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Physical Compatibility of Chemicals used in Paddy Ecosystem

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ABSTRACT

Laboratory studies were conducted during *kharif* 2017 to know the physical compatibility of recommended insecticides (Thiamethoxam 25 WG, Imidacloprid 17.8 SL, Profenophos 50 EC, Chlorpyriphos 20 EC, Flubendiamide 480 SC and Chlorantraniliprole 18.5 SC) and fungicides (Hexaconazole 5 SC, Tricyclazole 75 WP, Carbendazim 50 WP and Propiconazole 25 EC) against rice insect pests and diseases with most commonly used foliar nutrient. All the 24 combinations tested showed physical compatibility with no foaming and sedimentation. The pH value of majority of the insecticide and fungicides combinations tested was neutral to moderately acidic but when mixed with foliar nutrient, the solution turned to be strongly acidic.

Key Words : Physical compatibility, Paddy, Pesticide combinations.

INTRODUCTION

Paddy (*Oryza sativa* L.) is one of the major staple food for more than half of the world population. India is the second largest producer of rice next to China and is cultivated on almost one-fourth of the total cropped area, providing food to about half of the Indian population (Seni and Naik, 2017). Like other crops, paddy also suffers incidence of insect pests and diseases together which demands the spray of pesticides both insecticides and fungicides at a time. Farmers use tank mixing of majority of insecticides, fungicides and nutrients for the management of insect pests *viz*., leaf folder and stem borer and blast disease for which compatibility is not known. Due to this, there is loss in the efficacy of certain insecticides and fungicides against the target pest. At present, highly effective fungicides and insecticides with novel modes of action are available and these are becoming increasingly important in modern agriculture as a component of integrated pest management and resistance management strategies. Although, combined application of pesticides is a labour saving method, but an understanding and knowledge of pesticide compatibility is essential.

Pesticide combinations may show physical, chemical or phytotoxic incompatibility causing undesirable results. Physical incompatibility may result in an unstable mixture or a soapy flocculate. Usually this may be visualized as layering or balling up or sediment formation affecting the efficacy of the pesticides. It can be caused by improper mixing, inadequate agitation or lack of stable emulsifiers in some emulsifiable concentrates. In most cases, solids settle out of the mixture or the mixture separates into layers after agitation. So, physical compatibility of pesticides is a prerequisite for recommending combination of insecticides and fungicides under field conditions. Hence, an experiment was conducted under laboratory conditions to know the physical compatibility of recommended insecticides and fungicides against rice pests.

MATERIALS AND METHODS

Laboratory experiment on physical compatibility of six insecticides (Thiamethoxam 25 WG Imidacloprid 17.8 SL, Profenophos 50 EC, Chlorpyriphos 20 EC, Flubendiamide 480 SC and Chlorantraniliprole 18.5 SC) and four fungicides

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Parameter	pH value	Parameter	pH value
Extremely acidic	< 4.5	Very strongly acidic	4.5–5.0
Strongly acidic	5.1–5.5	Moderately acidic	5.6–6.0
Slightly acidic	6.1–6.5	Neutral	6.6–7.3
Slightly alkaline	7.4–7.8	Moderately alkaline	7.9–8.4
Strongly alkaline	8.5–9.0	Very strongly alkaline	> 9.1

(Hexaconazole 5 SC, Tricyclazole 75 WP , Carbendazim 50 WP and Propiconazole 25 EC) along with 19:19:19 foliar nutrient was carried out at Soil and Water Testing Laboratory, ICAR -Krishi Vigyan Kendra, Uttara Kannada, Sirsi, Karnataka during Kharif 2017. Jar compatibility test was followed to study the physical compatibility of pesticides. In this test, initially 500 ml of standard hard water (0.34 g calcium chloride and 0.139 g of magnesium chloride hexahydrate in one litre of double distilled water) was taken in one litre jar to which one insecticide and one fungicide were added in the order of Wettable powder (WP) followed by Dry flowables (DF), Flowables (F), Emulsifiable concentrates (EC) and finally by solubles designated as either solubles (S), soluble liquids (SL) or soluble concentrates (SC). The volume of insecticide, fungicide and foliar nutrient mixture was made up to 1 litre with hard water, agitated by shaking the jar and left undisturbed for 30 min. Observations were recorded after 30 and 60 min with respect to foaming and sedimentation. Also, pH of the insecticides and fungicides in combinations and also with 19:19:19 foliar nutrient were recorded and designated according to Bickelhaupt (2012) as following:

RESULTS AND DISCUSSION

The jar test studies conducted for foaming, sedimentation and pH of the tank mix insecticides / fungicides and 19 All foliar nutrient mixtures are presented in Table 1 and 2. Among 24 combinations, neither foaming nor sedimentation was observed in insecticide + fungicide combination and also after adding foliar nutrient indicating physical compatibility(> 20 ml / L as specified by ISI).

