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Adoption of integrated pest management practices by the farmers in rice cultivation: A case study of the Chhattisgarh plains

[1]Mahesh Kumar and [2]Dr. PK Sangode

[1]Ph.D. Scholar, Department of Agricultural Extension Education, COA, IGKV, Raipur, Chhattisgarh, India

[2]Professor, Department of Agricultural Extension Education, COA, IGKV, Raipur, Chhattisgarh, India

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Corresponding Author: Mahesh Kumar

Abstract

This study (2023-24) assessed IPM adoption among 320 rice farmers in the Chhattisgarh Plains. Deep summer ploughing (53.44%) was the most adopted cultural practice, while the coir rope method (59.06%) led in mechanical practices. Biological adoption was low, with only 5.00% using dragonflies. Chemical practices showed higher adoption, with 63.44 per cent using Chlorpyriphos 50% + Cypermethrin 5% EC for pest control and (69.38%) adopting Pendimethalin 30% EC for weeds. Carbendazim 50% WP was used by (43.13%) for seed treatment. Overall, 80.63 per cent of respondents exhibited a medium level of IPM adoption, highlighting the need for enhanced awareness and implementation.

Keywords: Integrated pest management (IPM), rice cultivation, IPM adoption

Introduction

Rice cultivation is a cornerstone of food security and livelihoods in the Chhattisgarh Plains. However, traditional pest management practices have raised concerns regarding sustainability, environmental harm, and health risks. Integrated Pest Management (IPM) offers a sustainable alternative by integrating biological, cultural, mechanical, and chemical methods for pest control. Despite its benefits, the adoption of IPM practices among rice farmers in the region remains inconsistent due to various constraints. This study evaluates the extent of IPM adoption, identifies barriers faced by farmers, and explores their awareness and practices. By addressing key challenges and providing actionable recommendations, the research aims to promote sustainable rice cultivation, enhance farmer well-being, and safeguard environmental health.

Results and Discussion

1. Extent of adoption of cultural practices

The data were also collected from the respondents on the extent of adoption of different cultural practices and the results of the study regarding this are presented under the following headings: Table 1. illustrates the extent of adoption of IPM cultural practices among the respondents. Complete Level of adopted the practice of deep summer ploughing had adopted by (53.44%) of the respondents. Field cleaning was adopted by 34.69 per cent while improved varieties for controlling insect pests were adopted by 4.06 per cent Seed treatment for plant protection was practiced by 27.81 per cent of respondents and trimming of bunds by 32.50 per cent Timely sowing had the highest adoption rate at 64.06 per cent Timely transplanting was practiced by 41.88 per cent of respondents. Water management practices were adopted by 26.25 per cent and cultural operation (Biasi) by 30.31 per cent Proper plant spacing (PP X RR) was practiced by 10.00 per cent of the respondents, while crop rotation was adopted by 23.13 per cent Finally, Interculture operations and weeding were practiced by 45.94 per cent of respondents.

Table 1: Distribution of the respondents according to their extent of adoption about IPM cultural practices

Sl. No	Cultural practices	Adoption					
		Complete		Partial		Nil	
		F	%	F	%	F	%
1.	Deep summer ploughing	171	53.44	51	15.94	98	30.63
2.	Adoption about field cleaning	111	34.69	32	10.00	177	55.31
3.	Adoption towards improved varieties to control of insect-pest	13	4.06	28	8.75	279	87.19
4.	Seed treatment for plant protection	89	27.81	67	20.94	164	51.25
5.	Trimming of bunds	104	32.50	21	6.56	195	60.94
6.	Timely sowing	205	64.06	13	4.06	102	31.88
7.	Timely transplanting	134	41.88	8	2.50	178	55.63
8.	Water management	84	26.25	11	3.44	225	70.31
9.	Cultural operation (Biasi)	97	30.31	20	6.25	203	63.44
10.	Plant spacing (PP X RR)	32	10.00	6	1.88	282	88.13
11.	Crop rotation	74	23.13	27	8.44	219	68.44
12.	Interculture operations / weeding	147	45.94	35	10.94	138	43.13

