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Insecticide usage pattern in major paddy growing regions of Karnataka

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Abstract
Insecticide usage patterns adopted by paddy growers to manage N. *lugens* were collected through roving surveys using a questionnaire during 2020-21 and 2021-22 *Kharif* season from the major paddy growing areas of Karnataka. It is evident from the survey that overall, 15 insecticides and one combination product belonging to various chemical groups with different mode of action have been sprayed in Karnataka to manage *N. lugens* (BPH). In which neonicotinoids and organophosphates comprise major share with 29 and 22 percent, respectively, followed by pyridine azomethines (Pymetrozine 50% WG) with 19 percent and novel mesoionic class with 10 percent. Overall, the survey found that farmers in the TBP and UKP areas were using several insecticides with repeated applications to manage N. *lugens*, followed by the Borewell irrigated area and the Cauvery command area. Whereas, rarely spray any insecticide for paddy pest management in hilly and coastal regions.

Keywords: Insecticide, usage patterns, roving surveys, *N. lugens*

Introduction
Rice (*Oryza sativa* L.) is produced in about 120 countries worldwide in 2021. China (about 214 million tons) and India (about 173 million tons) together account for more than 50 percent of rice production globally (Anon., 2022a) [2]. Rice is grown in more than a hundred countries, with a total harvested area of approximately 158 million hectares, producing more than 700 million tons annually. Nine of the top 10 rice-producing countries in the world are in Southeast Asia. Nearly 640 million tons of rice is grown in Asia, representing 90 percent of global production. Sub-Saharan Africa produces about 19 million tons and Latin America some 25 million tons. In Asia and Sub-Saharan Africa, almost all rice is grown on small farms of 0.5 to 3 ha (Anon., 2020) [1]. Rice is grown in 27 districts of Karnataka which covers more than 14 lakh hectares of the area cultivated in the state with 3.63 million tons (Anon., 2022b) [3]. It has a yield of more than 2,700 kg/hectare and accounts for more than 3 percent share in India. Out of which 14 districts were under high productivity yield more than 2,500 kg/ha group.
However, production of rice has been seriously affected by sucking insect pest damage particularly the brown planthopper (BPH), *Nilaparvata lugens* (Stål), the white backed planthopper (WBPH), *Sogatella furcifera* (Horváth), the small brown planthopper (SBPH), *Laodelphax striatellus* (Fallén) and green leafhopper, *Nephotettix* spp (Nakoa, 2017) [7].
The control of the BPH has relied on various insecticides throughout Asia. Initially, in 1950's it was started with conventional insecticides, which were highly persistent organochlorines such as DDT (dichlordiphenyltrichlorethan) and BHC (benzene hexachloride) but these insecticides have been banned since the 1970's due to environmental impact (Zhu and Cheng, 2013) [10]. Subsequently, the organophosphates and carbamates were widely used against BPH, but were replaced due to insecticide resistance. During the last decades neonicotinoid, insect growth regulator and phenylpyrazole insecticides have been widely applied to control BPH (Gorman *et al.*, 2008) [4]. In this context, to know the insecticides used by the farmers to manage the BPH across the different paddy growing regions of Karnataka, the present investigation was conducted.

Materials and Methods
Insecticide usage patterns adopted by paddy growers to manage N. *lugens* were collected through roving surveys using a questionnaire during 2020-21 and 2021-22 *Kharif* season from the major paddy growing areas of Karnataka. Paddy growing regions were classified in to six categories based on source of irrigation as presented in table 1.

Table 1: Sampling areas to collect data on insecticide usage pattern against N. *lugens*

Sl. No.	Rice grown in different irrigation systems	Region
1.	Upper Krishna command area (UKP)	Yadgir, Kalaburagi and Raichur
2.	Tungabadra command area (TBP)	Raichur, Koppal and Ballari
3.	Cauvery command area	Mandya and Mysore
4.	Coastal area (Rainfed)	Udupi and Uttar Kannada
5.	Hilly area (Rainfed)	Sirsi and Chikkamagaluru
6.	Tube well/Bore well irrigated area	Koppal

Each sample location consist of 20 farmers growing rice. Data was collected in two *kharif* cropping seasons, each area was visited and interacted with the farmers as per questioners.