The pH readings of pesticide mixtures without the addition of foliar nutrients revealed that Thiamethoxam in combination with Hexaconazole, Carbendazim and Propiconazole was neutral (6.6, 7.0 and 6.9 respectively) but its combination with Tricyclazole was slightly acidic (6.5). All the remaining combinations were moderately acidic (5.6 - 6.5) except Chlorpyriphos in combination with Hexaconazole, Tricyclazole and Propiconazole which was strongly acidic (5.5, 5.4 and 5.4 respectively). The present findings are in line with works of Visalakshmi *et al* (2016), where the combination of Chlorantranaliprole @ 0.3 ml/l + Propiconazole @ 1.0 ml/l, Chlorpyriphos @ 2.5 ml/l + Propiconazole @ 1.0 ml/l, Flubendiamide @ 0.25 ml/l + Propiconazole @ 1.0 ml/l and Profenophos @ 2.0 ml/l + Propiconazole 1.0 ml/l were physically compatible. Prasad *et al (*2009) noticed physical compatibility with Imidacloprid 200 SL @ 0.25 ml/l + Propiconazole 25 EC @ 1.0 ml/l and Thiamethoxam 25 WG @ 0.25 ml/l + Propiconazole 25 EC @ 1.0 ml/l. Similar type of experiments conducted by Raju *et al* (2018) revealed that Profenophos in combination with either Tricyclazole or Hexaconazole or Propiconazole in standard hard water show neither foaming nor sedimentation indicating that the combinations were compatible. When foliar nutrient 19 - All was added to the pesticide mixture, all treatment combinations showed very strongly acidic pH results except Thiamethoxam in combination with four fungicides *viz.*, Hexaconazole, Tricyclazole, Carbendazim and Propiconazole which were strongly acidic with pH value 5.2, 5.2, 5.2 and 5.3, respectively.

Table 1. Physical compatibility of insecticides, fungicides and foliar nutrient used in Paddy ecosystem.

Sr. No.	Pesticide combination	Foaming (ml/l)	Sedimentation (ml/l)
1	Thiamethoxam 25 WG @ 0.2 g/l + Hexaconazole 5 SC @ 1 ml/l	0	0
2	Thiamethoxam 25 WG @ 0.2 g/l + Tricyclazole 75 WP @ 0.6 g/l	0	0
3	Thiamethoxam 25 WG @ 0.2 g/l + Carbendazim 50 WP @ 1 g/l	0	0
4	Thiamethoxam 25 WG @ 0.2 g/l + Propiconazole 25 EC @ 1 ml/l	0	0
5	Imidacloprid 17.8 SL @ 0.3 ml/l + Hexaconazole 5 SC @ 1 ml/l	0	0
6	Imidacloprid 17.8 SL @ 0.3 ml/l + Tricyclazole 75 WP @ 0.6 g/l	0	0
7	Imidacloprid 17.8 SL @ 0.3 ml/l + Carbendazim 50 WP @ 1 g/l	0	0
8	Imidacloprid 17.8 SL @ 0.3 ml/l + Propiconazole 25 EC @ 1 ml/l	0	0
9	Profenophos 50 EC @ 2 ml/l + Hexaconazole 5 SC @ 1 ml/l	0	0
10	Profenophos 50 EC @ 2 ml/l + Tricyclazole 75 WP @ 0.6 g/l	0	0
11	Profenophos 50 EC @ 2 ml/l + Carbendazim 50 WP @ 1 g/l	0	0
12	Profenophos 50 EC @ 2 ml/l + Propiconazole 25 EC @ 1 ml/l	0	0
13	Chlorpyriphos 20 EC @ 2 ml/l + Hexaconazole 5 SC @ 1 ml/l	0	0
14	Chlorpyriphos 20 EC @ 2 ml/l + Tricyclazole 75 WP @ 0.6 g/l	0	0
15	Chlorpyriphos 20 EC @ 2 ml/l + Carbendazim 50 WP @ 1 g/l	0	0
16	Chlorpyriphos 20 EC @ 2 ml/l + Propiconazole 25 EC @ 1 ml/l	0	0
17	Flubendiamide 480 SC @ 0.2 ml/l + Hexaconazole 5 SC @ 1 ml/l	0	0
18	Flubendiamide 480 SC @ 0.2 ml/l + Tricyclazole 75 WP @ 0.6 g/l	0	0
19	Flubendiamide 480 SC @ 0.2 ml/l + Carbendazim 50 WP @ 1 g/l	0	0
20	Flubendiamide 480 SC @ 0.2 ml/l + Propiconazole 25 EC @ 1 ml/l	0	0
21	Chlorantraniliprole 18.5 SC @ 0.3 ml/l + Hexaconazole 5 SC @ 1 ml/l	0	0
22	Chlorantraniliprole 18.5 SC @ 0.3 ml/l + Tricyclazole 75 WP @ 0.6 g/l	0	0
23	Chlorantraniliprole 18.5 SC @ 0.3 ml/l + Carbendazim 50 WP @ 1 g/l	0	0
24	Chlorantraniliprole 18.5 SC @ 0.3 ml/l + Propiconazole 25 EC @ 1 ml/l	0	0

*19:19:19 foliar nutrient was mixed in above all combinations

Table 2. pH of the insecticide and fungicide combinations with and without foliar nutrient (19:19:19).

