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Physical and Biological Compatability of Insecticide diafenthiuron 50wp (NS) With Agrochemicals and also to test the Phytotoxicity study against Cardamom Pests

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Abstract: *Diafenthiuron 50 WP (NS) was physically compatible with nutrients like urea (2%), borax (1%) and molybdenum (0.025%) and fungicides like mancozeb (0.25%) and carbendazim (0.1%). Diafenthiuron at a dose very much lower than the field recommended dose was taken for this study i.e, 0.006 per cent, when combined with 0.05 per cent of carbendazim, its toxicity increased and 66.67 percent of Conogethes larva died in 24 HAT, which was higher than diafenthiuron alone (46.67%). But the toxicity of diafenthiuron was reduced by molybdenum and mancozeb and the mortality being, only 10 per cent at 24 HAT*

Key words*: Borax, carbendazim, cardamom pests, Diafenthiuron, urea, Mancozeb.*

I. Introduction

The pesticide use pattern in the present day situations has led to resistance build-up by pests and pesticide residues, which demands newer and safer pesticides with different modes of action. Thus, there is a greater need to evaluate pesticides that would leave no or lesser residues in the cardamom as well as in the environment. One such a compound is a diafenthiuron, a thio urea compound that has a novel mode of action which inhibits mitochondrial action inhibits and enhances biochemical sites such as respiration (Ishaaya et al., 2001); and energy metabolism (ATP synthesis) (Ruder and Kayser, 1992) and hence it is seen as a viable insectide for managing insects and mites. Registered insecticides which provide adequate control of the pests require repeated application in higher doses and might result in adverse effects on the environment and health. In order to circumvent the problems, replacement of conventional insecticides with new powerful molecules at lower dose is necessary (Shivanna et al., 2012). New formulations and new sources of existing molecules are likely to hold superiority in terms of higher toxicity, pest suppression, safety to natural enemies and non target organisms, reduced spray dosages and rounds of spray and the benefits accrued in terms of savings in labour and time

II. Materials and methods

Physical stability and compatibility of diafenthiuron 50 WP (NS)

Wettability test

Wettability of diafenthiuron 50 WP (NS) was assessed by observing the time required for complete submergence of the chemical in standard hard water. 2 g of diafenthiuron was weighed and transformed into a beaker containing 100 ml of standard hard water. The time required for complete submergence of the pesticide in the water was noted using a stop watch.

Compatibility of diafenthiuron 50WP

Physical compatibility of diafenthiuron 50WP with agrochemicals

Physical stability of diafenthiuron was studied for its stability in spray solution and for its compatibility with other agrochemicals as detailed below.

Preparation of standard hard water

Standard hard water was prepared by dissolving 0.302 g calcium chloride ($CaCl_2$) and 0.139 g magnesium chloride ($MgCl_2$) in one litre of distilled water. This water solution provides a hardness equivalent of 342 ppm calcium carbonate.

Recommended dose of the formulated chemical (0.048 g of diafenthiuron 50 WP 30ml) was added to 30 ml of standard hard water in a beaker. The contents of the beaker were stirred with a glass rod at a rate of four revolutions sec^{-1} during the addition. The diluted solution was made up to 100 ml with hard water and it was transferred immediately to a clean dry graduated cylinder. The graduated cylinder with its contents was kept in a water bath at $30 \pm 1^{o}C$ for 1 h. After one hour, the volume of the creamed matter at the top and /or the sediment, if any, at the bottom was observed. For stable emulsion, the creaming matter and /or the sediment, if any, should not

exceed 2.0 ml. Similarly, urea (2g), borax (1.0g), molybdenum (0.025g), carbendazim (0.1g) mancozeb (0.25g) and copper oxy chloride (0.25g), were prepared separately using standard hard water as described earlier with 100 ml of hard water in each case.

To 30 ml of the formulated chemical suspension (diafenthiuron) prepared, 30ml of the combination chemical (urea, borax, molybdenum, Carbendazim and mancozeb) was added separately and transferred to a clean dry graduated cylinder and the volume was made upto 100 ml with standard hard water, shaken well and kept in a thermostat at 30 ± 1°C for 1 h without any disturbance. The volume of the creamed matter at the top or the sediment, if any, at the bottom was observed. The creaming matter and / or the sediment not exceeding 2.0 ml was considered as the criteria for the compatibility

III. Results and Discussion

The results on the investigations carried out to study the physical stability in spray solution revealed that, none of the chemicals tested namely, urea, borax, molybdenum, mancozeb, copper oxy chloride and carbendazim in combination with diafenthiuron @ 1.6 g l^{-1}, produced creaming matter or sediment, more than 2.0 ml at the top or bottom of the 100 ml measuring cylinder (**Table 1**).

Biological compatibility test –phytotoxicity study

The results on the trial conducted to find out the phytotoxic effects of these combination products on cardamom variety Njellani Green Gold revealed that diafenthiuron 50 WP @ 0.16 g l^{-1} with the above said chemicals at the recommended doses did not cause any phototoxic symptoms such as injury to leaf tip and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty (**Table 2**).

Biological compatibility test – Bioefficacy study

Diafenthiuron at a dose very much lower than the field recommended dose was taken for this study i.e, 0.006 per cent, when combined with 0.05 per cent of carbendazim, its toxicity increased and 66.67 percent of Conogethes larva died in 24 HAT, which was higher than diafenthiuron alone (46.67%). But the toxicity of diafenthiuron was reduced by molybdenum and mancozeb and the mortality being, only 10 per cent at 24 HAT. Copper oxy chloride also imparted an antagonistic effect on diafenthiuron when mixed giving a mortality of only 16.67 and 50.00 per cent at 24 and 48 HAT, respectively **(Table** 3**).** But diafenthiuron when mixed with molybdenum and copper oxy chloride the toxicity increased.

