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Assessing the knowledge of integrated pest management strategies among cotton farmers in Punjab

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Abstract

Cotton is a crucial commercial fiber crop in India, often referred to as "white gold" because of its significant role in both agriculture and the industrial economy. The intensive cultivation of cotton, accounting for about 5 percent of total cultivated land in India, has led to the consumption of approximately 45 percent of total pesticides. Insect outbreaks, resurgences, and pesticide resistance are caused by farmers' reliance on synthetic chemicals to control illnesses and insect pests. Henceforth, this study was undertaken to evaluate the knowledge level of cotton growers regarding integrated pest management (IPM) in cotton. Conducted in the Bathinda and Fazilka districts of Punjab, the study involved a total of 120 respondents, selected through simple random sampling. An ex-post facto research design was utilized. The findings revealed that the majority of farmers possessed a moderate level of knowledge about integrated pest management in cotton. Further, education, farming experience, extension contact, innovativeness, and environmental orientation were positively and significantly related to the knowledge of respondents about integrated pest management, while age, scientific orientation, and economic motivation showed a non-significant relationship with the knowledge of respondents about integrated pest management. Enhancing the farmer's knowledge of Integrated Pest Management (IPM) is essential to ensure rural communities are well-versed in identifying and managing insect pests.

Keywords: Cotton, integrated pest management, pesticides, farmers, knowledge assessment

Introduction

Cotton (*Gossypium hirsutum* L.) holds immense agricultural significance globally, particularly in countries such as India, the USA, China, and Pakistan, collectively contributing to 85% of the world's cotton production (Singh and Kairon 2013; Singh *et al* 2021) ^[12, 13]. Approximately 40-50 million people are involved in cotton trading and processing, directly benefiting 6 million farmers. During 2022-23, the production of cotton was 336.60 lakh bales against consumption of 311 lakh bales (Anonymous 2023) ^[2]. As a key commercial crop, cotton holds significant importance in Punjab's agricultural landscape. It is the primary kharif crop in the south-western districts, commonly referred to as Punjab's cotton belt. Cotton is cultivated under irrigated conditions across approximately 33 percent of the state's geographical area, mainly encompassing the districts of Bathinda, Mansa, Sri Muktsar Sahib, Faridkot, Fazilka, and Barnala. However, the intensive cultivation of cotton, accounting for about 5 percent of the total cultivated land in India, has led to the consumption of approximately 45 percent of total pesticides. This pest-attractive and pest-sensitive crop, particularly the American long-duration cotton, has encountered challenges with resistant pests, resulting in increased usage of synthetic pyrethroids to combat issues like resistant Pink and American Bollworm (ABW). The indeterminate growth characteristics of the cotton crop provide a favorable environment for various

insects, influencing both cotton manufacturing and the socio-economic status of growers (Dhawan 2019) ^[3]. Insect outbreaks, resurgences, and pesticide resistance are exacerbated by farmers' reliance on synthetic chemicals to control pests and diseases. Residues of harmful pesticides used in traditional cotton production have been detected in fish, eggs, and cow milk (Angelova 2019) ^[1]. Nevertheless, a significant portion of these farmers lack the expertise to use these measures judiciously, primarily due to their limited understanding of pest management (Midega *et al* 2012) ^[8]. The perception of insect pests and their management significantly influences the extent of pesticide usage among farmers. Overuse of insecticides has led to the development of resistance among insects, rendering the insecticides less effective, and has also contributed to the resurgence of sucking pests (Rohini *et al* 2012) ^[11]. Integrated Pest Management (IPM) is an environmentally conscious strategy aimed at maintaining pest populations below economically damaging levels. It accomplishes this by employing a range of alternative pest control methods and techniques, such as cultural practices, mechanical interventions, and biological strategies. These approaches are designed to minimize the reliance on synthetic chemicals. The emphasis is particularly placed on the use of bio-pesticides and plant-based pesticides, such as neem formulations, which are environmentally friendly and reduce the risk of chemical residues. This integrated

approach not only helps in managing pest populations effectively but also promotes sustainable agricultural practices that safeguard the environment and human health. Enhancing growers' understanding of IPM is crucial to ensure that rural communities are well-informed about the identification and management practices related to insect pests.

Methodology

The research was carried out in the Bathinda and Fazilka districts of Punjab, chosen intentionally due to their extensive cotton cultivation areas. From each district, two villages were randomly selected. A total of 30 farmers were chosen from each village using a simple random sampling method, resulting in a total of 120 respondents. An interview schedule was developed for data collection. A knowledge test was developed for this study to assess the knowledge level of cotton growers about integrated pest management. The knowledge test consisted of items on various aspects of IPM strategies. The test was pre-tested before administration, retaining only items with a moderate difficulty level (30 to 80) and a discrimination index greater than 0.20 for the final version. A total of 34 items were considered for the final knowledge test. Each item was evaluated by asking respondents to provide answers in various formats, including multiple-choice, true or false, and fill-in-the-blank questions. Correct answers were awarded a score of 1, while incorrect answers received a score of 0. The cumulative scores for each respondent were calculated, and based on the range method, respondents were categorized into high, medium, and low levels of knowledge.

