environment.

Keywords: Agronomy, Climate-Smart Practices, Crop Production, Sustainable Agriculture, Soil Management

Introduction

In the contemporary landscape of global challenges, the imperative for sustainable agriculture has taken center stage. As the world grapples with burgeoning populations, climate change, and dwindling natural resources, the pivotal role of modern agronomy in fostering sustainability becomes increasingly apparent. Agronomy, the science of soil management and crop production, has undergone a profound evolution, embracing cutting-edge technologies and holistic approaches to address the intricate balance between food production and environmental preservation. This introductory exploration delves into the multifaceted role of modern agronomy, unraveling its significance in steering agriculture toward a resilient and sustainable future. Modern agriculture is a dynamic and interdisciplinary field that combines the insights of genetics, soil science, ecology, and technology. Its main objective is to optimize agricultural practices to meet growing food demand while minimizing the impact on the environment. This transformation is a response to the recognition that traditional agricultural methods, characterized by intensive resource use and environmental degradation, are not sustainable over the long term. Precision agriculture is the cornerstone of modern agriculture,

using technological advances to revolutionize agricultural practices. With satellite images, GPS, and sensor data collection, agronomists can analyze fields with unprecedented precision.

This precision allows efficient use of resources and reduces the environmental impact associated with excess water, fertilizers, and pesticides. “By adopting precision farming, modern agriculture not only increases productivity but also minimizes adverse environmental consequences, paving the way for a more sustainable agricultural model”. Genetic advancements and biotechnology play a decisive role in modern agricultural forestry and provide solutions to challenges in food security and environmental resilience.

Genetically modified crops that improve resistance to pests, diseases, and difficult environmental conditions contribute to increasing production and reducing dependence on chemical inputs. This innovative approach is consistent with sustainable principles and emphasizes the need to respond to global food demand without jeopardizing the health of ecosystems. The preservation and improvement of soil health has emerged as the core element of modern agricultural commitment to sustainability. Cover cropping, crop rotation and low irrigation are effective ways to preserve

soil fertility, structure, and humidity retention. These strategies not only increase crop yields, but also help to store carbon, thereby reducing the impact of climate change. Modern agricultural policy aims to ensure the long-term sustainability of agricultural technologies by recognizing the complex relationship between soil health and agricultural yields. Furthermore, the use of agroecological principles is a paradigm shift in modern agriculture. Understanding the complex interactions between crops, pests and beneficial organisms enables agronomists to develop integrated pest management plans. These solutions limit the need for synthetic pesticides, resulting in a more balanced and sustainable agricultural ecosystem. The inclusion of agricultural and ecological principles corresponds to the overall concept of sustainable agriculture, which emphasizes harmony with nature rather than domination.



Methodology

The methodology used in agronomy to promote sustainable agriculture involves a combination of experimental

research, field observations, and advanced technologies. Agronomists conduct soil tests, analyze nutrient dynamics, and study crop responses under varying environmental conditions. Modern tools such as remote sensing, GIS mapping, and precision farming technologies help in monitoring crop

health, predicting yields, and managing resources efficiently. Research trials on crop varieties, irrigation methods, organic amendments, and integrated pest management (IPM) provide evidence-based strategies for sustainable farming practices.

Discussion

The role of agronomy in sustainable agriculture is multi-faceted. One of its primary contributions is improving soil health. Sustainable agronomic practices such as crop rotation, reduced tillage, cover cropping, and organic manure application help maintain soil structure, fertility, and microbial diversity. These methods reduce erosion, enhance carbon sequestration, and improve water retention. Efficient water management is another critical area—agronomy promotes drip irrigation, rainwater harvesting, deficit irrigation, and moisture conservation techniques to address water scarcity. In pest and disease management, agronomy supports eco-friendly approaches such as IPM, biopesticides, resistant crop varieties, and biological control agents.

