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# Sugarcane Grower's Awareness of IPM Techniques in Western Uttar Pradesh: A Thorough Investigation

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## ABSTRACT

*The survey was undertaken in Western Uttar Pradesh during the year 2018, specifically focusing on the two districts, Saharanpur and Muzaffarnagar, and two blocks from each district were shortlisted on the basis of large numbers of sugarcane growers in terms of area and production. The main purpose was to evaluate how well sugarcane growers understand IPM practices and recognize the elements impacting IPM practice adoption. A random selection procedure was used to carefully choose 240 sugarcane growers from 16 villages, with 15 respondents chosen from each village. The selection of the villages was made randomly. The respondents were approached directly to gather the research data. The findings indicated that a significant portion of the respondents possessed knowledge of cultural methods viz., partially aware (55.97%), fully aware (34.93%), and remaining were not aware followed by the mechanical method of pest control. This study provides a useful way to enhance crop yields, leading to a higher economic impact. One of the major challenges was that local farmers lacked awareness of IPM techniques, making it challenging to obtain comprehensive data. There was considerable diversity in farming practices throughout the region, creating inconsistencies in IPM adoption and complicating data analysis and generalization. Awareness and effective execution of IPM strategies lead to improved pest management programmes. Biological controls, resistance cultivars, and less reliance on chemical pesticides are a few possible strategies. This investigation was regional focused, mainly on Western Uttar Pradesh, a major sugarcane-producing state of India. The geographical conditions offer a vision how local conditions impact the thoughtfulness and adoption of IPM techniques. This study has made significant contributions by improving IPM adoption among sugarcane farmers, bringing policy recommendations to the table along with promoting and enhancing sustainable agriculture in Western UP.*

***Keywords:*** *Extension, Sampling, Sugarcane, Knowledge exchange, Awareness, IPM, Crop protection, Farm productivity, Rural agriculture, Sustainable agriculture*

## Introduction

Globally, it is a known fact that India is the place of origin of sugarcane and sugar. In the diets of people across all regions, sugar is a major sucrose source. Sugarcane has been cultivated in India since the Vedic era. Sugarcane is grown in diversified climatic conditions *viz*., tropical and subtropical areas. Out of 115 countries of the World in which sugarcane is cultivated, India is the only one where both types of agro-climatic conditions exist [1]. Two third of total sugar is produced by this source which remains the main source of Indian sugar [2]. India covers the world's biggest sugarcane cultivation area. Sugar industries are the second largest agro-based industry after the cotton textile in rural areas of the country [3]. A diversity of climates, including tropical and subtropical regions, are suitable for growing sugarcane. Out of 115 countries, India is the world's largest producer of sugarcane, with a total area of 5.88 million hectares. With a yield of 84.05 tonnes per hectare, it generates 494.22 million tons yearly.

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With an area of 2.74 million hectares, a yearly production of 225.22 million tonnes and a productivity of 82.20 tonnes per hectare, Uttar Pradesh tops the nation in sugarcane cultivation among the several states. Maharashtra, Karnataka, Tamil Nadu and other states come in second, third, and fourth, respectively, in terms of production. While in terms of productivity, Uttar Pradesh lines seventh. Regarding the area and output of sugarcane agriculture in Uttar Pradesh, the Meerut district is pivotal. The crop is cultivated on 13.245 thousand hectares land, yielding 8316.70 thousand tons and 627.91 quintals per hectare productivity [4].

As stated by the researcher, the vast majority (60.83%) of respondents fall into the category of medium knowledge [5]. 13.33% of the respondents fell into the poor knowledge group, whereas 25% of them lie into high knowledge category. These practices include hand weeding, treating setts with carbendazim solution (0.1%), irrigating the crop frequently to control termite incidence, using chemicals to control the incidence of early shoot borer; reducing lower leaves to control scale incidence whereas deep tillage and choosing disease-free seed material to control red rot disease and set rot. Conversely, biological approaches like *Trichogramma* egg parasite have shown a lower level of acceptance [6]. Respondent's use of IPM approaches was positively correlated with their level of education, agricultural experience, risk and management orientations, innovativeness, and extension contact [7].

