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Analyzing the adoption patterns of integrated pest management practices among soybean growers

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Abstract
This study examines the extent of adoption of integrated pest management (IPM) practices among soybean growers, focusing on cultural, mechanical, biological, and chemical strategies. The findings reveal a positive trend in the adoption of various IPM practices, with deep summer ploughing, recommended doses of chemical fertilizer, and the use of resistance varieties demonstrating high acceptance rates, indicating a proactive approach to pest management. The prevalence of hand weeding or hoeing and the adoption of proper seed rates and spacing showcase a balanced cultural strategy. Mechanical practices such as collecting and destroying infested plant parts, handpicking larvae/eggs, and using light traps highlight growers' hands-on approach to pest control. The study identifies opportunities for increased awareness and promotion of biological control methods, as evidenced by moderate adoption rates of Trichoderma viride seed treatment, installing perchers for birds, and the spraying of bio-pesticides. The chemical control measures, including soil application of Phorate 10 G, seed treatment with Thiram+Carbendazim, and spraying of chemical insecticides, exhibit varying adoption levels, emphasizing the need for targeted interventions and careful monitoring to prevent overreliance. The analysis of the overall extent of adoption indicates a majority falling within the medium range, signaling a positive inclination toward IPM. The study concludes by highlighting the importance of tailored interventions and educational programs to further encourage sustainable pest management practices among soybean growers for enhanced agricultural sustainability.

Keywords: Soybean growers, adoption patterns, and sustainable agriculture

Introduction
In contemporary agriculture, the sustainable management of pests has emerged as a critical component for ensuring food security, preserving ecosystems, and safeguarding human health. Integrated Pest Management (IPM) represents a holistic and science-based approach that integrates various strategies to control pests while minimizing the impact on the environment and non-target organisms. In the specific context of soybean cultivation, a vital global crop with economic and nutritional significance, effective pest management is pivotal for optimizing yields and ensuring the sustainability of agricultural practices. This research aims to meticulously scrutinize the adoption patterns of IPM practices among soybean growers, recognizing the multifaceted nature of their decisions and practices. The soybean agroecosystem, like many others, faces an array of pest challenges ranging from insects and diseases to weeds. Consequently, understanding the nuanced choices made by soybean farmers concerning cultural practices, mechanical interventions, biological control methods, and chemical applications is essential for devising targeted and effective strategies.

The adoption of IPM practices reflects not only the responsiveness of farmers to pest pressures but also their commitment to sustainable and environmentally friendly agricultural approaches. As soybean production continues to play a crucial role in global agriculture, unraveling the complexities of IPM adoption becomes imperative for devising policies, extension services, and educational programs that align with the needs and challenges faced by soybean growers.

This research, through an in-depth analysis of the adoption patterns, seeks to identify prevailing trends, potential barriers, and areas of improvement within the soybean farming community. By shedding light on the factors influencing the adoption of specific IPM practices, the research aims to provide actionable insights that can contribute to the development of more targeted and effective extension services, policy interventions, and educational initiatives. Ultimately, the overarching goal is to enhance the resilience and sustainability of soybean cultivation by fostering a widespread and informed adoption of

integrated pest management practices.

Material and Methods

Sample and sampling procedure

Selection of blocks

Bhopal district comprise 2 subdivisions, out of which Berasia of block will be selected purposively because this block having largest area under soybean crop and the researcher is also well acquainted with the area and local detail.

Selection of villages

Berasia block consist 304 villages, out of which 6 villages, Damila, Chanpura, Dolatpura, Hamid Khedi, Goria, Netapura, were selected randomly for the presents study.

Election of respondents

Out of total soyabean growers in each selected village, 20 percent farmers from each villages were selected randomly, thus the total 120 farmers were selected for the present study.

Result and Discussion

Practice wise extent of adoption regarding commended IPM practices of soybean

Table 1 found that the distribution of the respondents with respect to their practice wise extent of adoption regarding commended IPM practices of soybean.

Table 1: Distribution of respondents according to their practice wise extent of adoption regarding commended IPM practices of soybean