Results

The knowledge level of cotton growers about integrated pest management is detailed in Table 1 and the results indicated that in Punjab, the majority of respondents (47.50%) exhibited medium knowledge levels regarding integrated pest management in cotton, followed by those with high knowledge levels (28.33%), and there is a considerable proportion of respondents demonstrated low knowledge levels (24.17%).

Table 1: Distribution of respondents according to their knowledge of integrated pest management in cotton

Knowledge level	Punjab (n=120)	
	f	%
Low (<15)	29	24.17
Medium (15-25)	57	47.50
High (>25)	34	28.33

Relationship between knowledge level regarding integrated pest management in cotton crop and selected independent variables.

The data shown in Table 2 indicate that education, farming experience, extension contact, innovativeness, and environmental orientation have a positive and significant correlation with respondents' knowledge of integrated pest management. In contrast, variables such as age, scientific orientation, and economic motivation did not exhibit a significant relationship with the respondents' knowledge of integrated pest management at the 0.05 and 0.01

significance levels.

Table 2: Relationship between knowledge level regarding integrated pest management in cotton crop and independent variables

Independent variable	Dependent variable	Punjab (r)
Age	Knowledge	0.084
Education		0.381**
Farming experience		0.204*
Extension contacts		0.223*
Scientific orientation		0.154
Economic motivation		0.132
Innovativeness		0.196*
Environmental orientation		0.212*

*Significant at 5% level of significance, ** Significant at 1% level of significance

Discussion

To practice sustainable pest management in cotton crop according to the recommended practices, it is necessary to have adequate knowledge of integrated pest management in cotton. The study's findings highlight that the majority of farmers (47.50%) in Punjab possess a moderate level of knowledge about integrated pest management practices in cotton, as shown in Table 1. This medium level of knowledge could be primarily due to the lack of training programs regarding IPM practices, low level of engagement with extension services, and financial constraints in implementing new methods. These results suggest a moderate understanding of pesticide management among farmers, with room for improvement, particularly in enhancing awareness and knowledge dissemination efforts. These findings are consistent with those reported by Dodiya *et al* (2016) [4], and Khatri and Chauhan (2020), Rathwa *et al* (2021) [10]. Overall, there is a noteworthy portion of farmers reported a low level of knowledge (21.67%) regarding integrated pest management in cotton. Insufficient knowledge about pest control among smallholder farmers poses a notable obstacle to implementing effective pest management strategies (Hashemi and Damalas 2010; Hashemi *et al* 2012; Khan and Damalas 2015) [5, 6, 7]. The prevalence of medium-level knowledge implies a potential gap in comprehensive understanding or adoption of advanced pesticide management techniques.

The study's correlation analysis was performed to evaluate the relationship between various independent variables and the respondents' knowledge of integrated pest management. The data from Table 2 indicates the relationships between various independent variables and the knowledge of integrated pest management (IPM) among cotton growers in Punjab. In Punjab, education, farming experience, extension contact, innovativeness, and environmental orientation were found to have a positive and significant correlation with IPM knowledge. Conversely, age, scientific orientation, and economic motivation did not show a significant relationship. This aligns with Patel *et al* (2011) [9], who found that among trained cotton growers, multiple variables including education, extension contact, and training were significantly correlated with knowledge levels, while untrained growers only showed significant correlations with education and training received. Additionally, Upadhyay *et al* (2014) [14] found that the characteristics of education, social

participation, and extension participation had a positive and significant relationship with the knowledge level about IPM. Therefore, factors such as education, farming experience, extension contact, innovativeness, and environmental orientation are crucial for enhancing farmers' knowledge and promoting the adoption of IPM practices.

Conclusion

Worldwide, synthetic pesticides have emerged as the primary approach to pest management. This reliance on pesticides is especially pronounced in cotton farming, where pest infestations can significantly reduce crop yields. Given the environmental and economic challenges posed by extensive pesticide use, an alternative approach to minimize its usage is the adoption of integrated pest management. The research findings indicated that most participants demonstrated a moderate level of understanding concerning integrated pest management. Therefore, it is essential to enhance growers' understanding of Integrated Pest Management (IPM) to ensure that rural communities are well-informed about the identification and management practices related to insect pests. Education, farming experience, extension contact, innovativeness, and environmental orientation were positive and statistically significant relationship with the knowledge of respondents about integrated pest management. The government should organize awareness campaigns and training related to integrated pest management. Furthermore, institutions and state agricultural universities should motivate farmers to adopt various sustainable pest management approaches.

Conflict of Interest: None

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