Climate-smart agriculture, an emerging approach within agronomy, aims to enhance resilience against climate change impacts. Practices such as agroforestry, drought-resistant cultivars,

adjusted sowing dates, and soil carbon enhancement help farmers cope with extreme weather events. Agronomy also facilitates efficient nutrient management by promoting balanced fertilizer application, slow-release fertilizers, and site-specific nutrient management (SSNM). Sustainable agronomy ensures that farming remains productive while reducing environmental footprints such as greenhouse gas emissions, chemical residues, and biodiversity loss. Furthermore, agronomy integrates modern digital tools—AI-based crop monitoring, sensor-driven irrigation systems, drones for field scanning, and decision-support systems—to enhance precision and sustainability. These innovations empower farmers to make informed decisions, reduce resource waste, and optimize yields. The economic benefits include lower input costs, improved productivity, and higher profitability, making sustainable agronomy both practical and profitable.

Conclusion

In conclusion, agronomy plays an essential role in achieving sustainable agriculture by blending scientific knowledge with practical

field applications. Through improved soil health, efficient water use, climate-resilient practices, and advanced technologies, agronomy ensures long-term productivity while safeguarding the environment. As global agricultural challenges continue to grow, sustainable agronomic practices will remain vital in securing food security, promoting environmental conservation, and supporting rural livelihoods. The continued advancement of agronomic research and sustainable technologies will shape the future of agriculture, ensuring resilience and sustainability for generations to come.



Methodology

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SPICES AND IMMUNITY: THE SCIENCE BEHIND THE FLAVOUR



DR.D.V.SWAMI¹, DR.V.SIVAKUMAR², DR.K.RAVIN-DRA KUMAR³

Spices and Immunity: The Science behind the Flavour

Dr.D.V.Swami¹, Dr.V.Sivakumar², Dr.K.Ravindra Kumar³

¹Associate Director of Research

Dr.YSRHU-Regional Horticultural Research Station (RHRS), Kovvur

²Scientist (Hort.), Dr.YSRHU-Regional Horticultural Research Station (RHRS), Kovvur

³Senior Scientist (Hort.), Dr.YSRHU-Regional Horticultural Research Station (RHRS), Kovvur

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India is universally recognized as the "Home of Spices," possessing a botanical and agricultural heritage that has shaped global trade, culinary traditions, and medicinal practices for millennia. Of the 109 spice varieties recognized by the International Organization for Standardization (ISO), India actively cultivates over 75, making it the undisputed global leader in spice production, consumption, and export (Spices Board India, 2025). Total production was 12.48 million tonnes in 2023-24 and is estimated at 11.99 million tonnes for 2024-25. Of the 52 spices grown in the country, commercial cultivation is concentrated in a few crops, namely chilli, turmeric, black pepper, cardamom, ginger and the seed spices, which matter in both domestic and international trade (Nybe *et al.*, 2007). Spices are also a major export earner. Exports reached an all-time high in 2024-25 at 17.99 lakh tonnes, worth US\$4,722.65 million. In 2025-26, exports were 17.34 lakh tonnes, worth US\$4,430.90 million, and chilli (27%), cumin (12%) and spice oils and oleoresins (12%) led the export basket by value (Spices Board India, 2026).

The human immune system is a remarkably complex network of cells, tissues, and organs that work in unison to defend the body against attacks by "foreign" invaders. These invaders include bacteria, viruses, parasites, and even fungi. In the

modern era, while pharmaceutical interventions are vital, there has been a significant resurgence in exploring the prophylactic and therapeutic potential of natural substances. Among these, culinary spices stand out not just for their flavor profiles, but for their dense concentrations of bioactive compounds.

Spices are low-volume, high-value crops. They add taste, colour and aroma to food, and they have long been used as appetizers and preservatives (Srinivasan, 2005). Many spice compounds also have antimicrobial activity against food-borne pathogens and spoilage organisms, which helps explain their traditional use in food preservation (Tajkarimi *et al.*, 2010).

Beyond the kitchen, spices have a long record in traditional medicine, including Ayurveda and Traditional Chinese Medicine. Experimental studies in animals and humans have documented digestive stimulant, hypolipidemic, antidiabetic, antioxidant, and anti-inflammatory effects (Srinivasan, 2005). Reviews of spice antioxidants link these compounds to their potential effects on human health (Yashin *et al.*, 2017). There is also growing interest in their chemopreventive potential, since several spice constituents have antioxidant and anti-inflammatory activities relevant

to tumour promotion (Surh, 2002; Kaefer & Milner, 2008). Because of these bioactive properties, spices are increasingly regarded as functional foods (Tapsell *et al.*, 2006).