*Data are based on multiple responses

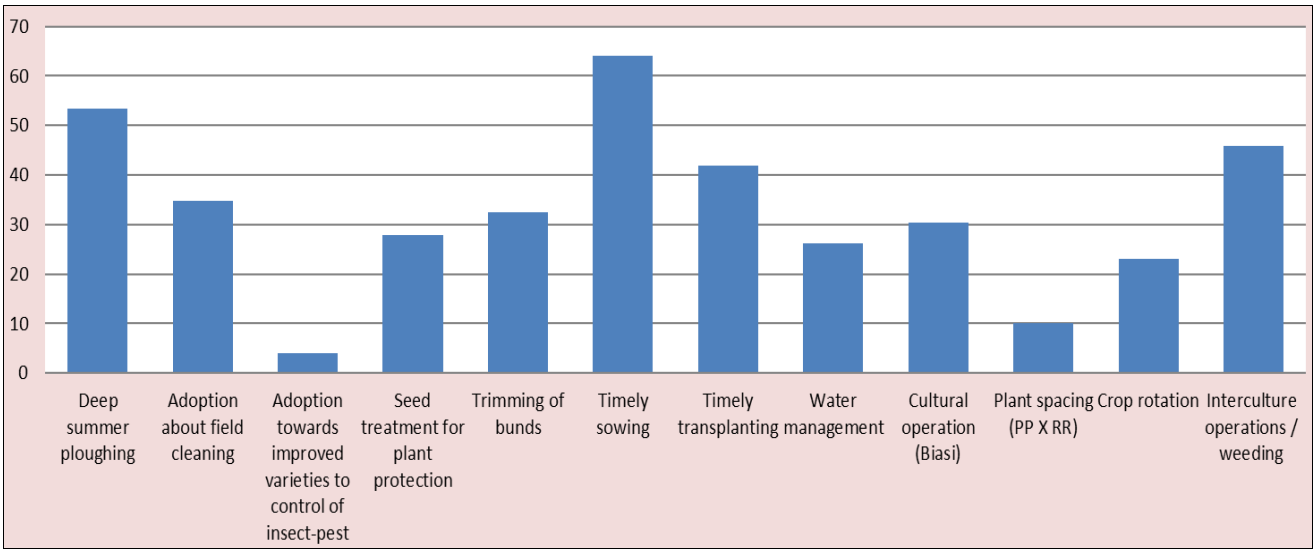

Fig 1: Distribution of the respondents according to their extent of adoption about IPM cultural practices

In case of partial level of adopted by respondents. The most widely adopted practice is seed treatment for plant protection, with (20.94%) of respondents implementing it. Deep summer ploughing follows with a 15.94 per cent adoption rate. Adoption of field cleaning and Interculture operations/weeding stands at 10.00 per cent and 10.94 per cent respectively. Improved varieties for insect-pest control are adopted by 8.75 per cent of respondents, while crop rotation has an adoption rate of 8.44 per cent trimming of bunds, cultural operation (Biasi), and timely sowing are less commonly adopted, with rates of 6.56 per cent 6.25 per cent and 4.06 per cent respectively. Timely transplanting and water management are the least adopted practices, with 2.50 per cent and 3.44 per cent adoption rates, respectively. Plant spacing (PP X RR) shows the lowest adoption at 1.88 per cent

These figures indicated a varied level of adoption across different IPM cultural practices, highlighting areas where adoption is relatively low and may require additional promotion or support.

2. Extent of adoption of manual/mechanical practices

Table 2 presents the extent of adoption of complete adopted various IPM mechanical practices. The most widely adopted practice is the coir rope method, implemented by (59.06%) of respondents it. This is followed by the removal and destruction of insect-pest-infested plant parts, adopted by 53.75 per cent of respondents. Destroying insects by hand is practiced by 25.31 per cent of respondents. Adoption rates for trapping methods are relatively low, with only 2.50 per cent using nets, 5.94 per cent using light traps, 0.94 per cent using sticky traps, and a minimal 0.31 per cent employing pheromone traps.