Indiscriminate use of broad spectrum insecticides led to the resistance development in insects and ill effects on the environment and opened a new era of novel chemicals with special mode of action with target specificity and safety to environment. Newer insecticides whenever introduced are being evaluated for their bioefficacy against different pests. In this connection, diafenthiuron, a novel insecticide with different mode of action of ATP synthesis inhibition with IGR activity was test verified. Spraying of insecticide, fungicide and nutrients to crops are necessarily done simultaneously now a days, due to complex pest problems and nutrient deficiencies.

Thus compatibility studies with the agrochemicals used for the crop are also necessary. Diafenthiuron is physically compatible with nutrients like urea (2%), borax (10 Kg ha^{-1}) and molybdenum (0.25 Kg ha^{-1}) and produced no phytotoxic symptoms in cardamom. Fungicides like mancozeb (0.25%), copper-oxy chloride (0.25%) and carbendazim (0.05%) were found to be compatible thus can be used in the field as a mixture for the control of insect pest and damping off or panicle rot in cardamom

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Mondal and Mondal (2012) reported that diafenthiuron when mixed with Redux (See weed extract (10%) + Chavicol (2%)) and garlic extract (10 %) was compatible and effective against chilli mite P. latus and diafenthiuron in combination with thiamethoxam (300 + 25 g a.i.ha^{-1}) was compatible and gave good control over whitefly, Bemisia argentifolii Bellows & Perring in beans (Scarpellani, 2000). Likewise diafenthiuron is compatible with methyl demeton so can be sprayed simultaneously for complex pest problems like borer, thrips and cardamom aphids which is a vector for cardamom mosaic disease. Scarpellani (2000) reported that diafenthiuron in combination with thiamethoxam (300 + 25 g a.i. ha^{-1}) gave good control over whitefly, *Bemisia argentifolii* Bellows & Perring in beans. This is also in line with the findings of Sudhakaran et al. (1995) who reported that Polo® (diafenthiuron) and Match® (lufenuron) at 400 + 400 ml ha^{-1} were more effective in controlling the bollworm damage in cotton.

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Table 1. Physical compatibility of diafenthiuron 50 WP (NS) with other chemical - Wettability test

S.No	Treatments	Dose (g)	Creamy layer at the top (ml)	Sediment at the bottom (ml)
1.	Diafenthiuron 50 WP (NS)	0.048	Nil	Nil
2.	Diafenthiuron 50 WP (NS) + Urea	0.048 + 2	Nil	Nil
3.	Diafenthiuron 50 WP (NS) + Borax	0.048 + 1	Nil	Nil
4.	Diafenthiuron 50 WP (NS) + Molybdenum	0.048 + 0.025	Nil	Nil
5.	Diafenthiuron 50 WP (NS) + Carbendazim	0.048 + 0.1	Nil	Nil
6.	Diafenthiuron 50 WP (NS) + Mancozeb	0.048 + 0.25	Nil	Nil
7.	Diafenthiuron 50 WP (NS) + Urea + Borax + Molybdenum + Carbendazim + Mancozeb	0.048 + 2 + 1 + 0.025 + 0.1 + 0.25	Nil	Nil
8.	Untreated check	--	---	---

NS- Newer source

Table 2. Compatibility of diafenthiuron with agrochemicals – Phytotoxicity study

S.No	Treatments	Creaming matter at the top (ml)	Sediment at the bottom (ml)	Phytotoxicity symptoms
1.	Diafenthiuron 0.08%	-	-	0
2.	Diafenthiuron 0.08% + Urea 2%	-	-	0
3.	Diafenthiuron 0.08% + Borax @ 10 Kg ha^{-1}	-	-	0
4.	Diafenthiuron 0.08% + Molybdenum @ 0.25 kg ha^{-1}	-	-	0
5.	Diafenthiuron 0.08% + Carbendazim 0.05 %	-	-	0
6.	Diafenthiuron 0.08% + Mancozeb 0.25 %	-	0.4	0
7.	Diafenthiuron 0.08% + Copper oxy chloride 0.25 %	-	-	0
8.	Diafenthiuron + Urea + Molybdenum	-	-	0
9.	Diafenthiuron + Urea + Mancozeb	-	0.4	0
10.	Diafenthiuron + Urea + Copper oxy chloride	-	-	0
11.	Diafenthiuron + Urea + Carbendazim	-	-	0
12.	Diafenthiuron + Urea + Borax	-	-	0
13.	Diafenthiuron + Molybdenum + Mancozeb	-	0.6	0

NS- Newer source

Table 3. Compatibility of diafenthiuron with agrochemicals – Bioefficacy study

S.No	Treatments	Mortality at 24 h	Mortality at 48 h
1.	Diafenthiuron 0.006%	46.67	100.00
2.	Diafenthiuron 0.006% + Urea 2%	16.67	66.67
3.	Diafenthiuron 0.006% + Borax @ 10 Kg ha^{-1}	50.00	100.00
4.	Diafenthiuron 0.006% + Molybdenum @ 0.25 kg ha^{-1}	10.00	66.67
5.	Diafenthiuron 0.006% + Carbendazim 0.05 %	66.67	100.00
6.	Diafenthiuron 0.006% + Mancozeb 0.25 %	10.00	43.33
7.	Diafenthiuron 0.006% + Copper oxy chloride 0.25 %	16.67	50.00
8.	Diafenthiuron + Urea + Molybdenum	30.00	76.67
9.	Diafenthiuron + Urea + Mancozeb	53.33	100.00
10.	Diafenthiuron + Urea + Copper oxy chloride	16.67	50.00
11.	Diafenthiuron + Urea + Carbendazim	66.67	100.00

Mortality of *C. punctiferalis* larvae bioassayed using ginger