The high cost of fertilizer, late release of bank loans, high interest rates, and delayed transportation of harvested cane from the field by factories were some of the main barriers to the widespread adoption of sugarcane production. Hence, the timely and adequate supply of inputs like fertilizers, chemicals, and irrigation facilities at reasonable prices is essential to the adoption of better practices [8]. Therefore, the present study is relevant to increase knowledge about IPM methods among farmers in Western U.P. to learn the perception of respondents about attributes of integrated pest management practices and to scrutinize the knowledge of respondents about these practices.

## Material and Methods

Two districts (Saharanpur and Muzaffarnagar) were purposefully chosen among the 26 districts of Western Uttar Pradesh in 2018 based on production and productivity. Two community development blocks were chosen randomly from each district and from every community development block, four villages were selected at random. From each village, fifteen responders were chosen at random. From every selected community, a comprehensive list of all growers of sugarcane was prepared. 240 sugarcane producers in total were chosen from the list using a random sample method . Using a pre-tested interview schedule, the investigator himself gathered the data from the participants.

The change in the existing knowledge test was evaluated concerning IPM tactics. A discrete choice experiment survey was used to find out how much 240 sugarcane producers knew about IPM methods. A specific question was asked about each activity. 'The Knowledge Quotient scale was used to measure the knowledge level of responders [9]. Three-point scale *viz*., fully aware, partially aware, and not aware was used to rate the respondent's response to the question. The scores were 3, 2 and 1, respectively. In technical terms, processing means that the gathered data has been edited, coded, categorized, and tabulated so that it can be analyzed. In order to draw reliable conclusions, the data was processed and examined using the statistical program SYSTAT 12, which was designed at the time of the study plan.

## Results

### Knowledge level regarding cultural practices

The comprehensive data regarding farmer's acquaintance with cultural practices is displayed in . They were examined regarding their understanding of several cultural elements such as summer deep ploughing, appropriate spacing, ideal seed rate, clearance of previous leftovers of crops, crop rotation and mixed cropping. It was discovered that the majority of responders knew about summer deep plowing. Of the respondents in the entire sample, 46.25 per cent were fully aware of the summer deep ploughing, 40.42 per cent were slightly aware and 13.33 per cent were not. The majority of those surveyed knew only a little about appropriate spacing. Regarding the appropriate spacing in the sugarcane crop, 71.67 per cent of respondents were found to be slightly informed, 24.58 per cent to be fully aware, and 3.75 per cent to be completely unaware. Of the respondents, 69.17 per cent were only slightly aware of the optimum sugarcane seed rate, 27.08 per cent were fully knowledgeable, and 3.75 per cent were not. makes it clear that the majority of respondents, 60.83 per cent were only partially aware of the clearance of previous crop residues, followed by those who were totally aware (32.08 per cent ) and those who were unaware (7.08 per cent).

The majority of respondents 67.08 per cent were only slightly aware of the crop rotation in the sugarcane crop, 19.58 percent were fully knowledgeable, and 13.33 per cent were deemed to be unaware. The majority of responders had information about mixed cropping in sugarcane. Of the respondents in the entire sample, 60.00 per cent were said to be fully aware of the mixed cropping in sugarcane, 26.67 per cent to be slightly knowledgeable, and 13.33 per cent to be unaware.

### Knowledge level regarding mechanical practices

contains information about the mechanical procedures related to blind hoeing, pest monitoring, barriers like screens, sett treatments, avoiding planting sugarcane under or near trees, and cultivating Arhar surrounding the fields. Concerning blind hoeing procedures in the sugarcane crop, the majority of respondents, 67.75 per cent were reported to be slightly aware, 19.58 per cent to be fully aware and 16.67 percent to be completely unaware. The majority of those surveyed had no idea that pests were being monitored. Out of the entire survey size, 15.0 per cent of respondents were fully aware of pest monitoring, 19.58 per cent were just slightly aware and 65.42 per cent were not informed. The majority of respondents were unaware of the restrictions, including screens. Of the respondents in the entire sample, 67.50 per cent were unaware of the barriers, such as screens, in the sugarcane crop, whereas 16.67 per cent were totally knowledgeable and 15.83 per cent were slightly aware. explicitly demonstrated that the majority of respondents, 63.75 per cent were unaware of the sett treatments in sugarcane crops, 18.75 per cent were only slightly aware of them and 17.50 per cent were completely aware of them. The data revealed that irresistibly 67.92 per cent of the respondents were reported to be partially aware, 22.50 per cent fully aware and 9.58 percent were not at all aware of the fact should refrain from growing sugarcane crops next to or beneath trees. It is clear that the majority of responders were unaware of the arhar's growth surrounding the crops. Of the respondents in the entire sample, 63.75 per cent were not aware, 18.75 per cent were aware and 17.50 percent were fully aware of the arhar growing around the sugarcane production fields.