Table 2: Distribution of the respondents according to their extent of adoption about IPM mechanical practices

Sl. No	Mechanical practices	Adoption					
		Complete		Partial		Nil	
		F	%	F	%	F	%
1.	Use of coir rope method	189	59.06	69	21.56	62	19.38
2.	Destroyed insects by hand	81	25.31	64	20.00	175	54.69
3.	Removal and destruction of insect pest infested plant parts	172	53.75	94	29.38	54	16.88
4.	Collection of egg masses and larvae and their placement in bamboo cage	0	0.00	0	0.00	320	100.00
5.	Trapping of pests by net	8	2.50	89	27.81	223	69.69
6.	Light trap	19	5.94	62	19.38	239	74.69
7.	Sticky trap	3	0.94	14	4.38	303	94.69
8.	Pheromone trap	1	0.31	3	0.94	316	98.75

*Data are based on multiple responses

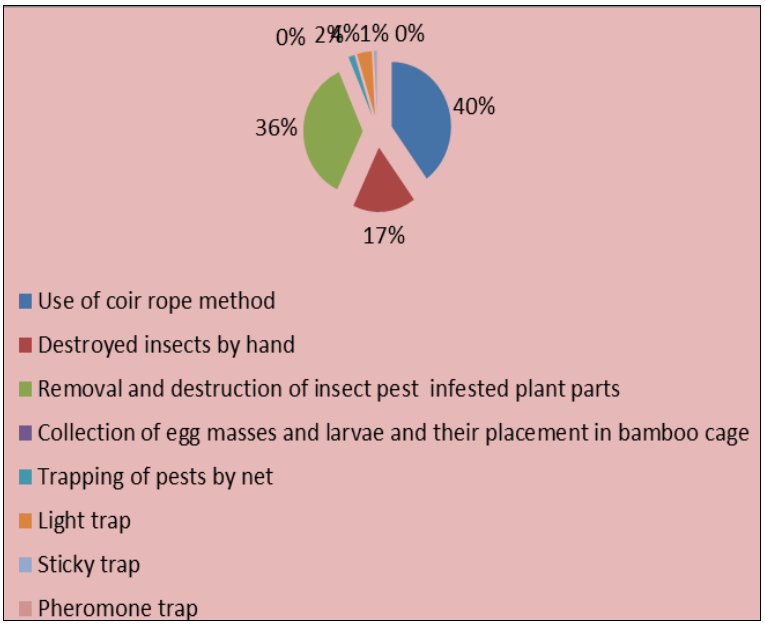

Fig 2: Distribution of the respondents according to their extent of adoption about IPM mechanical practices

In case of partial level of adopted by respondents the removal and destruction of insect pest-infested plant parts is the most widely adopted practice, with (29.38%) of respondents implementing it. Trapping of pests by net follows closely, with 27.81 per cent adoption. The use of the coir rope method and destruction of insects by hand are also notably practiced, with 21.56 per cent and 20.00 per cent adoption rates, respectively. Light traps are used by 19.38 per cent of respondents. Adoption rates for sticky traps and pheromone traps are much lower, with only 4.38 per cent and 0.94 per cent of respondents using them, respectively.

Remarkably, none of the respondents have adopted the practice of collecting egg masses and larvae and placing them in a bamboo cage. These results indicate a varied adoption of mechanical practices, with some methods being more commonly used than others.

3. Extent of adoption of biological practices

Table 3 presents the extent of adoption of various IPM biological practices among respondents. Complete level of adoption the most adopted practice is the use of dragonflies, with (5.00%) of respondents implementing this method to control harmful insects. Conservation of natural enemies, such as spiders, is also relatively adopted, with 4.38 per cent of respondents practicing it to manage green leaf hoppers and caterpillars. The adoption rates for other biological practices are notably lower: parasitoids (Trichogramma) are adopted by only 1.25 per cent of respondents, predators (ladybird beetles) by 0.94 per cent and Bacillus thuringiensis by 0.63 per cent and Beauveria bassiana by 0.94 per cent

Table 3: Distribution of the respondents according to their extent of adoption about IPM biological practices

Sl. No	Biological practices	Bio insect name	Against insect	Adoption					
				Complete		Partial		Nil	
				F	%	F	%	F	%
1.	Parasitoids (*Trichogramma*)	T. Chilonis @1 lakh/ ha. Egg masses	Stem borer, Leaf folder	4	1.25	3	0.94	313	97.81
2.	Predators (Lady bird beetle)		Brown plant hopper, Green leaf hoppers	3	0.94	2	0.63	315	98.44
3.	*Bacillus thuringiensis*	Bactospeine ver. kursktaki	Leaf folder	2	0.63	2	0.63	316	98.75
4.	*Beauveria bassiana*	Deltamethr in 2% WP	Leaf folder	3	0.94	5	1.56	312	97.50
5.	Conservation natural enemies like Spiders		Green leaf hopper, Caterpillars	14	4.38	12	3.75	294	91.88
6.	Dragonfly		Harmful insects	16	5.00	18	5.63	286	89.38