Each spice crop contains a characteristic set of phytochemicals that contribute to health and to the functioning of the immune system. Curcumin in turmeric, gingerols and shogaols in ginger, capsaicin in chilli, piperine in black pepper, allicin in garlic and thymoquinone in black cumin are among the best studied of these bioactive principles (Zhenget al., 2016). Through such compounds, spices have been reported to act as antioxidants, antimicrobials, antidiabetic and anti-mutagenic agents, anti-inflammatory compounds and digestive stimulants (Srinivasan, 2005; Kaefer & Milner, 2008).

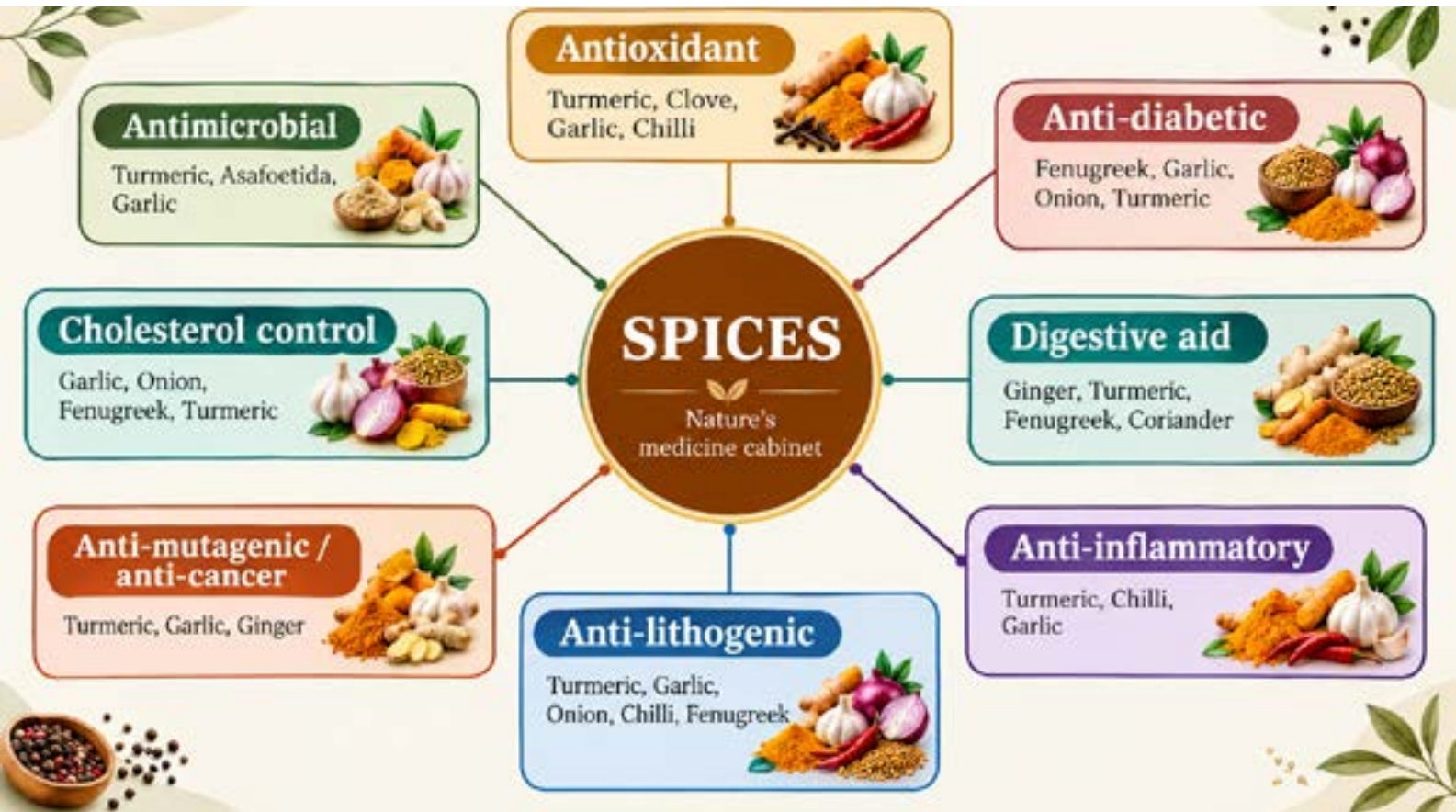
The immune system defends the body against foreign invaders such as bacteria, viruses, fungi, parasites, and their toxins, which cause common seasonal infections including colds, coughs, and fevers. Diet is one of the modifiable factors that influences immune competence, and a number of herbs and spices have demonstrated immunomodulatory activity (Beswa & Ndlovu, 2021). Ginger, for example, exerts antioxidant and anti-inflammatory effects through the Nrf2 and NF-κB signalling pathways, shifting the balance of pro- and anti-