### Knowledge level regarding biological practices

Comprehensive information about farmer's expertise with biological approaches such as the usage of biopesticides, neem-based products, biofertilizers, natural enemies, resistant cultivars, and microbial control had shown in . Regarding the usage of biopesticides in sugarcane crops, the majority of respondents 57.92 percent were found to be moderately aware of the practice, followed by those who were not (22.08 per cent) and those who were aware (20.00 per cent). However, the majority of responders only had a partial understanding of how to utilize the neem-based product. 51.67, 25.42, and 22.91 per cent of the sample as a whole were partially, completely or not aware of the usage of the Neem-based product in the sugarcane crop. It is clear that the majority of respondents knew only a little bit about the application of biofertilizers to sugarcane. Of the entire sample size, 53.75 per cent knew something about the use of bio-fertilizers in sugarcane crops, 24.58 per cent did not and 21.67 per cent knew everything. Regarding natural enemies, the majority of respondents 51.67 per cent were found to be moderately aware of their use in sugarcane crops, while 24.58 per cent were not aware of it and 23.75 per cent were fully knowledgeable. The majority of responders knew only a little bit about the resistant varieties.

Majority 51.25 per cent were partially aware, 24.58 per cent not aware, and the remaining 24.17 per cent were aware of the resistant varieties of the sugarcane crop. In regard of use of microbial control in sugarcane, maximum number of the respondents were not aware at all. The percentage of respondents who were not aware, slightly aware, and completely aware of the use of microbial control in sugarcane crops was 57.92, 27.08, and 15.00 per cent of the total sample size.

**Knowledge level regarding chemical practices**

The data related to the amount of knowledge in context to chemical practices namely, seed treatment, use of balanced fertilizer in sugarcane, use of pesticides against different pests in sugarcane, recommended doses of pesticides, pesticides application in sugarcane and soil treatments has been conferred in The majority of responders knew only a little bit about the sugarcane crop's seed treatment. The majority 55.42 per cent were partially aware, 26.25 per cent were not aware and 18.33 per cent were fully aware of the seed treatment in the sugarcane crop. It is evident that 64.58, 22.08, and 13.33 per cent of the respondents were slightly aware, not aware, and completely aware of the use of balanced fertilizers, respectively. makes it abundantly evident that the majority of respondents only had a partial understanding of how pesticides were used to combat various pests in sugarcane. The percentage of respondents who were partially, not aware, and fully aware of the usage of pesticides against various pests in sugarcane crops was 69.17, 19.58, and 11.25 percent of the overall sample size. The vast majority of those surveyed, 70.83 per cent were only partially aware of the recommended pesticide dosages for sugarcane crops, 22.50 per cent were unaware and 6.67 per cent were fully knowledgeable. The majority of respondents knew only a little bit about the use of pesticides on sugarcane crops. Of the respondents, 63.33, 27.08, and 9.58 per cent of the total sample size were slightly, not aware, and completely aware of the use of pesticides in sugarcane crops, respectively. Ten percent of respondents were fully aware of soil treatments in sugarcane, compared to 64.17 per cent who were just slightly knowledgeable, and 25.83 per cent who were not.

## Discussion

The goal of the IPM method is to reduce the amount of pesticide load in the environment by utilizing all possible control measure techniques to contain and combat pest infestation [10]. An ecological method of managing pests, integrated pest management (IPM) combines cultural, mechanical, biological, and chemical approaches to reduce hazards to the environment, economy, and public health. Furthermore, it is a dynamic process and approach that differs from one place to another, periodically, crop to crop, pest to pest, etc. [11]. It is not only a pest control method that excludes the use of chemicals or biological control but is based on optimization rather than maximizing the use of chemical pesticides [12]. In order to prevent harmful effects on the environment, human health, and beneficial insects, IPM techniques are advised to reduce the usage of dangerous chemicals [13].