*Data are based on multiple responses

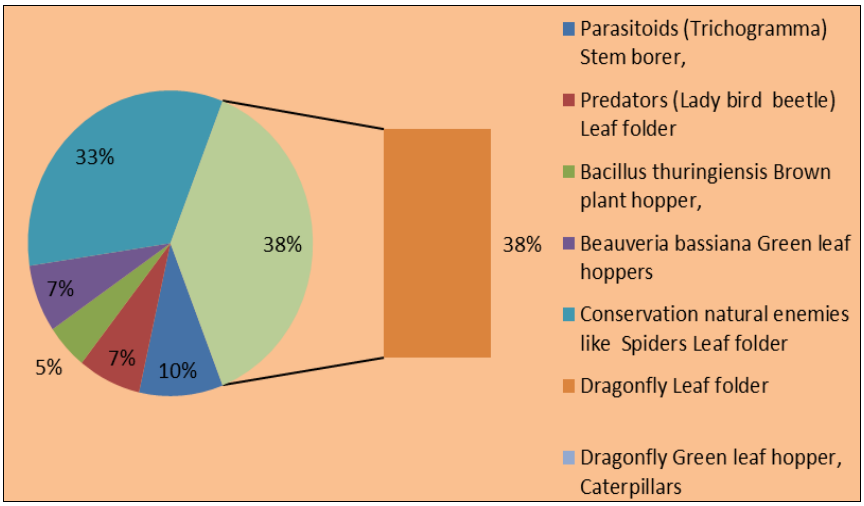

Fig 3: Distribution of the respondents according to their extent of adoption about IPM biological practices

In case of partial level of adopted by respondents among these, the use of dragonflies is the most widely adopted, with (5.63%) of respondents employing them to manage harmful insects. Conservation of natural enemies, such as spiders, follows with 3.75 per cent adoption, targeting green leaf hoppers and caterpillars. *Beauveria bassiana*, used against leaf folders, is adopted by 1.56 per cent of respondents. In contrast, parasitoids *(Trichogramma) and Bacillus thuringiensis* each have a very low adoption rate of 0.94 per cent and 0.63 per cent respectively. Similarly, predators like ladybird beetles have a minimal adoption rate of 0.63 per cent

These figures suggest that although some biological practices are acknowledged and utilized their overall adoption remains relatively low compared to other pest management strategies.

4. Extent of adoption of chemical practices

Table 4 details the extent of adoption of IPM chemical practices for pest control. Complete level of adoption the majority of respondents were insecticides Chlorpyriphos 50% + Cypermethrin 5% EC is the most widely adopted chemical practice, with (63.44%) of respondents utilizing it against gall midge, stem borer, and leaf folder. This is followed by Profenophos 40% EC + Cypermethrin 4% EC, with a 53.44 per cent adoption rate, targeting leaf folders and pencil mites. Bifenthrin 10% WP and Imidacloprid 17.8% SL are also commonly used, with adoption rates of 31.88 per cent and 30.63 per cent respectively. Other chemicals such as Acephate 75% SP and Cartap hydrochloride 50% SP have lower adoption rates of 29.38 per cent and 23.44 per cent respectively. Deltamethrin 02.50% WP and Fipronil 05% SC have the lowest adoption rates at 19.06 per cent and 10.00 per cent respectively.

Table 4: Distribution of the respondents according to their extent of adoption about IPM Chemical practices