inflammatory cytokines (Ayustaningwarno et al., 2024). Curcumin likewise modulates the activity of macrophages, lymphocytes and natural killer cells (Zheng et al., 2016).

Taken together, spices possess a broad range of bio-functions whose combined action may support the body's defences. It should be noted, however, that much of this evidence comes from in vitro and animal studies, and that well-controlled human trials remain limited for most spices.

Spice crop	Phyto-nutrients	Spice crop	Phyto-nutrients
Chilli	Capsaicin	Nigella	Thymoquinone
Turmeric	Curcumin	Sweet flag	Acorin
Ginger	Gingerol	Aniseed	Anethole
Black pepper	Piperine	Nutmeg	Myricetin
Cardamom	Cineole	Coriander	Linalool
Clove	Eugenol	Saffron	Cicrocrosin
Asafoetida	Ferumine	Fenugreek	Diosgenin
Ajwain	Thymole	Cumin	Cuminol
Cinnamon	Cinnamaldehyde	Fennel	Limone

Table 1. Some of the specific phyto-nutrients available in Spice crops



Black pepper has traditionally been used for pain relief and for complaints such as rheumatism, influenza, the common cold and indigestion, and it is also recognized as an antimicrobial agent. Ginger has a long history in herbal medicine for fever, diabetes, liver disorders, bronchitis, hypertension, tuberculosis and sinus complaints. Turmeric has been used for centuries for rheumatism, body ache, skin diseases, intestinal worms, diarrhoea, intermittent fevers, constipation, urinary discharges, leukoderma and dental problems, as well as for digestive complaints such as indigestion, ulcers, dyspepsia, acidity and colic, and for inflammatory disorders including arthritis, colitis and hepatitis. Garlic has been used for fevers, liver disorders, diabetes, tuberculosis, rheumatism, dysentery and hypertension (Anupam et al., 2018). Other spices have comparable reported effects through antimicrobial, anti-inflammatory and antioxidant activities.

Free radicals arise from normal metabolic processes within the body and from external sources such as ionizing radiation, cigarette smoke, air pollutants and industrial chemicals. They are highly reactive and short-lived, but within that time they can damage DNA, proteins and membrane lipids. When the generation of reactive species exceeds the capacity of the body's defence systems, the resulting oxidative stress can cause mutations and cumulative cellular damage. Oxidative stress has been implicated in cardiovascular disease, stroke, cancer, arthritis, respiratory disease, neurodegenerative conditions such as Parkinson's disease, and ageing (Pham-Huy et al., 2008).

Antioxidants, also termed free radical scavengers, limit this damage by donating an electron or a hydrogen atom to the unstable radical, converting it into a comparatively stable, non-reactive species while the antioxidant itself becomes a low-reactivity radical that is subsequently regenerated or safely eliminated. The body's antioxidant defences comprise enzymatic systems such as superoxide dismutase, catalase and glutathione peroxidase, together with dietary antioxidants including vitamins C and E, carotenoids and polyphenols (Pham-Huy et al., 2008).

