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Effectiveness and Adoption of IRAC Group 30 Insecticide Molecules in Chilli Cultivation

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ABSTRACT

The introduction of IRAC Group 30 insecticides, which act as GABA-gated chloride channel allosteric modulators, represents a significant advancement in pest management due to their novel mode of action and prolonged residual activity. These insecticides, including meta-diamides and isooxazolines, have gained importance in controlling insect and mite pests in high-value crops such as chilli. However, their increased use may impose selection pressure on pest populations, making it essential to understand both their effectiveness and adoption patterns at the farm level. In this context, the present study was undertaken to analyse the effectiveness of Group 30 pesticide molecules on chilli crop and to identify the factors influencing their adoption by chilli farmers in Guntur district of Andhra Pradesh. The study was conducted in two major chilli-growing mandals, Prathipadu and Medikonduru, where four villages were selected based on maximum chilli acreage. A total sample of 120 chilli farmers was selected through random sampling. Primary data were collected through personal interviews using a structured interview schedule. The study examined farmer's opinions, perceived effectiveness of Group 30 pesticides in terms of pest control, yield improvement, cost, application rate, potency and risk factors, as well as economic, social and technical factors influencing adoption. Analytical tools such as Likert's five-point scale and Garrett's ranking technique were employed to quantify perceptions and prioritize influencing factors. The results revealed that all sampled farmers were aware of and had adopted Group 30 pesticide molecules. Most farmers perceived these insecticides as effective in controlling pests and improving crop yield and overall crop health. Input dealers played a crucial role as information sources influencing pesticide choice and usage. Despite generally positive perceptions, concerns related to cost, safety, environmental impact and market competition were also reported. The study concludes that while Group 30 insecticides are widely accepted and beneficial for chilli cultivation, continuous farmer training, technical guidance and supportive extension services are essential to ensure their safe, effective and sustainable use.

Keywords: Agriculture, Cilli, Insecticide, Potency,Vegetable.

INTRODUCTION

Group 30 insecticides were first used in agriculture in 2018 as GABA-gated chloride channel allosteric modulators. They played an important role in controlling insect and mite pests in agricultural and horticultural markets. IRAC Group 30 is a new mode of action group, acting on the insect nervous system, that allosterically inhibits the GABA-activated chloride channel, causing hyper-excitation and convulsions. GABA is the major inhibitory neurotransmitter in insects. This group is represented by Meta-diamides and Isooxazolines. Three insecticidal compounds are currently classified within this group: Broflanilide (meta-diamide), Levamfetamine and Isocycloseram (isooxazolines). However, registration status differs between compounds and depending on region not all of them are available to all end users. 30 GABA-gated chloride channel allosteric modulators Nerve & muscle action Broflanilide, Fluxametamide and Isocycloseram. Insecticides which are considered GABA-gated chloride channel allosteric modulators and are classified into Group 30 of the IRAC Mode of Action Classification are a new class of insecticide chemistry, with first registrations in agriculture made during 2018. Multiple Group 30 products are commercially available or under development.

Group 30 insecticides are highly effective and can provide long residual activity depending on

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method of application and rate used. While these characteristics are desirable, without proper management, they have the potential to impose 3 significant selection pressure on a target pest population (Sumayya *et al*, 2023; Sumiya *et al,* 2024). This can decrease the susceptibility of selected pest populations in a relatively short period of time (Singh *et al*, 2019; Kaur *et al,* 2016). In view of this backdrop, the present area of study on Group 30 pesticides molecules is significant in Guntur district study area as it is predominant in chilli crop cultivation and also in usage of Group 30 pesticides (Rajamanickam, 2020). Thus, the study was undertaken to analyse the effectiveness of Group 30 pesticides molecules on chilli crop and to study the factors influencing the adoption of Group 30 pesticides molecules by the chilli crop farmers.

MATERIALS AND METHODS

Guntur district in Andhra Pradesh was chosen purposively for the current study as the district is known for its largest chilli crop production in the state and significant use of pesticides on chilli crop. Two mandals in the district (Prathipadu and Medikonduru) with the largest acreage in chilli crop were selected for the study. From the selected mandals, four villages with the largest chilli acreage were identified. The top two villages from each mandal were selected: Paladugu and Korrapadu from Medikonduru mandal and Yanamadala and Gottipadu from Prathipadu mandal, thus making a total of four villages. Chilli farmers from the selected villages were listed and 30 farmers from each village were randomly chosen for the survey resulting in a total sample size of 120 farmers. The primary data collection involved direct interactions with farmers to gather first-hand information. This was done using an interview schedule, which is a set of pre-determined questions designed to elicit specific information from the respondents regarding Opinion on Group 30 pesticides, Effectiveness of Group 30 pesticides molecules on Chilli crop and Factors influencing the adoption of Group 30 pesticides molecules.