Sl. No	Categories	Trade name	Against insect	Adoption					
				Complete		Partial		Nil	
				F	%	F	%	F	%
I. Insecticides									
1.	Chlorpyriphos 50% + Cypermethrin 5% EC	505 Trysil Boss 505	Gall midge, Stem borer, Leaf folder	203	63.44	21	6.56	96	30.00
2.	Bifenthrin 10% WP	Talstar	Stem borer, Leaf folder, Green leaf hopper	102	31.88	46	14.38	172	53.75
3.	Profenophos 40% EC + Cypermethrin 4% EC	Rocket	Leaf folder, Penicle mite	171	53.44	42	13.13	107	33.44
4.	Imidacloprid 17.8% SL	Kohinor, Admire	Brown plant hopper	98	30.63	24	7.50	198	61.88
5.	Cartap hydrochloride 50% SP		Stem borer, Leaf folder	75	23.44	17	5.31	228	71.25
6.	Deltamethrin 02.50% WP	Savier	Aphids, Thrips, Mites,	61	19.06	12	3.75	247	77.19
7.	Acephate 75% SP	Kitron	Stem borer, Brown plant hoppers, Green leaf hopper	94	29.38	39	12.19	187	58.44
8.	Fipronil 05% SC	Fax SC	Stem borer, Brown plant hopper, Green leaf hopper, Rice leafhopper, Rice Gall midge,	32	10.00	10	3.13	278	86.88
II. Herbicides									
1.	Pendimethalin 30% EC	Stomp, Dhanutop	*Echinochloa colonum, Eclipta alba, Cyperus difformis*	222	69.38	13	4.06	85	26.56
2.	Bispyribac sodium 10% SC	Nominee gold	*Cyperus difformis, Cyperus iria*	84	26.25	24	7.50	212	66.25
3.	Pretilachlore 50% EC	Preagle plus	*Cyperus difformis*	91	28.44	37	11.56	192	60.00
4.	Butachlore 50% EC	Hunter	*Echinochloa colonum, Eleusine indica, Eclipta alba, Fimbristylis miliacea,*	102	31.88	12	3.75	206	64.38
5.	Anilofos 30% EC	Anilogaurd	*Echinochloa colonum, Cyperus difformis, Eclipta alba*	92	28.75	28	8.75	200	62.50

6.	Anilofos 24% +2,4-D ethyl Ester 32% EC	Weedmar, super	Broad leaf weeds	83	25.94	35	10.94	202	63.13
7.	Quinclorac 250g/l SC	Rice star	*Echinochloa spp.* (Barnyard grass),	62	19.38	23	7.19	235	73.44
	Chemical practices	Trade name	Against weeds						
III. Seed treatment chemical fungicide									
1.	Carbendazim /fungicide 50% WP	Dhanustin	Blast, Sheath blight, Brown spot	138	43.13	24	7.50	158	49.38
2.	Pseudomonas fluorescens 0.5% WP	Pseudocare	Bacterial leaf blight, Blast	51	15.94	6	1.88	263	82.19

*Data are based on multiple responses
* EC = Al + solvent + emulsifier = EC
* WP = carrier + wetting agent = WP (wettable powder)
* SC = soluble concentrate / powder
* SL = soluble concentrate / powder

In case of partial level of adopted by respondents. The most adopted chemical is Chlorpyriphos 50% + Cypermethrin 5% EC, used by (63.44%) of respondents to control gall midge, stem borer, and leaf folder. This is followed by Profenophos 40% EC + Cypermethrin 4% EC, adopted by 53.44 per cent for leaf folders and pencil mites. Bifenthrin 10% WP is used by 31.88 per cent of respondents for controlling stem borer, leaf folder, and green leaf hopper. Imidacloprid 17.8% SL has a 30.63 per cent adoption rate, primarily for brown plant hopper. Other chemicals include Acephate 75% SP, with 29.38 per cent adoption, and Cartap hydrochloride 50% SP, with 23.44 per cent Deltamethrin 02.50 per cent WP and Fipronil 05% SC have lower adoption rates, at 19.06 per cent and 10.00 per cent respectively.

Weeds control presents the study extent of adoption of various IPM herbicide practices for weed management. There was a complete level of adoption in the majority of respondents, were herbicides Pendimethalin 30% EC is the most widely adopted herbicide, with (69.38%) of respondents using it to control *Echinochloa colonum*, *Eclipta Alba*, and *Cyperus difformis*. Butachlore 50% EC follows, adopted by 31.88 per cent of respondents for managing a range of weeds including *Echinochloa colonum* and *Eleusine indica*. Pretilachlore 50% EC and Anilofos 30% EC are also popular, with adoption rates of 28.44 per cent and 28.75 per cent respectively. Anilofos 24% + 2,4-D ethyl Ester 32% EC is used by 25.94 per cent for broadleaf weeds, while Bispyribac sodium 10% SC and Quinclorac 250g/l SC have adoption rates of 26.25 per cent and 19.38 per cent respectively.