n=120

S. No.	Integrated pest management	Extent of adoption (percent) Low	medium	high
	A. Cultural practices.			
1.	Deep summer ploughing.	07 (5.83)	18 (15.00)	95 (79.17)
2.	Use of recommended dose of chemical fertilizer i.e. NPK	03 (2.50)	63 (52.50)	54 (45.00)
3.	Use of resistance varieties.	04 (3.33)	46 (38.33)	70 (58.33)
4.	Hand weeding or hoeing.	31 (25.83)	77 (64.17)	12 (12.00)
5.	Seed rate and adoption of proper spacing	42 (35.00	60 (50.00)	18 (15.00)
6.	Removal destruction of stubbles of previous crop.	03 (2.50)	55 (45.83)	62 (51.67)
7.	Crop rotation	05 (4.17)	59 (49.17)	46 (38.33)
8.	Inter-cropping	02 (1.67)	74 (61.67)	44 (36.67)
	B. Mechanical practices			
9.	Collection and destruction of plant parts infested with Girdle beetel, *Spodopteralitura.*	23 (19.17)	86 (71.67)	11 (9.17)
10.	Hand picking and destruction of larvae/eddgs of *helicoverpaarmigera /spodopterasp,* Semiloopers.	02 (1.67)	42 (35.00)	76 (63.33)
11.	Use of light trap for destruction of insect	23 (19.17)	87 (72.50)	10 (8.33)
	C. Biological control			
12.	Seed treatment with *Trichodermaviride* @ 4-5 g/kg seed).	23 (25.83)	79 (65.83)	10 (8.33)
13.	Installing perchers for birds	02 (33.75)	41 (48.75)	77 (17.50)
14.	Spraying of bio-pesticide Dipale @ I lit/ha or Biobit @ 1kg/ha 15 days after the spray of chemical insecticide	30 (25.00)	86 (71.67)	04 (3.33)
	D. Chemical control.			
15.	Soil application of Phorate 10 G @ 15 kg/ha at sowing time to prevent early seeding mortality due to stem fly.	54 (45.00)	40 (33.33)	26 (21.67)
16.	Seed treatment with Thiram+Carbendazim (2:1) i.e. 2 gm Thiram+ 1 g Carbendazim per kg seed should be done.	31 (25.83)	78 (65.00)	11 (9.17)
17.	Spraying to Trizophos 40 EC @ 80 ml/ha or chloropayriphos 20 EC @ 1500 ml/ha insecticide at flowring stage	12 (10.00)	72 (60.00)	36 (30)
18.	Seed treatment with Thiamethoxam 70 WS @ 3-4 gm/kg seed.	31 (25.83)	77 (64.17)	12 (10.00)

F-Frequency (%) – Percent

Cultural Practices

Deep Summer Ploughing

The high adoption rate of deep summer ploughing (79.17%) underscores the recognition among soybean growers of the efficacy of this cultural practice in pest management. This is a positive indicator of the willingness to engage in proactive measures. The high adoption rate of deep summer ploughing indicates its effectiveness in pest management, likely attributed to its ability to disrupt pest life cycles by exposing them to adverse conditions. Soybean growers seem to recognize its importance for pest control.

Use of Recommended Doses of Chemical Fertilizer (NPK)

The data reveal a significant portion of respondents (52.50%) adopting chemical fertilizers at a medium level. This suggests the need for targeted educational efforts to promote the recommended doses for optimal pest control. The moderate to high adoption of chemical fertilizers suggests their integral role in soybean cultivation. However, it is crucial to balance their use with other IPM practices to prevent overreliance and associated environmental concerns.

Use of Resistance Varieties

The high adoption rate (58.33%) of resistance varieties indicates a positive trend among soybean growers in incorporating genetic resistance as part of their pest management strategy. The high adoption of resistance varieties suggests growers' awareness of the importance of plant genetics in pest resistance, a positive trend for sustainable pest management.

Hand Weeding or Hoeing

The prevalence of hand weeding or hoeing at a medium level (64.17%) suggests its widespread adoption. This practice aligns with sustainable agriculture principles by minimizing the reliance on chemical interventions. The high adoption of manual weeding indicates its perceived effectiveness. However, the low adoption in some cases suggests the need

for awareness programs to emphasize its importance.

Seed Rate and Adoption of Proper Spacing
The fairly distributed adoption of proper seed rates and spacing indicates a balanced approach among respondents, with 50% falling into the medium category. The moderate to high adoption of proper seeding practices suggests a positive inclination toward optimizing plant growth conditions, contributing to pest resistance.

Removal Destruction of Stubbles of Previous Crop
The majority (51.67%) adopting stubble removal at a high level reflects an understanding of its importance in breaking pest cycles. This cultural practice contributes significantly to pest management strategies. The mixed adoption rates may indicate varying perceptions of the practice's effectiveness. Further research and communication are needed to address potential misconceptions.

Crop Rotation and Inter-cropping
Crop rotation and inter-cropping, though moderately adopted, present opportunities for increased awareness and promotion among soybean growers. Efforts can be directed towards showcasing the benefits of diversification in minimizing pest pressures. The moderate to high adoption of crop rotation indicates a positive trend toward sustainable farming practices. Crop rotation disrupts pest life cycles and enhances soil health. On the other hand high adoption of inter-cropping reflects an understanding of its benefits in diversifying agro-ecosystems and mitigating pest pressures.

Mechanical Practices
Collection and Destruction of Plant Parts Infested with Pests
The substantial medium-level adoption (71.67%) of collecting and destroying infested plant parts indicates a proactive approach to pest management, particularly in addressing specific pest challenges.

Hand Picking and Destruction of Larvae/Eggs
The high adoption rate (63.33%) of hand-picking larvae/eggs showcases a hands-on approach among soybean growers. This is a positive sign of active pest monitoring and control.

Use of Light Trap for Destruction of Insects
With a majority (72.50%) adopting light traps at medium level, growers demonstrate a willingness to explore innovative and mechanical means of pest control. This aligns with the principles of IPM.