Farmer's opinion on Group 30 pesticides

It was aimed to understand the perceptions and opinions of chilli farmers regarding the use of Group 30 pesticide molecules. Questions were designed to capture their experiences, satisfaction levels, perceived benefits and any concerns or issues they faced while using these pesticides.

Effectiveness of Group 30 pesticides molecules on Chilli crop

This aspect of the study was sought to analyse how effective the farmers found these pesticides in terms of pest control, crop yield improvement and overall crop health. Data collected using indicators of effectiveness such as potential benefits, cost factors, rate of application, potency and risk factors.

Factors influencing the adoption of Group 30 pesticides molecules

The study also aimed to identify the factors that influence farmer's decision to adopt or reject these pesticides. This included economic factors (cost of pesticides and financial benefits), social factors (peer influence, recommendations) and technical factors (ease of use, availability and technical support). The study sought to identify the factors influencing farmer's decisions to adopt or reject Group 30 pesticides recognizing that these choices are shaped by a complex interplay of economic, social and technical factors.

Likert's scale

Five-point scale was given to the different parameters which are strongly agree, agree, neutral, disagree and strongly disagree to measure the pest management techniques adopted, services provided by pesticide private companies, agriculture department, support given by private dealers and peer groups.

Garrett's ranking technique

Garrett's ranking technique was employed to prioritize or rank the level of information sources available on pest management, basis of application of chemical pesticides, factors influencing in the quantity of pesticides usage and brand selection, problems while purchasing pesticides from private dealers and agriculture department by the farmers.

RESULTS AND DISCUSSION

Effectiveness of group 30 pesticides molecules on chilli crop

The effectiveness of Group 30 pesticides molecules was analysed by using five indicators *viz.,* potential benefits, cost factors, rate of application, potency and risk factor.