Results and Discussion

Extensive information was collected on the insecticide usage pattern adopted by farmers of main six paddy growing regions of Karnataka *viz*., TBP (Raichur, Koppal and Ballari), UKP (Yadgir, Kalaburagi and Raichur), Cauvery command area (Mandya and Mysore), Borewell irrigated region (Koppal), Hilly region (Sirsi and Chikkamagaluru) and Coastal region (Udupi and Uttar Kannada) for protecting paddy crop from ravages of N. *lugens* menace is provided in Table 2. It is evident from the survey that overall, 15 insecticides and one combination product belonging to various chemical groups with different mode of action have been sprayed in Karnataka to manage N. *lugens* (BPH). In which neonicotinoids and organophosphates comprise major share with 29 and 22 percent, respectively (Fig. 1), followed by pyridine azomethines (Pymetrozine 50% WG) with 19 percent and novel mesoionic class with 10 percent.

Table 2: Insecticide usage pattern followed by farmers of paddy growing regions of Karnataka

Location	Insecticide	Crop label	Recommended dose*	Farmer practice*	Increase (%)	No. of sprays (Range)
TBP	Pymetrozine 50% WG	Yes	400	966.8	141.7	2-4
	Triflumezopyrim 10% SC	Yes	232	232	0	
	Thiamethoxam 25% WG	Yes	100	216.21	116.21	
	Imidacloprid 17.80% SL	Yes	150	370.65	147.1	
	Monocrotophos 36% SL	Yes	650	1235.5	90.08	
	Fipronil 5% SC	Yes	1000	1500	50	
	Carbosulfun 25% EC	Yes	900	1000	11.11	
	Dinotefuran 20% SG	Yes	200	250	25	
	Buprofezin 25% SC	Yes	800	1853.25	131.65	
	Acephate 75% SP	Yes	833	2471	196.6	
UKP	Pymetrozine 50% WG	Yes	400	617.75	54.43	2-3
	Imidacloprid 17.80% SL	Yes	150	308.87	105.91	
	Fipronil 5% SC	Yes	1000	1500	50	
	Triflumezopyrim 10% SC	Yes	232	232	0	
	Acephate 75% SP	Yes	833	1235.5	48.31	
	Dinotefuran 20% SG	Yes	200	250	25	
	Carbofuran 3G	Yes	10000	10000	0	
	Monocrotophos 36% SL	Yes	650	1000	53.85	
	Thiamethoxam 25% WG	Yes	100	125	25	
	Buprofezin 25% SC	Yes	800	1000	25	
	Carbosulfun 25% EC	Yes	900	1000	11.11	
Cauvery	Pymetrozine 50% WG	Yes	400	494.2	23.55	1-3
	Imidacloprid 17.80% SL	Yes	150	211.48	40.99	
	Acephate 75% SP	Yes	833	1235.5	48.31	
	Profenofos 50% EC	No	1000	1250	25	
	Fipronil 5% SC	Yes	1000	1235.5	23.55	
	Fipronil 0.3% G	Yes	2500	2500	0	
	Monocrotophos 36% SL	Yes	650	650	0	
	Buprofezin 25% SC	Yes	800	1000	25	
	Carbosulfun 25% EC	Yes	900	900	0	
Tube well	Pymetrozine 50% WG	Yes	400	617.75	54.43	2-3
	Imidacloprid 17.80% SL	Yes	150	308.87	105.91	
	Triflumezopyrim 10% SC	Yes	232	232	0	
	Chlorpyrifos 50 EC	Yes	775	1000	29.03	
	Monocrotophos 36% SL	Yes	650	1000	53.85	
	Buprofezin 25% SC	Yes	800	1250	56.25	
	Carbosulfun 25% EC	Yes	900	1000	11.11	
	Fipronil 5% SC	Yes	1000	1235.5	23.55	
Hilly	Monocrotophos 36% SL	Yes	650	750	15	0-1
	Chlorpyrifos 50% + Cypermethrin 5% EC	Yes	687.5	750	9.09	
	Imidacloprid 17.80% SL	Yes	150	150	0	
Coastal	Carbofuran 3G	Yes	10000	10000	0	0-1