The majority of respondents were well knowledgeable about the cultural approach of IPM

which ranked 1$^{st}$ followed by the mechanical method ranked as 2$^{nd}$, the biological method as 3$^{rd,}$ and the chemical method was ranked as 4$^{th}$ in a row. Several scientists also found variations in the knowledge level of respondents regarding the use of bio-control agents [14], [15], [16].

The findings showed that, among the IPM techniques, the majority of farmers in the study region possessed knowledge of cultural approaches. The results are in broad conformity with some of the investigators [17], [18], [15], [19]. Regarding IPM procedures, there is a significant disconnect between acceptance and knowledge. Therefore, it can be said that they also need to be made aware of the other IPM procedures. The findings also revealed that most respondents were ignorant of the biological and chemical approaches, so there is a definite need to establish an information centre at the Panchayat level which will be helpful for the rural farmers to gain more knowledge about the other IPM practices. Some farmers use pesticides in accordance with the norms and regulations, however, others do not because of ignorance. Since most farmers are unable to administer pesticides owing to various limitations, it is necessary to train them in many areas. This strategy will certainly contribute to increase the knowledge level of integrated pest management among all the farmers.

The outcomes clearly displayed that the farmers in Western Uttar Pradesh had a basic understanding of IPM but still, there is a knowledge gap as they are not fully aware of all the IPM methods. There are certain health and environmental hazards associated with the utilization of chemical pesticides, highlighting the need to shift towards sustainable strategies.

**Educational Advantage:** Initiating the IPM-focused training programmes can increase knowledge, and understanding and promote adoption. In addition to that, practical demonstrations could be more effective [20].

**Economic Support:** Providing financial support to the farmers where input costs can be reduced and outcomes could be more effective and focused to achieve [21].

**Reinforcing Extension Assistance:** Upsurging the range and efficacy of agricultural extension services can aid in the transfer of knowledge and rise community involvement [22].

**Civic engagement:** Goal of IPM can be successfully achieved by motivating the farmers to share their experiences and best practices through local organizations [23].

## Conclusion

The following conclusion has been made in light of the research findings: The majority of those surveyed were in the middle age range, belonged to the OBC category, had education up to Primary school to post-graduation level, land holding size 2-3 ha, associated with the nuclear family and most of them had a membership of two organizations but the maximum number of respondents were unaware about the IPM practices. Lack of access to bio-agents, bio-pesticides, traps, deficiency of availability of IPM recommended pesticides in the market and IPM recommended knowledge not communicated in the understandable form. The results depicted that in the selected area, there was a major lack of education, therefore, it is necessary to raise the level of education, and extension personnel should take the responsibility to make them aware. To achieve the goal of IPM, execution strategies like extension-related training and workshops; surveys and interviews; association with agricultural universities, KVKs, and NGOs; preparation of informative materials *viz*., brochures, posters, online content; promote successful stories; exploiting technology; engage policymakers; assessment and evaluation could be proven effective.

**Future Scope of the Study:** Further studies should determine the long-term impact of IPM adoption on crop productivity, pest resilience, environmental sustainability, and the economic security of growers.

**Conflicts of interest:** The authors declare no conflict of interest.

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**State -** Uttar Pradesh

**Zone** Western Plain Zone

**Districts–**
(Two districts were selected from Western Plain Zone) Saharanpur, Muzaffarnagar

**Blocks –**
(Randomly selected 2 blocks from Each district) Nakur, Ballia Kheri, Jansath, Charthawal

**Villages –**
(Randomly selected 4 villages From each block) Vill. Vill. Vill. Vill. | Vill. Vill. Vill. Vill. | Vill. Vill. Vill. Vill. | Vill. Vill. Vill. Vill.

**Respondents -**
(Randomly Selected 15 respondents from each village) 15 15 15 15 | 15 15 15 15 | 15 15 15 15 | 15 15 15 15