Spices are more than just flavor enhancers; they are concentrated pharmacies in our kitchens. By understanding the role of compounds like Curcumin, Gingerol, and Allicin, we can move from accidental consumption to intentional nourishment. Incorporating a variety of these spices—especially in synergistic combinations—provides a low-cost, high-impact strategy for maintaining immune homeostasis. The antioxidant properties of spices are relevant to the oxidative modification of low-density lipoprotein cholesterol an early step in atherogenesis. The principal

antioxidant constituents include flavonoids and phenolic amides from black pepper, capsaicin and capsaicinol from chilli, eugenol and gallates from clove, gingerols and diarylheptanoids from ginger, and curcumin from turmeric. Several of these compounds also show anti-mutagenic activity; curcumin from turmeric and the organosulfur compounds of garlic are notable examples (Srinivasan, 2005). Foods with higher Oxygen Radical Absorption Capacity (ORAC) values may be more effective at neutralizing free radicals.

Combination	Target Benefit	Biological Reason
Turmeric + Black Pepper	Systematic inflammation	Piperine inhibits the metabolism of Curcumin, keeping it in the bloodstream longer.
Garlic + Ginger	Respiratory defence	Combined antiviral and anti-inflammatory action that targets the mucous membranes.
Cinnamon + Clove	Pathogen shield	Overlapping antimicrobial profiles that cover a wider range of bacteria and fungi
Spice + Healthy Fat	Nutrient absorption	Fat-soluble compounds (like those in turmeric and pepper) require lipids for transport.

Table 2. Synergistic Effects: The Power of Combinations

The concept of synergy is where nutrition becomes "medicine." In nature, compounds rarely work in isolation.

FOOD ITEM	ORAC values
Egg Whites	10
Beef Steak - Meat	10
Egg Yolk	20
Egg, Whole	20
Instant White Rice, Cooked	30
Milk, 2% Fat	50
Fried Chicken Without Skin, Frozen – Meat	60
Fried Chicken With Skin, Frozen Meat	50
Fried Chicken Without Skin, Frozen - Meat	60

FOOD ITEM	ORAC values
Cabbage, Boiled	856
Cauliflower, Raw	870
Eggplant, Raw	932
Mangos, Raw	1300
Broccoli, Raw	1510
Red Grapes, Raw	1837
Cashews, Nuts	1948
Pomegranates, Raw	4479
Garlic, Raw	5708
Saffron Spice, Whole	20580

FOOD ITEM	ORAC values
Fried Chicken With Skin, Frozen - Meat	50
Honey	130
Watermelon, Raw	142
McDonald's Crispy Chicken Sandwich	180
Pizza Hut Cheese Pizza	170
Green Peas, Canned	120
Papaya, Raw	300
White Tea, Bottled	264
Green Tea, Bottled	520
Oyster Mushrooms, Raw	664
Butter	730

FOOD ITEM	ORAC values
Garlic, Raw	5708
Saffron Spice, Whole	20580
Paprika Spice	21932
Black Pepper Spice	34053
Ginger Spice, Ground	39041
Cumin Seed Spice	50372
Basil Spice, Dried	61063
Allspice, Ground	100400
Dried Vanilla Bean	122400
Turmeric Spice, Ground	127068
Ground Cinnamon Spice	131420
Ground Cloves Spice	290283

Source: ORAC values database 2020

Conclusion

Spices contribute to human health through several mechanisms, acting as antioxidants, anti-mutagens, anti-inflammatory and antimicrobial agents, and as modulators of immune function, with reported antiviral and cancer-preventive potential. Because each spice contains a distinct combination of bioactive principles, and because these may act synergistically when spices are consumed together, a well-spiced diet is likely to make food not only more flavourful but also more

healthful.

The evidence reviewed here nevertheless comes largely from in vitro systems and animal models. Well-designed clinical trials in humans are needed to establish effective doses, bioavailability, safety at dietary and supplemental levels, and possible interactions with medication. Further work is also required on the nutritive and phytochemical composition of the lesser-studied spices, and on how growing conditions, post-harvest handling, processing and cooking affect the retention of their bioactive constituents.