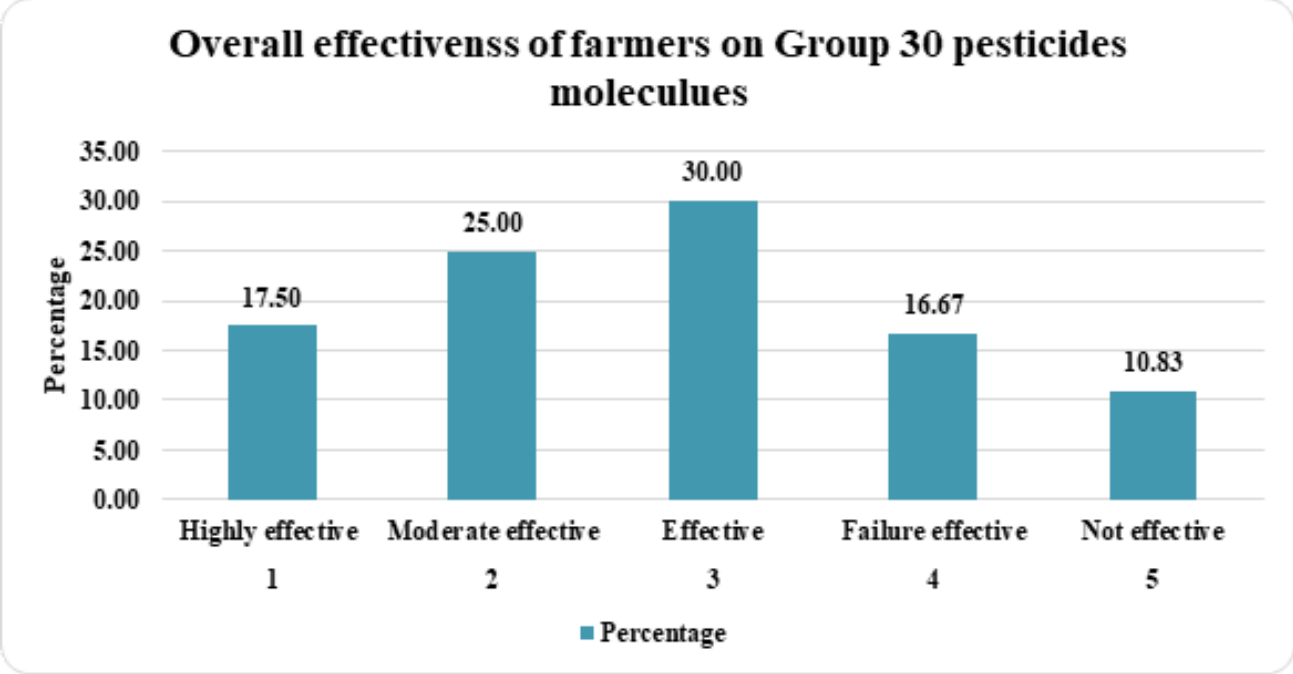

Fig. 1: Overall effectiveness of group 30 pesticides molecules

Potential benefits

The data (Table 1) revealed that the most significant benefit of Group 30 pesticide molecules was their ability to increase yield, which was prioritized by stakeholders. The importance of maintaining healthy crops was also highly valued, ranking second. The availability of a wider range of brands was considered important but slightly less critical, ranking third. Pest resistance prevention ranked fourth with a notably lower score, indicating that while it is a concern, it was deemed less important compared to yield and crop health. Overall, stakeholders focused primarily on productivity and crop health when assessing the benefits of these pesticides. These findings were in confirmation with Parween *et al* (2016) and Kodandaram *et al* (2015) who reported that new pesticides molecules had Potential benefits comparatively other molecules increasing in yield, pest tolerance and its effect on growth and metabolism.

Cost factors

The data revealed that the most significant factor influencing the adoption of Group 30 pesticide molecules was the positive output price, highlighting stakeholders focus on potential revenue. The second most critical factor was the reduced investment in other pesticides, indicating the value placed on cost savings. The benefit-cost ratio ranked third, emphasizing the importance of economic efficiency. Lastly, affordability though important was considered the least critical factor. Overall, stakeholders prioritized economic returns and cost efficiency in their adoption decisions.

Rate of application

It was found that the most critical factor influencing the rate of application for Group 30 pesticide molecules was the requirement for optimal dosages, emphasizing the importance of efficiency and precision. Safety to humans and crops was the second most important factor, reflecting stakeholders concern for safety during application. Minimizing collateral damage ranked third, highlighting the need to avoid unintended harm. Ease of application without special equipment was also valued, ranking fourth. Finally, the versatility of the pesticides modes of action was considered the least critical but still relevant in determining the application rate.

Potency

The data (Table 1) revealed that the most crucial factor in assessing the potency of Group 30 pesticide molecules was the absence of adverse effects on crops, indicating stakeholder's strong emphasis on crop safety. The approval of the chemical composition was the second most important factor, highlighting the value placed on regulatory compliance. Stakeholders

Table 1: Analysing the Group 30 pesticides molecules on various parameters. (n=120)

Sr. No.	Parameter	Total score	Mean score	Rank
A.	**Potential Benefits**			
1	Ability to get more yield	458	3.82	I
2	Ability to get healthy crop	455	3.79	II
3	More number of brands	443	3.69	III
4	Pest does not resistance	342	2.85	IV
B.	**Cost factors**			
5	Output price is positive	426	3.55	I
6	Less investment on other pesticides	348	2.90	II
7	Benefit-Cost ratio is more	339	2.83	III
8	Affordable prices	300	2.50	IV
C.	**Rate of Application**			
9	Only optimal dosages are required	497	4.14	I
10	Safe to human and crop	480	4.00	II
11	Less collateral damage	446	3.72	III
12	Safe while applying without any equipment	417	3.48	IV
13	Multiple modes of action	406	3.38	V
D.	**Potency**			
14	No adverse effects on crop	440	3.67	I
15	Approved chemical composition	422	3.52	II
16	Not vulnerable to non-target pests	408	3.40	III
17	Low Pest resistance	400	3.33	IV
18	Long term impact on pest	309	2.58	V
E.	**Risk factor**			
19	High competing brands	498	4.15	I
20	Crop loss is minimized	487	4.06	II
21	Safe to human and crop health	482	4.02	III
22	No chronic effects reported	411	3.43	IV
23	Toxicity is optimum	354	2.95	V

Table 2: Overall effectiveness of Group 30 pesticides molecules (n=120)

Sr. No.	Overall effectiveness	Frequency	Percentage
1	Highly effective	21	17.50
2	Moderate effective	30	25.00
3	Effective	36	30.00
4	Failure effective	20	16.67
5	Not effective	13	10.83

also prioritized the specificity of the pesticides as shown by the third-ranked factor, vulnerability to non-target pests. Concerns about pest resistance were evident, ranking fourth, while the long-term impact on pests was considered the least critical factor, though still relevant in evaluating pesticide potency. These findings were in confirmation with Rajawat *et al* (2017) and Scott *et al* (2008) reported that most of respondents had knowledge and positive opinion towards effectiveness of pesticides molecules of the low pest resistance and not vulnerable to non-target pests.