*-formulation ml or gm/ha

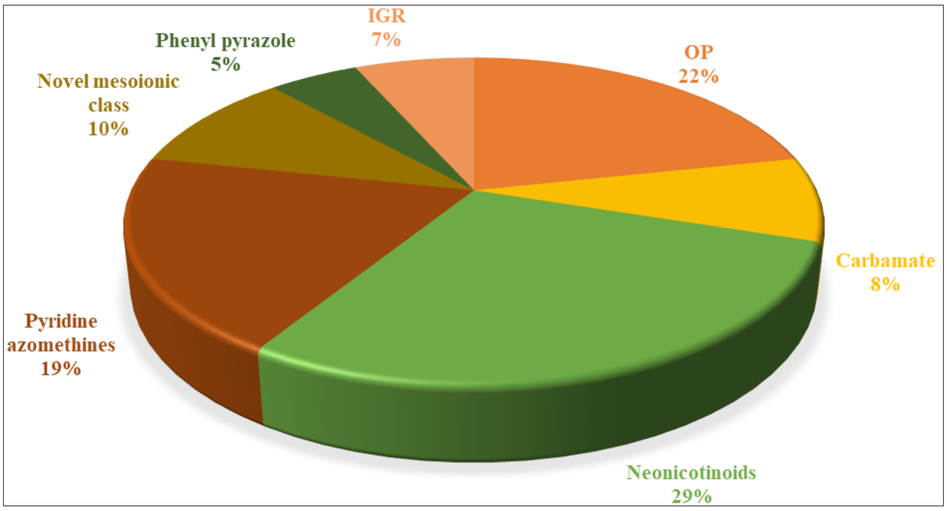


Figure 1: Usage of insecticides in paddy growing regions of Karnataka

Organophosphorous insecticides

Organophosphate (OP) pesticides are esters of phosphoric acid used in large quantities worldwide for managing various insect pests. Particularly Cauvery command area farmers were using 28 percent of OP insecticides mainly acephate for the management of BPH, followed by farmers of TBP (20%) and UKP (21%) command areas. None of the paddy growers in the Coastal region were using OP compounds (Fig. 2a).

Carbamate insecticides

The highest percent of farmers in TBP area (46%) were using carbamate group (mainly carbosulfun) insecticides for managing the BPH, followed by 20 percent of farmers of each UKP and BW regions. On the contrary, only 7 percent of Cauvery command area and Coastal area farmers were using carbamate group. None of the Hilly area farmer were spraying carbamate group of insecticide (Fig. 2b).

Neonicotinoids insecticides

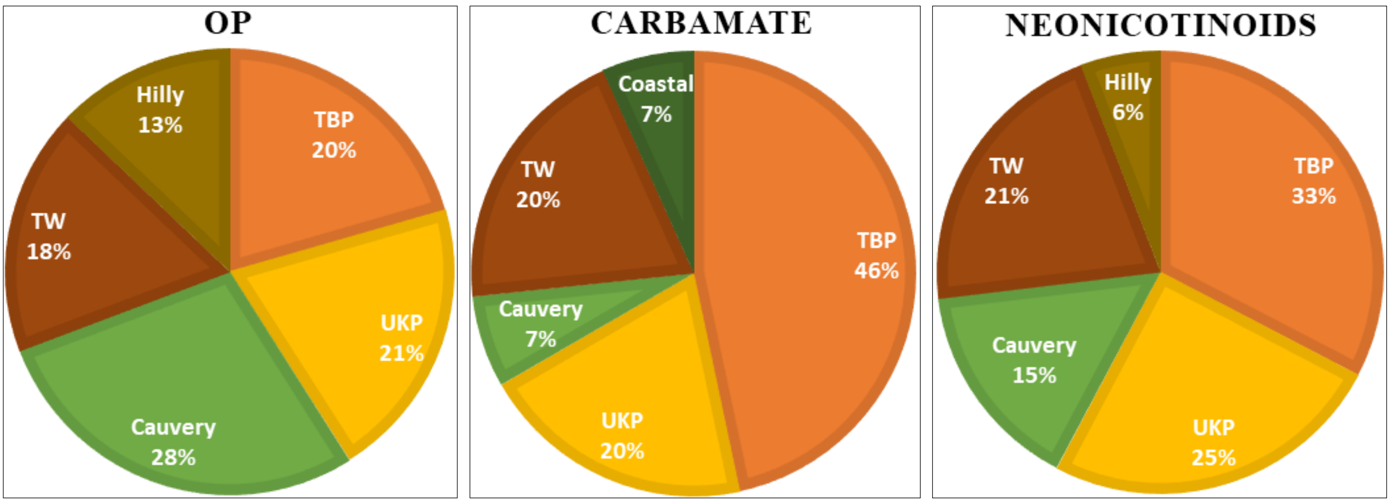
Thirty three percent of paddy growers of TBP region were using neonicotinoids, followed by UKP and Cauvery command area with 25 and 15 percent, respectively. Imidacloprid has the largest share and most commonly used neonicotinoids against N. *lugens*, principally owing to its efficacy against previously resistant populations and cost effective. Recently, however, reports of reduced efficacy have become more frequent and generally attributed to resistance development (Liu *et al*., 2002) [6] (Fig. 2c).