Generating such evidence would allow the health-promoting properties of spices to be incorporated into dietary guidelines and public-health strategy on a sound scientific footing, and would strengthen the position of spices as functional foods in both domestic and export markets.

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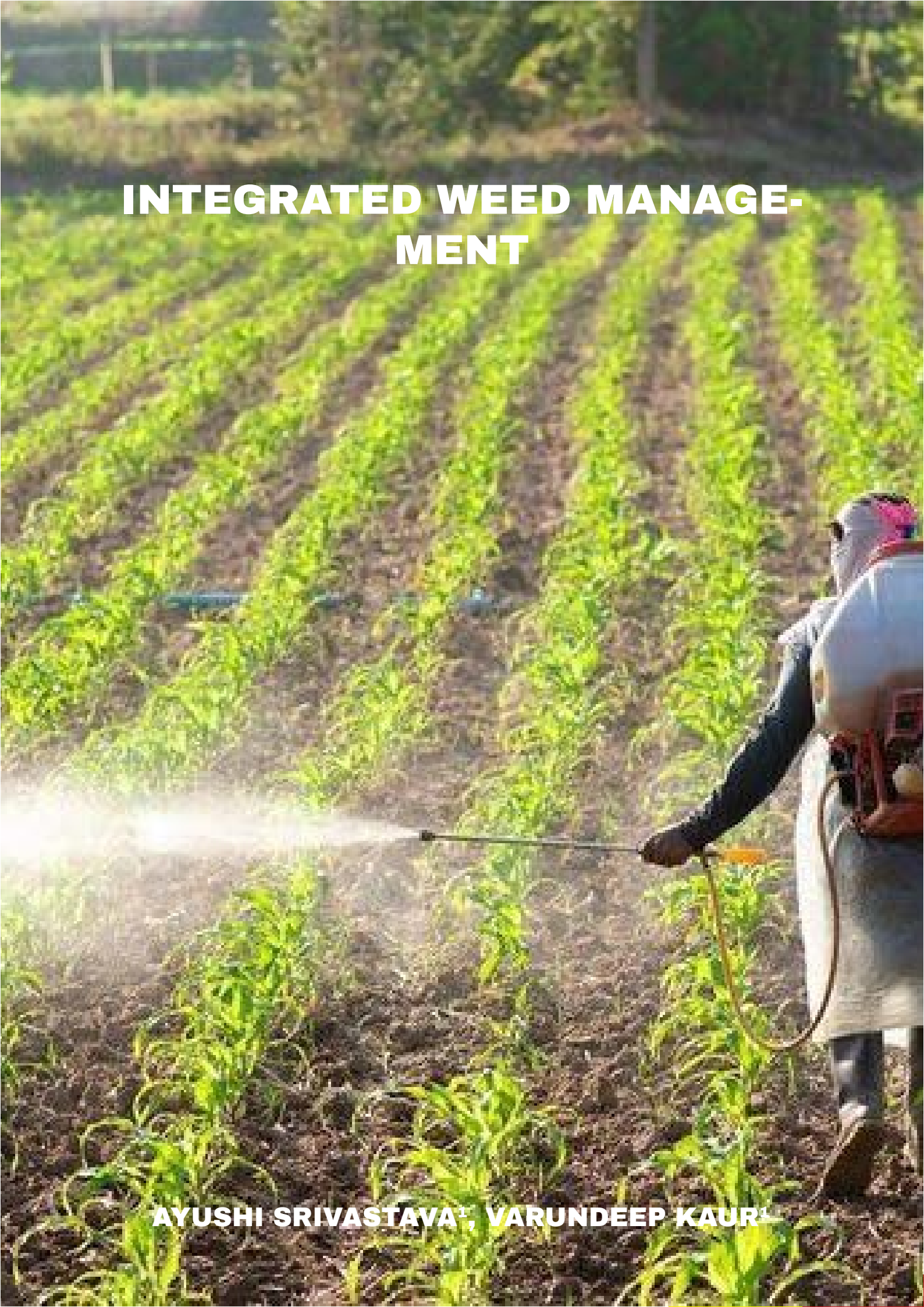
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INTEGRATED WEED MANAGE- MENT