In case of weeds, the respondents adopted only a partial level of control shows that Pretilachlore 50% EC is the most widely adopted herbicide, with (11.56%) of the respondents using it to control *Cyperus difformis*. This is followed by Anilofos 24% + 2,4-D ethyl Ester 32% EC, adopted by 10.94 per cent of the farmers for controlling broadleaf weeds. Anilofos 30% EC is used by 8.75 per cent of respondents to manage *Echinochloa colonum*, *Cyperus difformis*, and *Eclipta alba*. Bispyribac sodium 10% SC is adopted by 7.50 per cent of the farmers for controlling *Cyperus difformis* and *Cyperus iria*, while Quinclorac 250g/l SC is used by 7.19 per cent of respondents against Echinochloa spp. (Barnyard grass). Pendimethalin 30 per cent EC, targeting Echinochloa colonum, Eclipta alba, and Cyperus difformis, is adopted by 4.06 per cent of the farmers.Butachlore 50% EC, which controls Echinochloa colonum, *Eleusine indica*, Eclipta alba, and *Fimbristylis miliacea*, has an adoption rate of 3.75 per cent.

The extent of adoption of various seed treatment chemical fungicides in Integrated Pest Management practices (IPM) practices. Complete level of adopted majority of respondents Carbendazim 50% WP, used to manage Blast, Sheath blight, and Brown spot, is adopted by (43.13%) of the respondents followed by Pseudomonas fluorescens 0.5% WP, which targets Bacterial leaf blight and Blast, is used 15.94 per cent Of the respondents.

In case of partial adopted Carbendazim 50% WP, which is used to combination Blast, Sheath blight, and Brown spot, is adopted by (7.50%) of the respondents, while, Pseudomonas fluorescens 0.5% WP, effective against Bacterial leaf blight and Blast, is utilized by 1.88 per cent of the respondents,

5. Overall extent of adoption about integrated pest management practices by the rice growers

Table 5: Distribution of respondents according to their overall adoption regarding various insect pest management practices in rice crop (n=320)

Sl. No.	Categories	Frequency	Percentage
1.	Low (Up to 34 score)	35	10.94
2.	Medium (35 to 51 Score)	258	80.63
3.	High (Above 51 score)	27	8.44

The data given in the Table 5 expressed that majority of the 80.63 per cent respondents had medium level of adoption of IPM practices who for controlling various insect pests in rice crop, followed by 10.94 per cent of the respondents had low level of adoption 8.44 per cent of the respondents had high level of adoption of insect pest management practices to control the different insect pest of paddy crop.

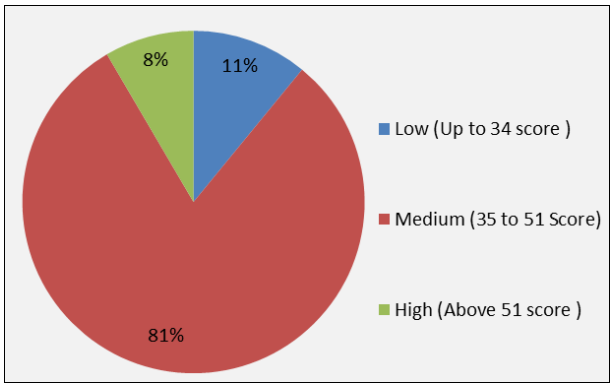

Fig 4: Distribution of respondents according to their overall adoption regarding various insect pest management practices in rice crop

Conclusion

The study assessed the adoption of Integrated Pest Management (IPM) practices among respondents. Deep summer ploughing was adopted by 53.44% of respondents, while the coir rope method was the most widely adopted mechanical practice (59.06%). Among biological practices, only 5.00% used dragonflies for insect control. Chemical practices showed higher adoption, with 63.44% of respondents using Chlorpyriphos 50% + Cypermethrin 5% EC against pests like gall midge and stem borer, and 69.38% adopting Pendimethalin 30% EC for weed control. For seed treatment, Carbendazim 50% WP was adopted by 43.13% to manage diseases like Blast and Sheath Blight. Overall, 80.63% of respondents exhibited a medium level of adoption of IPM practices, indicating room for further enhancement.

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