Pyridine azomethines insecticides

Pymetrozine does not have a knockdown effect and acts as an inhibitor for eating (Surahmat *et al*., 2016) [9]. A higher percent of TBP area (31%) farmers were spraying pymetrozine for managing the BPH, followed by UKP (28%) and TW (22%) area. None of the farmers from Coastal and Hilly areas were spraying pymetrozine for managing the BPH (Fig. 2d).

Novel mesoionic class insecticides

Recently, new molecules that are analogous to neonicotinoids are introduced like triflumezopyrim 10% SC of mesoionic class that exhibits high potential against BPH with a unique mode of action which acts as a weak agonist at the orthosteric site of nAChRs and produces lethargic nature instead of excitatory symptoms produced by other neonicotinoids (Holyoke *et al*., 2016) [5] and might be because of this unique mode of action it performing for better against BPH. Highest percent of paddy growers in TBP (39%) area were spraying triflumezopyrim for managing the N. *lugens* and closely followed by UKP and BW areas farmers with 33 and 28 percent, respectively. Farmers of Cauvery, Hilly and Coastal regions had not yet started spraying triflumezopyrim (Fig. 2e).



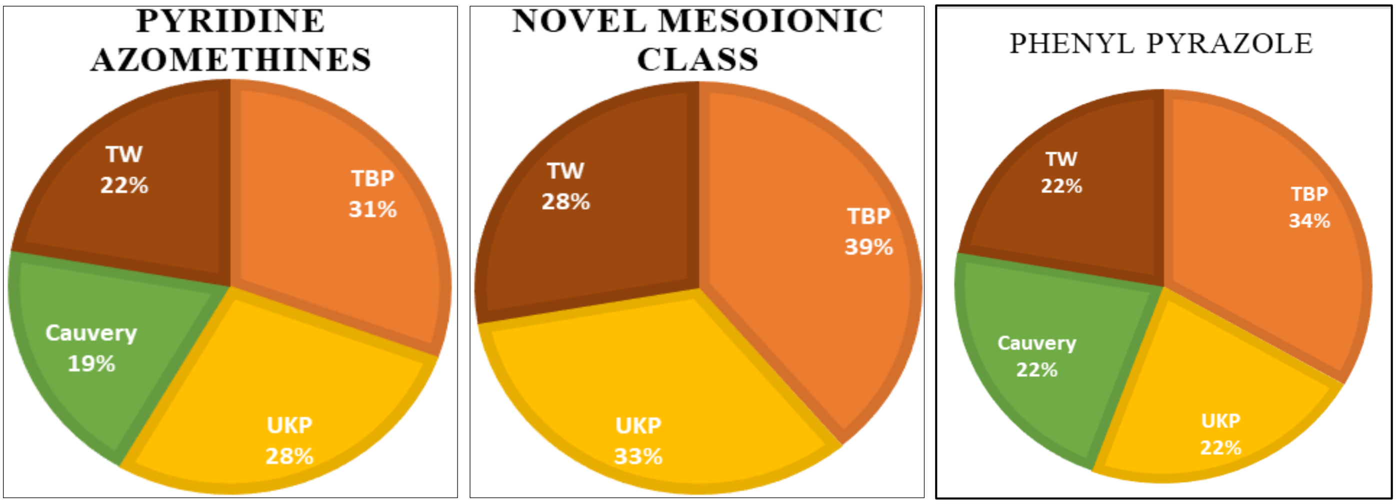


Fig 2: Usage of various groups of insecticides in paddy growing regions of Karnataka

Phenyl pyrazole insecticides

Thirty four percent of paddy growers in the TBP area were spraying fipronil for the management of BPH and other paddy pests, followed by 22 percent each in UKP, TW and Cauvery command area. None of the farmers in Hilly and Coastal area were spraying fipronil for managing the paddy insect pests (Fig. 2f).

IGR (Insect Growth Regulators) insecticides

Buprofezin is an IGR known as biorational insecticide which acts as inhibitors of chitin biosynthesis and 41 percent of farmers of TBP area were spraying this insecticide for managing the BPH, followed by UKP area with 25 percent. Seventeen percent paddy growers of Cauvery and TW areas were using buprofezin for N. *lugens* management. Again, farmers of Hilly and Coastal regions were not spraying buprofezin for the management of BPH (Fig. 3).