Sl. No	Pesticide combinations	pH without foliar nutrient (19:19:19)	Nature	pH with foliar nutrient (19:19:19)	Nature
1	Thiamethoxam 25 WG @ 0.2 g/l + Hexaconazole 5 SC @ 1 ml/l	6.6	Neutral	5.2	Strongly acidic
2	Thiamethoxam 25 WG @ 0.2 g/l + Tricyclazole 75 WP @ 0.6 g/l	6.5	Slightly acidic	5.2	Strongly acidic
3	Thiamethoxam 25 WG @ 0.2 g/l + Carbendazim 50 WP @ 1 g/l	7.0	Neutral	5.2	Strongly acidic
4	Thiamethoxam 25 WG @ 0.2 g/l + Propiconazole 25 EC @ 1 ml/l	6.9	Neutral	5.3	Strongly acidic
5	Imidacloprid 17.8 SL @ 0.3 ml/l + Hexaconazole 5 SC @ 1 ml/l	5.7	Moderately acidic	4.9	Very strongly acidic
6	Imidacloprid 17.8 SL @ 0.3 ml/l + Tricyclazole 75 WP @ 0.6 g/l	5.7	Moderately acidic	4.9	Very strongly acidic
7	Imidacloprid 17.8 SL @ 0.3 ml/l + Carbendazim 50 WP @ 1 g/l	5.8	Moderately acidic	4.9	Very strongly acidic
8	Imidacloprid 17.8 SL @ 0.3 ml/l + Propiconazole 25 EC @ 1 ml/l	5.9	Moderately acidic	4.9	Very strongly acidic
9	Profenophos 50 EC @ 2 ml/l + Hexaconazole 5 SC @ 1 ml/l	5.7	Moderately acidic	4.7	Very strongly acidic
10	Profenophos 50 EC @ 2 ml/l + Tricyclazole 75 WP @ 0.6 g/l	5.6	Moderately acidic	4.7	Very strongly acidic
11	Profenophos 50 EC @ 2 ml/l + Carbendazim 50 WP @ 1 g/l	5.6	Moderately acidic	4.8	Very strongly acidic
12	Profenophos 50 EC @ 2 ml/l + Propiconazole 25 EC @ 1 ml/l	5.6	Moderately acidic	4.8	Very strongly acidic
13	Chlorpyriphos 20 EC @ 2 ml/l + Hexaconazole 5 SC @ 1 ml/l	5.5	Strongly acidic	4.6	Very strongly acidic
14	Chlorpyriphos 20 EC @ 2 ml/l + Tricyclazole 75 WP @ 0.6 g/l	5.4	Strongly acidic	4.6	Very strongly acidic
15	Chlorpyriphos 20 EC @ 2 ml/l + Carbendazim 50 WP @ 1 g/l	5.7	Moderately acidic	4.8	Very strongly acidic
16	Chlorpyriphos 20 EC @ 2 ml/l + Propiconazole 25 EC @ 1 ml/l	5.4	Strongly acidic	4.7	Very strongly acidic
17	Flubendiamide 480 SC @ 0.2 ml/l + Hexaconazole 5 SC @ 1 ml/l	5.8	Moderately acidic	4.6	Very strongly acidic
18	Flubendiamide 480 SC @ 0.2 ml/l + Tricyclazole 75 WP @ 0.6 g/l	5.6	Moderately acidic	4.6	Very strongly acidic
19	Flubendiamide 480 SC @ 0.2 ml/l + Carbendazim 50 WP @ 1 g/l	6	Moderately acidic	4.9	Very strongly acidic
20	Flubendiamide 480 SC @ 0.2 ml/l + Propiconazole 25 EC @ 1 ml/l	5.8	Moderately acidic	4.7	Very strongly acidic
21	Chlorantraniliprole 18.5 SC @ 0.3 ml/l + Hexaconazole 5 SC @ 1 ml/l	5.7	Moderately acidic	4.6	Very strongly acidic
22	Chlorantraniliprole 18.5 SC @ 0.3 ml/l + Tricyclazole 75 WP @ 0.6 g/l	5.6	Moderately acidic	4.6	Very strongly acidic
23	Chlorantraniliprole 18.5 SC @ 0.3 ml/l + Carbendazim 50 WP @ 1 g/l	5.9	Moderately acidic	4.8	Very strongly acidic
24	Chlorantraniliprole 18.5 SC @ 0.3 ml/l + Propiconazole 25 EC @ 1 ml/l	5.8	Moderately acidic	4.7	Very strongly acidic

CONCLUSION

The physical compatibility studies conducted with recommended insecticide and fungicide combinations did not produce any foaming or sedimentation indicating all 24 combinations were compatible. The pH value of majority of the insecticide and fungicides combinations tested was neutral to moderately acidic, but when mixed with foliar nutrient, the solution turned to be strongly acidic. It can be concluded that insecticide and fungicide tank mix combinations can be recommended to farmers after assessing the performance under field conditions for bioefficacy and phytotoxicity studies. Another important factor was quality of water used for spraying which may also alter the pH of the spray solutions.

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