AYUSHI SRIVASTAVA¹, VARUNDEEP KAUR¹

Integrated Weed Management

Ayushi Srivastava¹, Varundeep kaur¹

¹Dr. Khem Singh Gill Akal College of Agriculture, Eternal University, Baru Sahib, Himachal Pradesh

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Abstract

Integrated Weed Management (IWM) is an ecologically sustainable approach combining cultural, mechanical, biological, and chemical methods to manage weeds effectively. This article highlights the importance of IWM in modern agriculture, its components, advantages, and the need for balanced adoption to reduce dependency on herbicides. By integrating multiple weed-control strategies, farmers can maintain crop productivity, prevent herbicide resistance, and promote soil and environmental health. The article also discusses practical IWM practices, their implementation, and the role of technological innovations in enhancing weed control. Overall, IWM ensures long-term sustainability in crop production by minimizing weed-competition losses while safeguarding ecological integrity.

Keywords: Integrated Weed Management, Weeds, Herbicides, Sustainable Agriculture, Cultural Practices, Biological Control

Introduction

Weeds are one of the major biological constraints in agriculture, competing with crops for nutrients, water, sunlight, and space. Traditional weed-control strategies, especially continuous herbicide use, have resulted in several challenges such as herbicide resistance, environmental contamination, and reduced soil biodiversity. Integrated Weed Management (IWM) provides

a holistic and scientific approach to weed control by combining various compatible practices to achieve effective and sustainable weed suppression. IWM ensures long-term productivity by reducing over-reliance on chemical methods and promoting ecological balance.

Methodology

This article is based on a review of published research papers, agricultural extension guidelines, and scientific documents related to weed management. The information was synthesized to present a comprehensive understanding of different components of Integrated Weed Management and its applicability under diverse cropping systems.

Components of Integrated Weed Management

01. Cultural Practices

Cultural methods modify crop and field environments to suppress weed growth. Major cultural approaches include crop rotation, use of competitive crop varieties, timely sowing, maintaining optimum plant population, and balanced fertilization. Crop rotation breaks the life cycle of specific weeds, while

dense crop canopies reduce sunlight availability for weed germination.

2. Mechanical and Physical Methods

Mechanical weed-control techniques such as hand weeding, hoeing, tillage, and the use of weeders play a significant role, especially in smallholder farms. Mulching using organic or plastic materials prevents weed emergence by restricting sunlight and conserving soil moisture. Mechanical methods are environmentally safe and improve soil aeration.

3. Biological Control

Biological control involves using natural enemies such as insects, pathogens, and grazing animals to suppress weed populations. Examples include the use of *Zygogramma bicolorata* for controlling *Parthenium hysterophorus*. Though biological control is slow, it provides long-term and eco-friendly weed management.

4. Chemical Control

Herbicides remain an effective weed-control tool when used judiciously. Selective and non-selective herbicides can be applied pre-emergence or post-emergence depending on weed type and crop stage. However, reliance solely on herbicides may lead to resistance development and environmental risks. Thus, herbicides



in IWM should be used as part of a broader strategy.

5. Preventive Measures

Preventive practices help avoid the introduction and spread of weeds. These include using clean seeds, preventing weed seed dispersal through irrigation channels or machinery, and regular field sanitation. Preventive measures

are cost-effective and reduce future weed infestation.

Discussion

Integrated Weed Management combines multiple control measures to create a synergistic effect on weed

suppression. The success of IWM depends on understanding weed biology, cropping system, and local ecological conditions. Adopting IWM reduces production costs, minimizes herbicide dependence, and enhances long-term agricultural sustainability. Technological innovations such as drones for herbicide application, sensor-based weed detection, and precision agriculture tools further strengthen IWM implementation.

Conclusion

Integrated Weed Management is essential for sustainable agricultural production. By integrating cultural, mechanical, biological, and chemical strategies, farmers can achieve efficient weed control while reducing environmental risks. IWM ensures better crop performance, prevents herbicide resistance, and supports ecological balance. Future advancements in digital and precision technologies will further strengthen IWM adoption, making weed management more effective and sustainable.

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