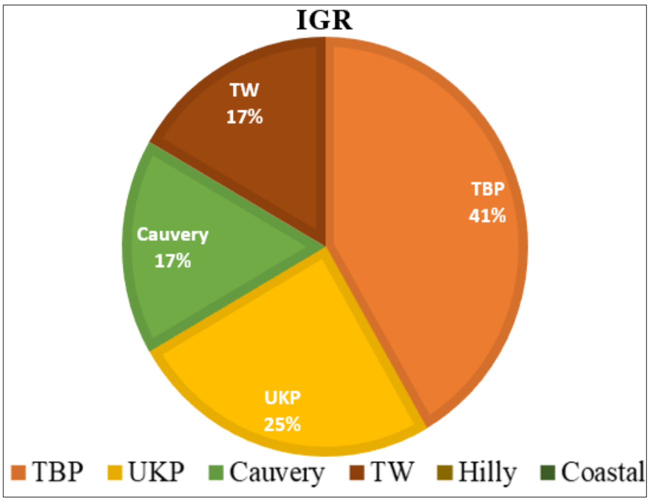


Fig 3: Usage of IGR (Insect Growth Regulator) (buprofezin) in paddy growing regions of Karnataka

Paddy growers of the TBP and UKP command areas are following intensive and continuous cultivation of rice year-round on a larger area, with excessive use of nitrogenous fertilizers, staggered and dense planting which led to increased severity of the BPH population due to increased succulency in rice plants (Singh *et al.*, 2019) [8] and has compelled farmers to use various insecticides repeatedly with higher than the recommended dose on calendar based. This might have led to the exertion of selection pressure over the BPH population and the development of insecticide resistance mechanism. On the contrary, only 30 percent of farmers in the hilly area used insecticide for management of paddy pests, in which the OP group comprised a major share and was applied on an average of one spray with almost the recommended dosage. Whereas, only 5% of paddy-growers in coastal areas used carbamate group insecticide. Continuous heavy rain in the hilly and coastal areas coupled with the growing of paddy in isolated patches with lower nitrogenous fertilizer application and following LEISA technology led to lower pest population density. Farmers of these particular regions are growing paddy majorly for their own consumption rather than for commercial purposes, which made them use fewer insecticides and in turn reduced selection pressure on the BPH populations, making them susceptible to various group of insecticides. The farmers of the TW and Cauvery regions also followed intensive cultivation but it was not to the extent of TBP and UKP areas. Further, they follow early planting in *kharif* season which escapes from sever BPH incidence hence farmers use various insecticides with less frequency, which makes BPH populations relatively less resistant.

Conclusion

Overall, the survey found that farmers in the TBP and UKP areas were using several insecticides with repeated applications to manage N. *lugens*, followed by the Borewell irrigated area and the Cauvery command area. Whereas, rarely spray any insecticide for paddy pest management in hilly and coastal regions.

References

1. Anonymous, Ricepedia, the online authority of rice; c2020, http://ricepedia.org /rice-as-a-crop/ rice-productivity; c2020.
2. Anonymous. FAO, Food Outlook – Biannual Report on Global Food Markets. Rome; c2022a. https://doi.org/10.4060/cb9427en.
3. Anonymous. Statista Research Department, Mar 16, 2022, Volume of rice production in Karnataka FY 2009-2020; c2022b.
4. Gorman K, Liu Z, Denholm I, Brüggen KU, Nauen R. Neonicotinoid resistance in rice brown planthopper, *Nilaparvata lugens*. Pest Manag. Sci. 2008;64(11):1122-1125.

5. Holyoke CW, Cordova D, Zhang W, Barry JD, Leighty RM, Dietrich RF, *et al*. Mesoionic insecticides: a novel class of insecticides that modulate nicotinic acetylcholine receptors. Pest Mgt. Sci. 2016;73(4):796-806.
6. Liu Z, Zhang L, Han Z, Dong Z, *et al*. A method for monitoring of imidacloprid resistance in brown planthopper, *Nilaparvata lugens*. Entomol. Knowledg. 2002;39:424-427.
7. Nakoa Y. Insecticide resistance in rice planthoppers. Agrochemical Research Center, Mitsui Chemicals Agro, Inc., Mobara, Chiba, Japan; c2017. p. 297-0017.
8. Singh A, Jaswal A, Sarkar S. Incidence of brown plant hopper in the rice field with the use of different doses of fertilizers. J Agric. Sci. 2019, 39(2):108-113.
9. Surahmat, Dadang EC, Prfijono D. Kerentanan wereng batang cokelat (*Nilaparvata lugens*) dari enam lokasi di pulau jawa terhadap tiga jenis insektisida, HPT Tropika. 2016;16(1):71-81.
10. Zhu ZR, Cheng JA. The evolution and perspective of rice insect pest management strategy in China, Plant Prot. 2013;39:25-32.