**Total Respondents- 240** 240 240

***Sampling procedure for selection of respondents for present study.***

***Knowledge level of respondents regarding cultural methods.***

| S. No. | Statements | Fully aware | | Partially aware | | Not aware | |
|---|---|---|---|---|---|---|---|
| | | R | P | R | P | R | P |
| 1. | Are you aware of the deep ploughing that occurs in sugarcane during the summer? | 111 | 46.25 | 97 | 40.42 | 32 | 13.33 |
| 2. | Are you aware of the ideal planting distance for both early and late sugarcane crop sowing? | 59 | 24.58 | 172 | 71.67 | 9 | 3.75 |
| 3. | Are you aware of the ideal sugarcane seed rate? | 65 | 27.08 | 166 | 69.17 | 9 | 3.75 |
| 4. | Are you aware of how sugarcane gets rid of leftover crop residue? | 77 | 32.08 | 146 | 60.83 | 17 | 7.08 |
| 5. | Do you know about the crop rotation in sugarcane? | 47 | 19.58 | 161 | 67.08 | 32 | 13.33 |
| 6. | Do you know about the advantage of intercropping in sugarcane? | 144 | 60.00 | 64 | 26.67 | 32 | 13.33 |

*R= Respondents, P= Percentage*

***Table 2. Knowledge level of respondents regarding mechanical methods.***

| S. No. | Statements | Fully aware | | Partially aware | | Not aware | |
|---|---|---|---|---|---|---|---|
| | | R | P | R | P | R | P |
| 1. | Do you know about the blind hoeing in sugarcane? | 47 | 19.58 | 153 | 63.75 | 40 | 16.67 |
| 2. | Do you know about pest monitoring? | 36 | 15.00 | 47 | 19.58 | 157 | 65.42 |
| 3. | Are you aware of the screens and other barriers that keep insects and birds out? | 40 | 16.67 | 38 | 15.83 | 162 | 67.50 |
| 4. | Do you know that RSD and GSD can be controlled in sugarcane by treating it with moist hot air at 54 °C for two to three hours? | 42 | 17.50 | 45 | 18.75 | 153 | 63.75 |
| 5. | Are you aware of the ways to prevent sugarcane from being planted beneath and near trees? | 54 | 22.50 | 163 | 67.92 | 23 | 9.58 |
| 6. | Are you aware that arhar is being grown around sugarcane fields to ward against attacks by root borer? | 42 | 17.50 | 45 | 18.75 | 153 | 63.75 |

*R= Respondents, P= Percentage*

***Table 3. Knowledge level of respondents regarding biological methods.***

| S. No. | Statements | Fully aware | | Partially aware | | Not aware | |
|---|---|---|---|---|---|---|---|
| | | R | P | R | P | R | P |
| 1. | Are you aware that sugarcane is being treated with bio-pesticides? | 48 | 20.00 | 139 | 57.92 | 53 | 22.08 |
| 2. | Are you aware of the use of products derived from neem in sugarcane? | 55 | 22.91 | 124 | 51.67 | 61 | 25.42 |
| 3. | Are you aware of the application of biofertilizers on sugarcane? | 52 | 21.67 | 129 | 53.75 | 59 | 24.58 |
| 4. | Are you aware of the application of natural enemies? | 57 | 23.75 | 124 | 51.67 | 59 | 24.58 |
| 5. | Do you know about the resistant varieties of sugarcane? | 58 | 24.17 | 123 | 51.25 | 59 | 24.58 |
| 6. | Do you know about the use of microbial control in sugarcane? | 36 | 15.00 | 65 | 27.08 | 139 | 57.92 |

*R= Respondents, P= Percentage*

***Table 4. Knowledge level of respondents regarding chemical methods.***

| S. No. | Statements | Fully aware | | Partially aware | | Not aware | |
|---|---|---|---|---|---|---|---|
| | | R | P | R | P | R | P |
| 1. | Do you know about the seed treatment in sugarcane? | 44 | 18.33 | 133 | 55.42 | 63 | 26.25 |
| 2. | Are you aware of the application of balanced fertilizer to sugarcane? | 32 | 13.33 | 155 | 64.58 | 53 | 22.08 |
| 3. | Are you aware of the names of the insecticides used to combat certain sugarcane pests? | 27 | 11.25 | 166 | 69.17 | 47 | 19.58 |
| 4. | Do you know how much pesticide is suggested for sugarcane to combat various pests? | 16 | 6.67 | 170 | 70.83 | 54 | 22.50 |
| 5. | Are you aware of how pesticides are used to combat various pests in sugarcane? | 23 | 9.58 | 152 | 63.33 | 65 | 27.08 |
| 6. | Do you know about the soil treatment against soil-borne insects and pathogens in sugarcane? | 24 | 10.00 | 154 | 64.17 | 62 | 25.83 |

*R= Respondents, P= Percentage*

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