Mechanical Practices
Seed Treatment with Trichoderma viride
The substantial medium-level adoption (65.83%) of seed treatment with Trichoderma viride. The moderate to high adoption of Trichoderma viride seed treatment reflects a positive attitude toward biological control methods, contributing to sustainable pest management.

Installing Perchers for Birds
With a maximum number of respondents (48.75%) adopting installing perchers for birds at medium level. The varied adoption rates indicate a potential need for awareness programs to highlight the role of birds in pest control, encouraging more growers to implement bird-friendly practices.

Spraying of bio-pesticide
With a maximum number of respondents (48.75%) adopting installing perchers for birds at medium level. With a majority of respondents (71.67%) adopting spraying of bio-pesticide. The moderate to high adoption of bio-pesticides signifies a positive shift toward environmentally friendly alternatives, reducing reliance on chemical insecticides.

Chemical control
Soil application of Phorate 10 G
The substantial low-level adoption (45%) of Soil application of Phorate 10 G @ 15 kg/ha at sowing time to prevent early seeding mortality due to stem fly. The widespread adoption of soil application of Phorate 10 G indicates its perceived efficacy in preventing early seeding mortality. However, the high adoption rate also suggests a potential need for monitoring to prevent overreliance.

Seed treatment with Thiram + Carbendazim
With a majority (65%) adopting seed treatment with Thiram+Carbendazim (2:1) i.e. 2 gm Thiram+ 1 g Carbendazim per kg seed should be done. The moderate to high adoption of seed treatment with Thiram+Carbendazim suggests recognition of its importance in preventing seed-borne diseases, aligning with good agricultural practices.

Spraying of Chemical Insecticides (Trizophos or Chlorpyriphos)
The substantial medium-level adoption (60%) of spraying to Trizophos 40 EC @ 80 ml/ha or chloropayriphos 20 EC @ 1500 ml/ha insecticide at flowering stage. The moderate to high adoption of chemical insecticide spraying during the flowering stage suggests that soybean growers recognize the importance of controlling pests during critical stages of plant development. However, the relatively lower to high adoption rate may indicate some concerns, warranting further investigation into potential alternatives or improved application practices.

Seed Treatment with Thiamethoxam 70 WS
With a majority of respondents (64.17%) adopting seed treatment with Thiamethoxam 70 WS @ 3-4 gm/kg seed. The moderate to high adoption of Thiamethoxam seed treatment highlights its recognition as an effective chemical control measure against specific pests. However, the lower to high adoption rate suggests that some growers may be exploring alternative strategies or exercising caution regarding chemical inputs.

Extent of adoption of recommended IPM practices of soybean
The analysis of the extent of adoption of integrated pest management practices among soybean growers reveals a diverse distribution, with 14.17% falling into the low adoption category (up to 17 scores), 65.83% in the medium adoption range (18-24 scores), and 20.00% exhibiting high adoption (25 and above scores) out of a total of 120 respondents. This distribution suggests a notable majority in the medium adoption category, indicating a generally positive inclination toward implementing integrated pest management strategies. While the high adoption group represents a commendable proportion, efforts can be directed toward further encouraging

practices associated with higher scores, fostering a more comprehensive integration of sustainable pest management approaches. These findings underscore the importance of tailored interventions and educational programs to bridge knowledge gaps and promote the wider adoption of integrated pest management practices among soybean growers for enhanced agricultural sustainability. (Table 2)

Table 2: Distribution of respondents according to overall extent of adoption regarding recommended IPM practices

(n=120)

S. No.	Extent of adoption	Frequency	Percent
1.	Low (up to 17 scores)	17	14.17
2.	Medium (18-24 scores)	79	65.83
3.	High (25 and above scores)	24	20.00
	Total	120	100.00

Conclusion

In conclusion, the comprehensive analysis of the adoption patterns of integrated pest management (IPM) practices among soybean growers reveals a positive trend toward sustainability. Cultural practices, such as deep summer ploughing, the use of recommended doses of chemical fertilizers, and the adoption of resistance varieties, showcase the growers' awareness of effective pest management strategies. Mechanical practices, including hand weeding, collection of infested plant parts, and handpicking of larvae/eggs, reflect a hands-on approach and a willingness to explore mechanical means for pest control. The adoption of biological control measures, such as seed treatment with Trichoderma viride, installing bird perchers, and the use of bio-pesticides, signifies a growing acceptance of environmentally friendly alternatives. Additionally, in chemical control practices, while there is a prevalent use of certain insecticides and seed treatments, the moderate to high adoption rates indicate a balanced approach, with growers possibly weighing the benefits against potential concerns. Overall, the majority falling into the medium adoption category suggests a foundation for further improvement through targeted education and awareness programs, aiming to encourage the wider integration of sustainable IPM practices among soybean growers for long-term agricultural resilience and productivity.

Application of research

The identified adoption levels can guide targeted extension services and educational programs to enhance the adoption of specific IPM practices, ensuring a holistic and sustainable approach to soybean cultivation. Overall, this research contributes valuable insights to agricultural practitioners, policymakers, and researchers, promoting practices that align with ecological balance and long-term crop health.

Research Category: Agricultural Extension and Communication

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