Table 3: Factors influencing adoption of Group 30 pesticides molecules by Chilli crop farmers

Sr. No.	Factor	Mean Garrette Score	Rank
1	Suitable to the pests attacking Chilli crop	76.73	I
2	Effectiveness of pesticides in productivity enhancement	66.44	II
3	Recommendation by input agencies	61.15	III
4	Increase Utilisation by Chilli farmers in the district	55.43	IV
5	Market Demand is there for the molecule	51.60	V
6	High Peer Recommendations	49.28	VI
7	Cost effectiveness (BC ratio is high)	42.23	VII
8	High Availability & Accessibility of pesticides	36.57	VIII
9	Safety and Environmental safety	32.52	IX
10	Pesticide can be safely stored	29.36	X

Risk factor

It was observed that the most significant risk factor associated with Group 30 pesticide molecules was the presence of high competing brands, which had the highest total and mean scores. Crop loss prevention was the second most important factor, emphasizing the effectiveness of the pesticides. Safety to human and crop health was also a key concern, ranking third. The absence of chronic effects was considered less critical but still relevant, ranking fourth. Finally, toxicity levels were deemed the least significant risk factor, though still of concern to stakeholders.

Overall effectiveness of group 30 pesticides molecules

The fig.1 illustrated respondent's views on the overall effectiveness of a particular intervention, categorized into five levels: Highly Effective, Moderately Effective, Effective, Failure Effective and Not Effective. The table includes both the frequency of responses and the corresponding percentage for each category. The data showed that 30.0 percent of the respondents, consider the intervention to be simply effective. A significant portion (25.0%) found it Moderately effective, while 17.50 per cent rated it as highly effective. On the other hand, 16.67 per cent of respondents felt that the intervention was a failure effective and 10.83 per cent believed it was not effective. This suggested that while most respondents view the intervention as somewhat effective there were varying opinions on its overall success, with some perceiving it as less effective or even a failure.

Factors influencing the adoption of group 30 pesticides molecules by the chilli crop farmers

The values in table 3 revealed that Chilli crop farmers prioritized the suitability of Group 30 pesticide molecules to target pests, as indicated by the highest mean Garrette score of 76.73. The effectiveness of these pesticides in enhancing productivity was also highly valued, ranking second. Recommendations from input agencies and the widespread use by peers within the district were significant factors influencing adoption. While cost-effectiveness, availability and safety were considered, they were less influential compared to pest suitability and productivity benefits in the decision-making process. Thus, as per the result in the table 7, we can conclude that suitable to the pests attacking followed by productivity enhancement are the significant factors influencing Group 30 Pesticides molecules. These findings were in confirmation with Ribka *et al* (2020) and Sahu and Nahatkar (2019) reported that most of farmers are influenced by major factors like performance, effectiveness, recommended by input dealers, competitive pricing, availability and accessibility.

CONCLUSION

The present study pointed out a vivid picture of the lives of chilli farmers in Guntur district, shedding light on their backgrounds and how they interact with Group 30 pesticides molecules. Majority of these farmers are middle-aged men who have not had much formal education, which underscores the importance of making training and learning resources more accessible to them. Economically many of them

were in the medium-income bracket and nearly half manage small plots of land showing that they work with limited resources. The findings revealed that every farmer was aware of the uses of Group 30 pesticides. While many farmers found these pesticides helpful in controlling pests and improving their crop yields not everyone had the same experience. A lot of them view these pesticides as being environmentally friendly but there were still concerns about how much they cost and their potential impact on the environment. Safety and the pressure from competing products in the market were also on some farmers minds. Input dealers who supply the products, play a significant role in shaping their farming practices. Having the right guidance and training is essential to using these pesticides effectively. Overall, most farmers feel good about their farming experience and the benefits they had been seen from using Group 30 pesticides. Yet, the study highlights the ongoing need for research and support to address the varied effectiveness, the challenges of cost and the safety issues. This would help ensure that these pesticides continue to be a sustainable solution for chilli farming.

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